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MOBILISING THE FUTURE

Horizon-scanning for emerging technologies and breakthrough innovations in the field of mobility

EU Policy Lab

JRC SCIENCE FOR POLICY REPORT

EMERGING TECHNOLOGIES

DISRUPTIVE INNOVATION

STRATEGIC FORESIGHT

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MOBILISING THE FUTURE

Horizon scanning for emerging technologies and breakthrough innovations in the field of mobility

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This report is part of the project FUTURINNOV, (FUTURe-oriented detection and assessment of emerging technologies and breakthrough INNOVation), a collaboration between the European Commission's (EC) Joint Research Centre (JRC) and the European Innovation Council (EIC), the EC's flagship program for deep tech, implemented by the European Innovation Council and SMEs Executive Agency (EISMEA).

This report contains the results of a thematic Horizon Scanning process, including a brief description of the methodology followed. It is the result of a participatory process involving external experts. Therefore, the views expressed herein do not necessarily reflect the views of the European Commission.

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Contents

Abstract

This report documents the process and findings of a horizon scanning exercise, part of a series under the FUTURINNOV (FUTURe-oriented detection and assessment of emerging technologies and breakthrough INNOVation) project, a collaboration between the European Innovation Council (EIC) and the Joint Research Centre (JRC), aiming to bolster the EIC's strategic intelligence through foresight and anticipatory methodologies.

The workshop, held on 16 October 2024, had as its primary goal the evaluation and prioritisation of trends and signals on emerging technologies and breakthrough innovation, across all technology readiness levels (TRLs), within the broad Mobility domain, broken-down into four key areas: transport systems, networks and multimodality; automotive and roads; rail/freight and logistics; and aviation and airports.

Signals for the workshop were gathered from experts, literature review, and text/data mining of patents, publications, and EU-funded projects. These signals were then scrutinised for their significance to the field's future by a diverse group of sector experts which led to the identification of 22 different key topics across the key areas above. These signals can be seen as hotspots of innovation that deserve the EIC’s attention for possible future support.

Participants also highlighted various factors that could influence the development, adoption, and promotion of these emerging technologies, which are presented in the report as drivers, enablers and barriers, and analysed specifically in each of the 4 key areas.

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We are also grateful for the time and contributions of the workshop participants. In line with our commitment to them, their names and affiliations (where available) are listed, but no comments or statements are attributed directly.

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- **Kapil Mittal**, Ericsson Drone Mobility
- **Matthias Schanze**, Rethink Ventures
- **Michal Rataj**, Joint Research Centre, European Commission
- **Mireia Gilibert**, EIT Urban Mobility
- **Nina Nesterova**, Breda University of Applied Sciences
- **Pascal Feillard**, Capgemini Engineering
- **Robin Bronwsell**, Flight Crowd
- **Sérgio Pedro Duarte**, Faculty of Engineering of the University of Porto

The authors are also grateful for the contributions received during the signal collection process from many other experts who were unable to participate in the workshop.

Executive summary

The mobility horizon-scanning workshop on 16 October 2024 was the sixth in a series of horizon-scanning workshops carried out as part of the FUTURINNOV project.

FUTURINNOV, a joint project of the European Innovation Council (EIC) and the Joint Research Centre (JRC), is designed to support the EIC in building strategic intelligence capacity through foresight and other anticipatory approaches.

The objective of this workshop was to assess and prioritise trends and signals of novelty within all Technology Readiness Levels (TRLs) in the of Mobility domain.

While this domain is not yet a specific EIC Portfolio, there are a number of relevant projects being funded by the EIC through the Open calls. The domain is also present in existing EIC portfolios (e.g. batteries for vehicles in the Advanced Materials portfolio).

Furthermore, the Mobility domain has been highlighted as an area of potential strategic interest in previous technology foresight exercises carried out by the JRC for the EIC and other Commission services.

It is in the strategic interest of the EIC to understand hotspots of emerging technologies and innovation breakthroughs across all fields, with a view to assessing and supporting strategic discussions on the rationale for supporting new areas such as mobility, though more targeted initiatives.

The workshop was based on signals which were sourced from experts[1], a literature review and text/data mining of patents, publications and projects. Section 2.1 provides a more detailed description of how the signals were sourced.

These signals were assessed for their importance for the future of mobility, in 4 key areas: transport systems, networks and multimodality; automotive and roads; rail/freight and logistics; aviation and airports.

This assessment was done through a participatory workshop with a group of experts, all well-versed in the issues but coming from different sectors. This diversity of perspectives is a key success factor for harnessing the collective intelligence of the group. The methodology used is described in Section 1.4.

Through the process of clustering and filtering, 22 topics related to emerging technologies and disruptive innovations were deemed to be of particular interest:

- Transport systems, networks and multimodality
    - Green roads against drought and floods
    - Smart infrastructure
    - Charging strategy for electric buses
    - Web3: the decentralised future of mobility
    - Dynamic routing and demand-responsive public transportation
    - Intermediary vehicles
- Automotive and Roads
    - Software defined vehicles: going between hardware and software
    - Deployment of charging infrastructure
    - Future architecture of vehicles
- Rail/Freight and Logistics
    - Remote driving
    - Fleet platooning

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[1] A wider pool of experts, which included all those invited to the workshop, contributed with signals.

  - Autonomous delivery
  - Green hydrogen
  - Public mass urban transport with autonomous pods
  - Electric last mile delivery vans
- Aviation and Airports
  - Cellular connected UAV
  - Sustainable aviation fuel
  - Battery-powered electric aircraft
  - Hydrogen fuel cell electric aircraft
  - Regional air mobility
  - Drone delivery and advanced air mobility for healthcare
  - Solutions for GPS vulnerabilities

The signals that were highlighted in the workshop can be found in Section 2.

Participants were also asked to identify factors that could drive, enable or hinder the development, take-up and promotion of emerging technologies, with a particular focus on the selected topics. Finally, the exercise included a cross-cutting analysis of common issues in most of these key areas. These additional topics can provide an overview and complementary insights for policymakers and the EIC in potential support to the Mobility field.

1 Introduction

1.1 Project objectives

FUTURINNOV (FUTURe-oriented detection and assessment of emerging technologies and breakthrough INNOVation) is a collaboration between the European Commission's (EC) Joint Research Centre (JRC) and the European Innovation Council (EIC), the EC's flagship program for deep tech, implemented by the European Innovation Council and SMEs Executive Agency (EISMEA).

FUTURINNOV was designed to support the EIC in building strategic intelligence capacity through foresight and other anticipatory approaches. In this way, it supports activities focused on funding targets, programme design, policy feedback, and institutional governance.

1.2 Work Package objectives and methodology

The project is structured into 5 work packages (WP), one of which focuses on Horizon Scanning (HS) in fields that are relevant to the EIC.

HS is a qualitative method of undertaking foresight which is aimed at the early discovery of developments not yet on the radar of most experts, decision makers, or the general public, and whose potential is not widely recognised. HS is not a predictive tool. It encourages the exploration of novelties that offer opportunities and challenges in the medium or long-term.[2] [3] [4]

This WP is formed of a series of workshops that follow a tailor-made approach to HS. This approach uses collective detection, clustering, and sense-making of signals, trends and contextual factors relating to emerging technologies and breakthrough innovations.

The understanding of what constitutes a signal, or a trend may vary [5] [6]. As it is not yet consensual, for the purposes of this project they are understood as tangible manifestations of novelty in science, technology, innovation, markets, media, and other fields. What distinguishes a trend from a signal in this context is a different level of consolidation. Both can be drawn from scientific literature, reports and news articles on early technological developments, patents and other data sources.

Each workshop is dedicated to a specific EIC Programme Manager's (PM) portfolio, or a potential new domain deemed of interest by the EIC and is anchored in a participatory exercise preceded by stakeholder engagement, qualitative desk research and quantitative data analytics.

Outcomes will support the strategic intelligence activities of the EIC and may be used to inform future funding topics for EIC Challenges and other EC calls. They can also provide input for

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[2] Amanatidou, E., Butter, M., Carabias, V., Könnölä, T., Leis, M., Saritas, O., ... & van Rij, V. (2012). On concepts and methods in Horizon Scanning: Lessons from initiating policy dialogues on emerging issues. Science and Public Policy, 39(2), 208-221.

[3] Farinha, J., Vesnic Alujevic, L. and Polvora, A., Scanning deep tech horizons: participatory collection and assessment of signals and trends, Publications Office of the European Union, Luxembourg, 2023, doi:10.2760/48442, JRC134369

[4] Dannemand Andersen, P., Bevolo, M., Ilevbare, I., Malliaraki, E., Popper, R. and Spaniol, M.J., Technology Foresight for Public Funding of Innovation: Methods and Best Practices, Vesnic Alujevic, L., Farinha, J. and Polvora, A. editor(s), Publications Office of the European Union, Luxembourg, 2023, doi:10.2760/759692, JRC134544.

[5] Rossel, P. (2012). Early detection, warnings, weak signals and seeds of change: A turbulent domain of futures studies. Futures, 44(3), 229-239. https://doi.org/ 10.1016/j.futures.2011.10.005.

[6] van Veen, B. L., & Ortt, J. R. (2021). Unifying weak signals definitions to improve construct understanding. *Futures*, *134*, 102837.

EIC and EC reports, as well as supporting other EU policy making initiatives.

1.3 Workshop objectives and scope

This was the sixth in a series of horizon-scanning workshops carried out as part of the FUTURINNOV project.[7] The objective of this workshop was to assess and prioritise trends and signals of novelty within all Technology Readiness Levels (TRLs) in the Mobility domain.

While this domain is not yet a specific EIC Portfolio, there are a number of relevant projects being funded by the EIC through the Open calls. The domain is also present in existing EIC portfolios (e.g. batteries for vehicles in the Advanced Materials portfolio).

Furthermore, the Mobility domain has been highlighted as an area of potential strategic interest in previous technology foresight exercises carried out by the JRC for the EIC and other Commission services.[8] [9] [10] [11] [12]

It is in the strategic interest of the EIC to understand hotspots of emerging technologies and innovation breakthroughs across all fields, with a view to assessing and supporting strategic discussions on the rationale for supporting new areas such as mobility, through more targeted initiatives.

Given the extensive nature of the field—which spans air, road, rail, and water transportation—along with its diverse challenges, solutions, and economic activities, the topic was divided into key areas. For each area, distinct sets of final signals and contextual factors were presented.

The signals' level of granularity targeted was lower than in previous exercises. The process prioritised identifying hotspots of innovation rather than highly detailing specific technological solutions.

To achieve this and effectively cluster the main topics into key areas, the first step of the exercise involved conducting desk research and preliminary signal collection to determine what these key areas should be.

As the result of this process, the following key areas were selected and agreed:

- Transport systems, networks and multimodality.
- Automotive and roads.
- Rail/freight and logistics[13].

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[7] From this series, three reports have been published to date: Quantum Technologies, Advance Materials for Energy and Medical Imaging and AI.

[8] Farinha, J., Vesnic Alujevic, L., Alvarenga, A. and Polvora, A., Everybody is looking into the Future! A literature review of reports on emerging technologies and disruptive innovation, Publications Office of the European Union, Luxembourg, 2023, doi:10.2760/144730, JRC134319.

[9] Farinha, J., Vesnic Alujevic, L. and Polvora, A., Scanning deep tech horizons: participatory collection and assessment of signals and trends, Publications Office of the European Union, Luxembourg, 2023, doi:10.2760/48442, JRC134369

[10] Farinha, J., Vesnic Alujevic, L., Alvarenga, A. and Polvora, A., Everybody is looking into the Future! A literature review of reports on emerging technologies and disruptive innovation, Publications Office of the European Union, Luxembourg, 2023, doi:10.2760/144730, JRC134319

[11] Bailey, G., Farinha, J., Mochan, A. and Polvora, A., Eyes on the Future - Signals from recent reports on emerging technologies and breakthrough innovations to support European Innovation Council strategic intelligence - Volume 1, Publications Office of the European Union, Luxembourg, 2024, doi:10.2760/144136, JRC137811

[12] Farinha, J., Mochan, A., Riveong, D., Bailey, G. And Polvora, A., Eyes on the Future - Signals from recent reports on emerging technologies and breakthrough innovations to support European Innovation Council strategic intelligence - Volume 2, Publications Office of the European Union, Luxembourg, 2024, doi:10.2760/9536236, JRC139313

[13] Water-based means of transportation were included in this cluster, as the signals collected primarily relate to logistics.

- Aviation and airports.

The selection of these key areas allowed the project team to identify and invite experts in each of these subdomains, as well as to target the signal collection (see section 2.1).

1.4 Policy context

The European Union is actively promoting the development of the Mobility and Transportation fields, namely through multiple policy initiatives that promote sustainability and ranging different stages of the policy cycle including implementation and funding. Examples of such initiatives include, but are not limited to:

- The Sustainable and Smart Mobility Strategy [14]
- The Horizon Europe programme (HE) which supports research and innovation in i.a. smart infrastructure technologies, promoting multimodality and integration of various transport modes, through cluster 5 [15]. Additionally, two of the five EU missions under HE target climate change and smart cities, where mobility plays a key role.[16]
- The ReFuelEU Aviation[17] and the FuelEU Maritime[18] regulations aiming to decarbonise these specific domains.
- A series of key initiatives during the 2019-2024 mandate aiming for a more resilient, connected, and competitive mobility [19] as well as the promotion of Intelligent Transport Systems (ITS)[20], namely through the Connecting Europe Facility (CEF)[21] funding projects that develop ITS across Member States.
- The European Institute of Innovation & Technology (EIT) Urban Mobility Knowledge and Innovation Community (KIC) [22], the largest innovation community for urban mobility in Europe. The EIT's Climate KIC[23] also delivers initiatives to develop innovative solutions that enhance the way citizens move about and engage with their local environments [24].

1.5 Workshop process

The workshop was held online on 16 October 2024 with the participation of 11 experts and the project team. The selection of experts included researchers, representatives from startups, established businesses, and policy makers. This diversity was key to bringing different perspectives to the conversation and their collective intelligence helped to build significant insights around the topics at hand.

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[14] https://transport.ec.europa.eu/transport-themes/mobility-strategy_en

[15] https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/cluster-5-climate-energy-and-mobility_en

[16] https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/eu-missions-horizon-europe_en

[17] https://ec.europa.eu/commission/presscorner/detail/en/ip_23_2389

[18] https://ec.europa.eu/commission/presscorner/detail/en/ip_23_1813

[19] https://transport.ec.europa.eu/eu-mobility-transport-achievements-2019-2024/resilient-connected-competitive-mobility_en

[20] https://transport.ec.europa.eu/transport-themes/smart-mobility/road/initiatives_en

[21] https://commission.europa.eu/funding-tenders/find-funding/eu-funding-programmes/connecting-europe-facility_en

[22] https://www.eiturbanmobility.eu/

[23] https://www.climate-kic.org/

[24] https://www.climate-kic.org/news/sustainable-cities-mobility-challenge-2024-projects/

1.5.1 Introduction

The main facilitator started the workshop with an explanation of the objectives as described in section 1.3. At this point it was made clear that no comments or statements would be attributed directly to individual participants.

Following a short presentation of the EIC, focused on the agency's objectives, budget and funding mechanisms, all participants were invited to introduce themselves.

The methodology, namely the steps and objectives of the session, was also explained to participants, including how outputs might be used as an evidence base for future EIC funding topics or in EIC feedback to policy activities with other services of the European Commission.

1.5.2 Thematic groups

The main part of the workshop was segmented into four breakout groups according to the four key areas defined in advance: transport systems, networks and multimodality; automotive and roads; rail/freight and logistics and aviation and airports. Experts were allocated to the groups in advance according to their specific expertise but in a way that ensured a mix of background profiles within each key area. Involving people who are subject matter experts but bring different perspectives to the discussion can create more interesting outcomes.

Although all experts received in advance the full list of signals, each thematic group was invited to focus on the cluster of signals specific to each key area. That clustering was done in advance by the authors. Additionally, in each key area, the authors also distributed the signals in sub-clusters to facilitate the workshop's sense making process and to identify recurrent topics.

In the breakout groups, participants were first asked to select the signals (see section 2.1) that they considered *most interesting for the future of their key area within the mobility sector* and then to allocate them to a matrix relating to the assessed impact and timeline to market.

They presented their selections to the group, explaining why they had chosen those specific topics. The participants in each group then asked questions about the individual selections and were invited to cluster together signals that were closely connected.

Next, participants were invited to add any relevant topics not yet raised in the discussion. These additional points were added and identified as such.

The following stage was to invite the participants to identify signals they felt answered the question: *What are the technologies and innovations that are more likely to breakthrough/grow/advance in the next 5 to 10 years?*

Once the signals were filtered in this way, there was a further discussion on interconnections aiming to reach a final 5-10 signals and/or clusters of signals which were agreed by the group.

After that, participants were asked to select individual signals that they considered the most novel and potentially disruptive, that could act as a wild card[25] in this domain. Participants had three votes to select signals from the pool captured before the workshop or proposed during the previous steps. All voted signals were taken to the next stage.

In the final step of the group exercise, participants were asked to identify contextual factors that could drive, enable or hinder the development and uptake of the selected signals, and

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[25] The idea of the wild card is to guard against potentially impactful innovations being lost through the process of clustering.

their underpinning emerging and disruptive technologies and innovations.

Some of these contextual factors were identified during the signal collection process and so were added in advance by the facilitators.

1.5.3 Plenary discussion

The participants returned to the plenary after the break-out groups for a collective presentation and discussion.

As the presentations took place, connections between the results of each group were mapped on the virtual board by the facilitators. These insights, generated from recurring topics that connect specific technological solutions, are presented in more detail in section 3.

In contrast to previous workshops conducted as part of the FUTURINNOV project, the plenary session did not produce a final list of technology-related topics. Given the unique characteristics of each of the four key areas, the project team decided that the results should all be presented within the context of each specific key area.

Mobility solutions involving cars, railways, or airplanes usually address distinct transportation and logistics needs. Prioritising one area over the others, just because there is an asymmetric number or level of novelty within the signals, would undermine the holistic approach required to address the challenge of mobility comprehensively.

Finally, since one of the key areas identified in advance focused on systems, networks, and multimodality, the exercise highlighted innovations relevant to this systemic approach, independent of specific modes of transportation.

1.5.4 Contextual factors

In the final exercise of the workshop, participants were asked to review the different contextual factors that emerged from the breakouts and identify common factors across the different key areas that could drive, enable or hinder the development and uptake of the selected signals, and their underpinning emerging and disruptive technologies and innovations.

In this way, overarching and recurring topics could be surfaced. These are described in section 3.

2 Workshop outcomes

2.1 Signal collection

The signals presented at the workshop were collected from three main sources.

The first source of signals was a literature review. For this review, the JRC gathered third party reports[26] - both sector- and non-sector-specific - which were recent (since 2022) and represented a wide geographic coverage. The JRC then extracted from these reports those signals which were assessed as sufficiently novel and impactful.

The second source of signals was a pool of experts[27]; who submitted signals via an online collection form. For each signal, they were asked to provide:

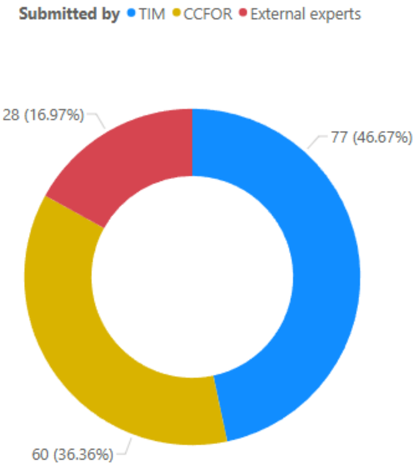
- Title
- Summary
- Domain(s) of application
- Maturity level
- A source URL or bibliographic reference
- An indication of the underlying technology

Experts were also provided with a guidance document to explain the process of signal collection.

The third source of signals was the JRC's text and data mining service, TIM Analytics. This service scours scientific publications, patents and EC previously funded proposals and uses a customised indicator to determine the "activeness" of certain keywords/sets of documents.[28] This indicator is defined as the ratio between the number of documents retrieved for the last three years, and the total number of documents in the dataset, which range more than a decade. A sudden increase in the activity in a certain domain area could suggest a weak signal becoming a strong(er) signal, manifested by a growing number of documented scientific and innovative outputs.

From the three sources, the JRC collected 165 signals: 60 from the literature review, 28 from experts, and 77 from text and data mining. Figure 1 below shows the diversity of sources for the signal collection. The literature review sources are marked as coming from CCFOR, or Competence Centre on Foresight. The signals coming from text and data mining are marked as submitted by TIM.

Figure 1. Signals collected for use in the Mobility workshop by different streams.



Source: Authors.

Figure 2 (on the next page) shows the diversity of signals collected in terms of maturity of the technology. 24 were considered as novel, 68 as emerging, and 53 as close to market, and 20 were unassigned. Experts were asked to

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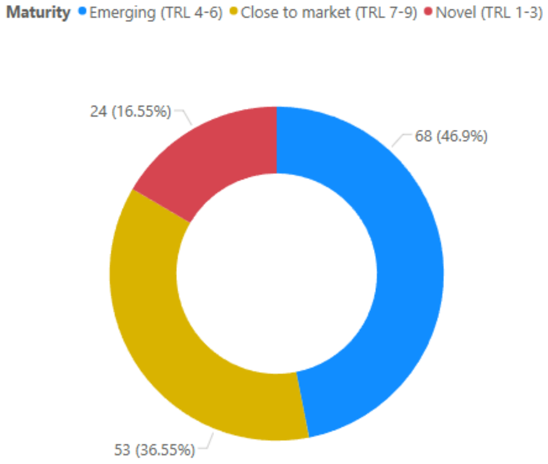
[26] Reports not authored or published by the European Commission.

[27] A wider pool of experts, which included all those invited to the workshop, was approached to contribute signals

[28] For these signals, descriptions were generated from the abstracts of the most cited scientific papers, with AI assistance. See Annex 1 for more details.

evaluate the maturity level of technologies mentioned in the signals they provided. The report's authors provided assessments for signals collected through desk research, as well as some from data and text mining. However, some signals remain unclassified due to insufficient information for proper assessment or if they refer to technologies already on the market.

Figure 2. Diversity of maturity of signals used in the Mobility workshop.



Source: Authors.

2.2 Thematic group results

2.2.1 Main signals selection

The following sections (2.3 to 2.6) contain the results of the breakout groups' work, namely the clusters and signals that were considered of high relevance by participants within each of the four key areas.

Some signals have a number, which refers to the original list sent to participants before the workshop (see Annex 1). Signals without a number were proposed by participants during the workshop.

2.2.2 Drivers, enablers and barriers

Participants in all groups were also invited to identify drivers, enablers and barriers[29] that could affect the development and take-up of technologies and innovations in their respective key area, with a particular focus on those selected in the previous step.

Some of these contextual factors can act in multiple ways. For example, standards can hinder through stifling innovation or can enable by creating an environment for interoperability.

Regulations can also play multiple roles, namely acting as barriers for development of novel solutions, but on the other hand, driving and aligning those innovations with ethical and legal frameworks.

In that sense, emphasis was on identifying the factor rather than finding the ideal categorisation. These insights provide a complementary view regarding the main issues affecting the mobility sector and provide potential input for further discussion.

The contributions were mapped through an adapted version of the "Futures Triangle" framework[30]. The following sections (2.3 to 2.6) contain the summary of this complementary information.

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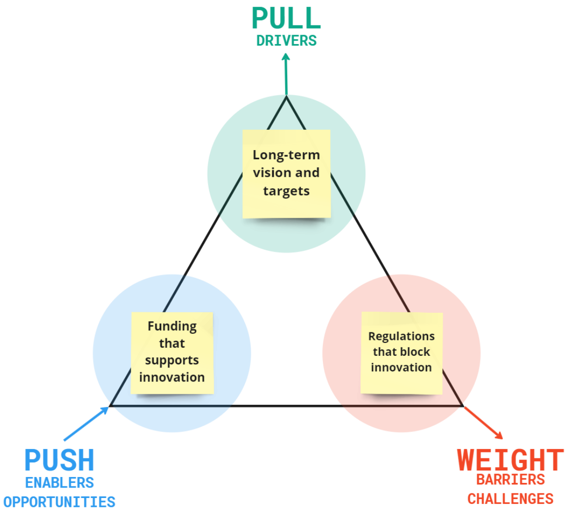
[29] Drivers are considered as guiding forces, elements that pull new developments. Enablers provide opportunities for further development and give a push to the technologies. Barriers are factors that do (or could) hinder technological advances.

[30] The Futures Triangle is a foresight method that maps three competing factors: the pull of the future, the push of the present, and the weight of history. It can be used as a stand-alone method or in conjunction with others for example scenarios. For this project, the authors adapted this framework to explore 3 types of contextual factors connected with those three temporal dimensions: drivers (mostly future), enablers (mostly present) and barriers (combination of past and present). For more information please see: Inayatullah, S. (2023). *The Futures Triangle: Origins and Iterations*. World Futures Review, 15(2-4), 112-121. https://doi.org/10.1177/19467567231203162

Figure 3. Visual representation of the adapted version of the "Futures Triangle" framework used in the workshop, including some examples given to the participants.



Source: Authors.

2.3 Transport systems, networks and multimodality

2.3.1 Main signals selection

Group A was tasked with examining transport systems, networks and multimodality and selected the following signals and micro-clusters[31] as most interesting to explore:

Green Roads against drought and floods (311)

This signal represents a low-tech trend in mobility that integrates transport infrastructure with climate adaptation strategies. By incorporating features such as embankments, channels, and dikes into road networks, this approach aims to mitigate the impacts of extreme weather events like droughts and floods. It enhances transport systems and promotes multimodality by increasing infrastructure resilience and functionality.

A notable case illustrating the effectiveness of this concept is the "Green Roads for Water". This initiative utilises road networks to capture and redirect water for agricultural use, resulting in increased agricultural yields and reduced road maintenance costs. Supported by organisations such as the World Bank, this model is gaining international attention for its scalability and potential applicability in various regions, raising the issue of how low-tech innovation might be as important as deep-tech developments.

Smart infrastructure

Smart infrastructure represents a significant advancement in mobility, integrating digital technologies into transport systems to enhance efficiency, safety, and sustainability. By leveraging sensors, IoT devices, and data analytics, smart infrastructure enables real-time monitoring and management of transport networks.

Recent breakthroughs include the deployment of 5G connectivity to support vehicle-to-infrastructure (V2I) communication, allowing autonomous and connected vehicles to interact seamlessly with road networks.

Additionally, advancements in artificial intelligence and machine learning facilitate predictive maintenance and dynamic traffic management, reducing congestion and emissions.

Smart infrastructures are expected to support multimodality by integrating various transport modes through digital platforms, improving user experience and accessibility.

The group stressed that as autonomous vehicles are introduced and adopted, it is crucial not to overlook the built environment that supports them.

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[31] The term "micro-clusters" refers to small aggregations of around three connected signals.

By integrating smart infrastructure, the process of adopting new mobility solutions can be facilitated, ensuring that the physical surroundings are conducive to technological advancements.

Charging strategy for electric buses (1212)

Charging strategies for electric buses involve creating optimal charging schedules and locations to minimise costs and operational downtime.

Recent innovations integrate multiple charging methods—plug-in fast charging, battery swapping, and dynamic wireless power transfer (DWPT), which allows buses to charge while in motion.

Advanced algorithms consider factors such as energy consumption rates, battery state-of-charge limits, time-of-use electricity tariffs, and station-specific load capacities to optimise charging under various constraints.

The group noted that charging strategies for electric buses require continued attention. While the focus was on buses, they suggested that these strategies could be scaled up to general fleets, indicating the broader importance of developing efficient charging infrastructure to support the electrification of transportation.

Web3: the decentralised future of mobility (1157)

Web3 technologies are set to transform the mobility sector by introducing decentralised, peer-to-peer services. Leveraging blockchain—a core component of Web3—enables transparent and secure transaction records, essential for decentralised ridesharing and vehicle leasing platforms.

Smart contracts automate and enforce agreements without intermediaries, reducing costs and enhancing efficiency. Additionally, decentralised autonomous organizations (DAOs) allow collective management of mobility services through community-driven decision-making.

The group mentioned that the development of Web3 and blockchain technologies can increasingly support Mobility as a Service (MaaS) models. This includes the potential for seamless ticketing, allowing for one ticket to cover different legs of a trip. Beyond trip planning and operationalisation, it is possible to look further to integrating various modes of transport through advanced web technologies.

Dynamic routing and demand-responsive public transportation (1535)

Dynamic routing and demand-responsive public transportation are innovative approaches shifting from fixed schedules to flexible, real-time services.

AI-driven algorithms and mobile applications that adjust routes based on passenger demand, improving efficiency, and reducing costs, are two of the most promising innovations.

While some cities in the USA and the middle east are already testing these systems, some EU member states still face challenges on this front such as limited large-scale trials, insufficient stakeholder cooperation, and data connectivity issues.

During the discussion, the group highlighted the importance of enhancing these technologies to address mobility poverty in both urban and rural areas and to assist vulnerable populations.

They observed that despite ongoing discussions, significant breakthroughs in scaling up these solutions are lacking and expressed hope for progress. Advancing these technologies is essential for creating inclusive, efficient transport systems that benefit all members of society.

Intermediary vehicles (1170)

Intermediary vehicles are novel, light electric vehicles (LEVs) that bridge the gap between bicycles and traditional cars. They currently take the form of electric microcars, advanced e-bikes, or electric scooters that offer greater speed and comfort than bicycles while remaining more energy-efficient and manoeuvrable than cars.

Innovations in battery technology have extended range and reduced charging times, enhancing practicality for daily use.

The group noted that such vehicles could provide alternatives to owning a second car in urban environments, recognising that while a second car is often unnecessary, bicycles may not suffice for all trips.

Developing these intermediary options could help solve issues related to urban space utilisation and reduce car dependency.

2.3.2 Wild cards

For **wild cards** the group selected the following (see Section 1.4.3):

- Shared autonomous electric vehicle (1237)
- Dynamic routing and demand-responsive public transportation (1535)
- AI's Role in Driving Sustainability and Safety in the Mobility Sector (691)
- Quantum Technology: The Next Frontier in Mobility (1154)

2.3.3 Contextual factors

The group then outlined key drivers, enablers and barriers impacting transport systems, networks and multimodality.

Drivers

Main drivers highlighted were the undeniable reality of climate change, which necessitates adaptation and the development of sustainability strategies. Concepts like 5/10 minute cities, zero-emission cities, and sustainable smart cities at the EU local and regional levels serve as drivers propelling efforts in sustainable mobility.

Legal compliance and the European Union's long-term strategies and legislation for sustainability were also seen as strong drivers, providing consistent direction and support even when local political climates may not prioritise these issues.

Enablers

Enablers included well-developed existing mobility ecosystems that facilitate the implementation of innovative solutions and cybersecurity advancements that are seen as crucial in supporting new technologies within transportation networks.

Additionally, the growing awareness among citizens and corporations, especially among younger generations, about cybersecurity acts as a support for this.

Barriers

The discussion about barriers focused on shifting political priorities at local, regional, and international levels, where sustainability and climate issues may not always be prioritised, potentially hindering progress. The group also identified climate fatigue and sustainability fatigue as barriers, noting that increased awareness can sometimes lead to public and corporate disengagement from sustainability initiatives. Workforce availability and skills gaps present further challenges, as does the perception of sustainable innovation being a cost rather than an opportunity.

Additional notes

The discussion in this group underscored the importance of leveraging the EU's long-term commitment to sustainability to maintain progress at the local level, despite potential political and social challenges.

Addressing issues like climate fatigue and workforce skill gaps is considered vital for advancing innovations in transport systems and multimodality, and for shifting the perception of sustainable innovation from being a cost to being an opportunity.

2.4 Automotive and Roads

2.4.1 Main signals selection

Group B examined the automotive and road key area and selected the following signals and micro-clusters as most interesting to explore:

Software defined vehicles: going between hardware and software (1551)

The traditionally hardware-focused automotive industry is undergoing a digital transformation toward software-defined vehicles (SDVs).

These vehicles integrate advanced software capabilities, offering features like sophisticated infotainment systems, over-the-air updates, and personalised modifications. The number of lines of code in vehicles is rapidly increasing, with software constituting a significant portion of a vehicle's total value.

This shift enables rapid feature deployment and customisation, enhancing functionality beyond the hardware's initial design.

However, the transition to SDVs poses challenges for the EU automotive sector, which faces strong global competition and must adapt quickly to maintain its leadership in automotive innovation. An additional tension might exist on this front, regarding interests in favour and against standardised solutions.

The group emphasised that software-defined vehicles and the shift toward decoupling software from hardware are essential for future vehicle architecture, allowing for more efficient software design, regular updates, and enhanced personalisation options. However, additional challenge remain in standardisation.

Deployment of charging infrastructure

The deployment of charging infrastructure is pivotal in advancing electric mobility within the automotive and road transport sectors. Recent breakthroughs include the installation of ultra-fast charging stations capable of delivering up to 350 kW, drastically reducing charging times for electric vehicles (EVs).

Innovations like wireless charging pads embedded in roads and dynamic charging technologies now allow EVs to charge while in motion, enhancing convenience and efficiency. Additionally, the integration of smart grid systems enables bidirectional charging, where vehicles can supply energy back to the grid (vehicle-to-grid or V2G).

These developments address range anxiety and are crucial for widespread EV adoption, marking a significant step toward sustainable transportation.

The group emphasised that the electrification of road transport hinges on the deployment of comprehensive charging infrastructure, recognising this as a key driver for broader EV adoption.

Future architecture of vehicles

The innovation in vehicle architecture is increasingly focused on sustainability and resilience, integrating circular economy principles into design and manufacturing processes.

Manufacturers are adopting recyclable and bio-based materials to facilitate easier disassembly and recycling at the end of a vehicle's lifecycle. To address pollution concerns from tires and braking systems, there is a shift toward developing low-emission tires that reduce microplastic release and implementing regenerative braking systems to minimise brake dust emissions. These innovations not only reduce environmental impact but also enhance vehicle performance and durability, marking a significant move toward eco-friendly mobility solutions in the automotive sector.

2.4.2 Wild cards

The group selected the signal on Quantum Technology: The Next Frontier in Mobility (1154) as their **wild card.** (see Section 1.3.1)

2.4.3 Contextual factors

The group outlined key drivers, enablers and barriers impacting automotive and roads.

Drivers

Main drivers highlighted were the current megatrends of sustainability and safety, as well as regulatory factors, including EU policies on phasing out combustion engines and Chinese advancements in EVs.

Enablers

Enablers included AI and machine learning, considered crucial for software-defined vehicles and automated mobility, alongside scalable digital infrastructure.

Barriers

The discussion about barriers and challenges focused on scalability: economic challenges such as infrastructure costs, demand tied to mobility expectations, and resource availability, such as cobalt for EV batteries.

Competitive pressures from international markets, especially Chinese subsidies, and stringent consumer expectations for safety, robustness, and reliability also present barriers, limiting the adoption of technologies like advanced driver-assistance systems (ADAS) Levels 4 and 5 if standards aren't met.

Additional notes

The discussion in Group B underscored the importance of aligning technological innovation with consumer demand, especially in urban mobility, where meeting safety, robustness and reliability expectations is considered vital for acceptance.

2.5 Rail/Freight and Logistics

2.5.1 Main signals selection

Group C was tasked with examining rail/freight and logistics and selected the following signals and micro-clusters as most interesting to explore:

Remote driving

Remote driving is emerging as a transformative innovation in rail freight and logistics, allowing operators to control trains and vehicles from distant locations.

This technology enhances operational efficiency, particularly in hazardous or hard-to-reach areas, by utilising advanced communication networks and control systems. Recent advancements have enabled precise remote operation of freight trains and yard vehicles, reducing the need for onboard personnel. This not only lowers operational costs but also improves safety by minimising human exposure to dangerous environments.

The group highlighted the potential of remote driving as a transitional solution to address driver shortages, enabling human operators to control vehicles from centralised control centres.

Fleet platooning (78)

Fleet platooning is an innovative approach in freight and logistics that links two or more trucks or transport modes using connectivity technology and automated driving support systems. These vehicles autonomously maintain a close, constant distance when connected, particularly on motorways. Innovations like advanced vehicle-to-vehicle (V2V) communication and sophisticated driver-assistance systems are enabling safer and more efficient platooning even in mixed traffic conditions. In the rail sector, platooning allows trains to operate more closely together, increasing track capacity and reducing energy consumption.

Autonomous platooning was seen by the group as a step toward full autonomy in deliveries.

Autonomous delivery (1200+1266)

Autonomous delivery is revolutionizing logistics by employing drones, delivery robots, and autonomous vehicles to tackle e-commerce growth and urban traffic. Innovations like Autonomous Delivery Robots (ADRs) and GPS-enabled Unmanned Aerial Vehicles (UAVs) enable precise, efficient, and sustainable last-mile deliveries.

These technologies reduce costs, energy use, and emissions but face challenges such as customer acceptance and risk perception. A standout application is healthcare logistics, where drones transport medical supplies and blood samples, offering rapid, cost-effective, and eco-friendly solutions.

Electric propulsion enhances sustainability and minimizes noise, benefiting emergency services. Advanced Air Mobility (AAM) in healthcare logistics, particularly for life-saving tasks, is expected to gain public trust, highlighting its transformative potential.

Green hydrogen (1178)

Green hydrogen is emerging as a promising energy source for the rail, freight, and logistics sectors, offering a clean alternative to fossil fuels.

Produced by using renewable energy—such as wind or solar power—to split water into hydrogen and oxygen, it generates no carbon emissions. Recent advancements have made production and storage more efficient and cost-effective, including offshore hydrogen generation using wind energy and improved methods for safe transport over long distances.

Embracing green hydrogen can significantly reduce environmental impact, but public awareness and support are crucial for its successful adoption.

When referring to sustainable fuels, the group considered green hydrogen as possibly more suitable than electric trucks due to battery life concerns, although further studies are needed to support this claim.

Public mass urban transport with autonomous pods

These small, electric, autonomous pods are designed to provide mass transportation and logistics solutions in urban environments. Utilising advanced autonomous driving technologies, real-time navigation systems, and vehicle-to-infrastructure communication, these pods could operate safely and efficiently without human drivers.

They propose flexible, on-demand transport services that can reduce congestion and emissions while enhancing connectivity. Pilot programs in various cities are demonstrating their potential to integrate seamlessly with existing public transport networks, offering efficient, sustainable, and user-centric transportation solutions.

Electric last mile delivery vans

This topic includes several already existing solutions, that address the aforementioned increased demand for quick, eco-friendly delivery services. New developments have led to improved battery technology extending driving ranges, rapid charging capabilities, and integration with smart logistics platforms for route optimisation.

Companies are deploying fleets of electric vans to reduce emissions, lower operational costs, and comply with urban environmental regulations.

The group highlighted cargo bikes as a sustainable option for last-mile deliveries in urban areas, indicating that some sustainable technologies are already in place. However further innovations on this fields are welcome as they could contribute to this sector's carbon neutrality.

2.5.2 Wild cards

Group C selected the following as **wild cards:**

- AI-based planning technology for goods distribution (1583)
- Europe's Longest Hyperloop Track: Paving the Way for Future Transportation (1146)
- Drone delivery (1179)
- Electrically rechargeable liquid fuel (826)
- Virtual coupling (1554)
- Smart ports (1195)
- Autonomous delivery robot (1194)
- Wind-assisted propulsion (1557)

Several wild cards were identified that could potentially disrupt the logistics sector, but it was acknowledged by the group that more foresight work and specific expertise was needed to refine this list.

Artificial Intelligence (AI) was mentioned as already playing a role in enhancing efficiency in planning and distribution within logistics operations. The group recognised that AI technology aids in optimisation and that it is already an existing tool in the sector.

Hyperloop technology was mentioned as a concept that might have significant future impact, although it was considered too futuristic for immediate application.

Drone delivery beyond healthcare applications was also seen as potentially disruptive, but they considered that it faces challenges related to regulation and public acceptance.

The idea of electrically rechargeable liquid fuels was brought up as a possible future technology for logistics, with the acknowledgment that further exploration is needed to determine suitable types for the sector.

Virtual coupling and smart ports were recognised as important emerging concepts that could influence logistics and freight operations.

2.5.3 Contextual factors

The group outlined key drivers, enablers and barriers influencing rail, freight, and logistics.

Drivers

The significant shortage of skilled and unskilled workers and drivers was considered a primary factor pushing the adoption of automation and remote driving technologies. Safety concerns for both cargo and drivers motivate the adoption of reliable and secure technologies.

The implementation of low-emission zones in cities encourages the use of sustainable transportation methods like cargo bikes. Consumer demand for sustainable deliveries is increasing, influencing companies to adopt greener practices. Additionally, the European Union's long-term emission targets will influence energy choices and technology adoption in logistics.

Enablers

Regarding enablers, the group identified AI and data utilisation as accelerating efficiency in logistics planning and optimisation.

The existing last-mile delivery infrastructure was seen as an asset that could be adapted and enhanced, potentially incorporating autonomous vehicles and drones.

Smart logistics systems were contributing to more efficient and responsive supply chains, and new battery technologies were supporting the feasibility of electric deliveries.

Barriers

Several barriers were noted. Europe's stricter regulations on autonomous driving compared to other regions were seen as slowing down the development and adoption of these technologies in Europe.

Strong regulations on AI ethics and data privacy also present obstacles to rapid implementation. Energy challenges need to be addressed to support emerging technologies, and issues related to regulations and cross-border flows can cause disruptions, as delivery drivers often come from different countries with varying regulations.

Additional notes

forces, elements that pull new developments in the sector include the significant shortage of skilled and unskilled workers and drivers, which is a primary factor pushing the adoption of automation and remote driving technologies. The implementation of low-emission zones in cities encourages the use of sustainable transportation methods like cargo bikes.

Safety concerns for both cargo and drivers motivate the adoption of reliable and secure technologies. Consumer demand for sustainable deliveries is increasing, influencing companies to adopt greener practices.

Additionally, the European Union's long-term emission targets will influence energy choices and technology adoption in logistics. The group also considered social and regional factors. Changing consumer behaviours, especially post-pandemic, have shifted expectations and demands in delivery services.

Territorial differences, such as the absence of services like Amazon Prime in certain countries (e.g., Switzerland), highlight the need to consider regional contexts in logistics planning.

Social values and expectations related to sustainability and technology adoption vary across regions, affecting how logistics services are perceived and utilised.

2.6 Aviation and Airports

2.6.1 Main signals selection

Group D examined aviation and airports and selected the following signals and micro-clusters as most interesting to explore:

Cellular connected UAV (1248)

Cellular-connected Unmanned Aerial Vehicles (UAVs) are transforming aviation by integrating drones into cellular networks as aerial base stations or mobile terminals. This integration enhances network coverage, capacity, reliability, and energy efficiency. These UAVs perform tasks like real-time video streaming, item delivery, and offloading computation tasks to ground base stations through mobile edge computing while in flight.

Their high mobility in three-dimensional space and line-of-sight channels introduce new challenges and opportunities in communication quality, interference management, and energy efficiency.

Innovations such as interference-aware path planning using deep reinforcement learning optimise UAV trajectories for reduced latency and minimised interference, marking significant advancements in aviation and airport operations.

Sustainable aviation fuel (838+990)

Sustainable aviation fuel (SAF) seeks to reduce the environmental impact of aviation by substituting conventional jet fuels with alternatives made from renewable resources like waste oils, agricultural residues, and non-food energy crops.

This approach can significantly lower greenhouse gas emissions compared to fossil-based fuels. Innovations include enhanced production processes that improve efficiency and sustainability, as well as the development of new feedstocks that avoid competing with food supply.

Despite these promising strides, challenges like high costs, scalability issues, and limited availability remain. Overcoming these challenges is crucial for the widespread adoption of SAF and for substantially decreasing the aviation sector's carbon footprint.

In this sense, a promising innovation was recently developed by researchers at Oak Ridge National Laboratory and the University of California, Riverside. They have created a new method to convert waste lignin—a byproduct of corn and wood production—into sustainable aviation fuel (SAF). This process achieves a yield of up to 18%, significantly higher than the

Enzymatic Hydrolysis Lignin (EHL) processes previously trialled in Europe.

Notably, the production cost is lower than the current cost of conventional jet fuel in the U.S. This innovation holds the potential to make SAF more economically viable, promoting wider adoption and reducing the aviation industry's carbon footprint by utilising renewable waste materials. The European Commission has already several ongoing funded projects on this domain.

Battery-powered electric aircraft (417)

Battery-powered electric aircraft utilise electric motors driven by batteries to spin propellers or ducted fans, generating thrust without combustion emissions.

This technology significantly reduces environmental impact, potentially lowering operational emissions to zero. Latest innovations in battery technology, such as improvements in energy density and weight reduction, have enabled longer flight ranges and the development of viable electric aircraft for short-haul flights and urban air mobility.

Challenges remain, including the need for further enhancements in battery energy density to extend range and payload capacity, and securing access to substantial amounts of renewable energy to charge the batteries sustainably. Despite these hurdles, battery-powered electric aircraft represent a promising step toward decarbonizing the aviation industry.

Hydrogen fuel cell electric aircraft (416)

Hydrogen fuel cell electric aircraft generate electricity by hydrogen reacting in fuel cells, which, like the battery-powered aircraft mentioned above, powers electric motors to spin propellers or ducted fans, producing thrust without combustion emissions.

When coupled with sustainable energy sources for hydrogen production (green hydrogen), this approach can achieve nearly zero emissions while maintaining flight ranges of up to approximately 1,000 kilometres. Challenges include the limited adoption of fuel cell technology and the development of infrastructure for hydrogen production and refuelling.

Significant progress is being made in enhancing fuel cell efficiency and reducing system weight, making hydrogen-powered aviation increasingly viable. Advances in hydrogen storage and distribution technologies are also crucial for broader implementation of this sustainable aviation solution.

Regional air mobility

Regional air mobility focuses on improving short-distance air travel between smaller cities and remote areas, making air transportation more accessible and efficient.

Although already existing for a specific market niche, through private or rented helicopters, this signal highlights the potentially democratisation of these kind of solutions.

Innovations in electric and hybrid-electric aircraft offer reduced emissions and lower operating costs. The development of electric Vertical Take-off and Landing (eVTOL) aircraft enables point-to-point travel without the need for traditional runways, expanding access to underserved regions.

Advances in battery technology and lightweight materials have extended flight ranges and increased aircraft efficiency. Enhanced air traffic management systems and automation facilitate the safe integration of these new aircraft into existing airspace.

Drone delivery and advanced air mobility for healthcare (1179+1266)

Drone delivery, a subset of autonomous delivery, leverages unmanned aerial vehicles (UAVs) to enhance last-mile logistics. Operating alongside traditional methods, drones extend delivery reach by launching from trucks and accessing diverse locations.

They optimize routes based on time, cost, battery life, and payload compatibility, excelling in scenarios like emergencies and pandemics with contactless service. Advanced algorithms enable drones and trucks to collaborate seamlessly, enhancing efficiency.

A key application is healthcare logistics, where drones deliver medical supplies and blood samples to remote hospitals. Additionally, electric aerial vehicles, including advanced "helicopters" under development for emergency patient transport, promise faster, eco-friendly, and quieter operations.

These technologies minimize infrastructure needs, reduce costs, and improve sustainability, particularly in critical, life-saving contexts, positioning drone delivery as a transformative logistics solution.

Solutions for GPS vulnerabilities (1120)

Planes and unmanned aerial vehicles (UAVs) are increasingly vulnerable to GPS signal disruptions caused by jamming and spoofing attacks.

Initially observed near war zones in Europe and the Middle East, these disruptions are now affecting busy airspaces like the North Atlantic, where over 1,700 transatlantic flights operate daily.

Such interference can overwhelm GPS signals or mislead receivers about their actual location, leading to navigation challenges.

One prominent approach is adopting alternative navigation systems, such as eLoran, which operates independently of satellite-based systems. Another critical measure is leveraging inertial navigation systems (INS), which rely on onboard sensors to calculate the aircraft's position, speed, and direction without needing external signals, ensuring continuity in navigation.

Additional measures include advanced antenna technologies like controlled reception pattern antennas (CRPAs), which can filter out interference while focusing on legitimate satellite signals. Artificial intelligence (AI) is also being trained to navigate aircraft using Earth's magnetic fields, offering a backup in scenarios where GPS is disrupted.

Together, these strategies aim to bolster aviation safety and ensure reliable navigation even under challenging conditions caused by jamming attacks.

2.6.2 Wild cards

Several **wild cards** were selected by the group (see Section 1.4.3):

- Accelerated drone UAV connectivity
- AI for urban air mobility (1083)
- Revolutionary 50-Year Nuclear Battery for a Wide Array of Applications (589)
- Hydrogen fuel cell electric aircraft (416)
- Sustainable aviation fuel (838)
- Regional air mobility
- New Biofuel Process for Potentially Cost-Effective Sustainable Aviation Fuel (990)

The group commented specifically on the signal regarding AI for urban mobility in aviation. They noted that with the anticipated surge in the number of aerial vehicles—not just for passenger transport but significantly in short-term cargo transport—human management of air traffic may become insufficient.

This will require the use of artificial intelligence to ensure the interconnectedness and efficient management of the aerial ecosystem. AI was considered crucial in handling the complexities of increased aerial traffic, enabling real-time decision-making and coordination that will surpass human capabilities.

This advancement inherently relies on underlying connectivity technologies such as 5G, which provide the essential technological infrastructure for communication and control.

2.6.3 Contextual factors

In the discussion of contextual factors for aviation and airports, the experts identified several key drivers, enablers, and barriers.

Drivers

As already referenced, one of the strongest demands for Advanced Air Mobility (AAM) comes from the use of drones in healthcare sector, where it can support the transport of medical supplies such as bespoke defibrillators, address doctor shortages, and ensure medical coverage in remote areas.

The military also presents a major demand for AAM, using these technologies for offensive, defensive and surveillance aims.

Enablers

A critical enabler for the adoption of AAM is the development of digital and physical infrastructure, particularly for eVTOL vehicles, which will need designated landing areas and integration with existing aviation standards.

Public acceptance will be essential, requiring education on safety, environmental benefits, and impacts.

Regulatory harmonisation is also key; cross-border AAM operations demand consistent standards, especially with respect to 5G and future 6G connectivity.

Barriers

Regulatory and technical standards present ongoing barriers for vehicle certification and airspace integration. Profitability is another major challenge, as manufacturers must find economically viable business models.

Social acceptance remains a significant hurdle, with previous cases, like the Paris Olympic Games, showing that public concerns can limit the scale of deployment.

Furthermore, the uninterrupted coverage of technologies like 5G is essential for safe and reliable AAM operation. Lack of continuous connectivity could create navigational hazards, especially in an autonomous future.

3 Conclusions

The results presented in the previous sections and these conclusions drawn from them, will support the strategic intelligence activities of the EIC and may be used to inform future funding topics for EIC Challenges and other EC calls.

In the concluding plenary session of the workshop, participants from the different groups connected the top selected topics and the contextual factors that emerged from the four key areas, surfacing common challenges, opportunities, and considerations for advancing technologies in the mobility field.

These insights provide complementary reflections for policymakers and the EIC in potential support to the field of Mobility, including potential additional policy actions in this domain.

Electrification of mobility across sectors

A prominent theme identified across all groups was the electrification of mobility. This encompassed charging strategies for electric buses (Group A), deployment of charging infrastructure for road transport (Group B), electric last-mile delivery vans in logistics (Group C), and battery-powered electric aircraft (Group D).

Some participants emphasised that charging infrastructure in freight and logistics remains a bottleneck, similar to the challenges faced in passenger car electrification five to ten years ago. The electrification of heavy vehicles like trucks presents new hurdles, such as the need for appropriate battery technologies and widespread charging facilities capable of supporting larger vehicles.

Other comments underscored that while electrification is not a new trend, the real challenge lies in balancing electric drivetrains with internal combustion engines (ICEs). They argued that there is no one-size-fits-all solution and stressed the importance of scaling up technologies and making them affordable. Participants highlighted that infrastructure, while an enabler, is not the primary consideration; instead, the focus should be on manufacturing technologies at scale and aligning them with consumer behaviours and expectations.

The experts cautioned against an overemphasis on technology without considering the human element, asserting that user needs, cost considerations, and satisfaction levels are crucial for widespread adoption.

The discussion reinforced the necessity for both technological advancement and strategies to scale existing technologies, making them accessible and cost-effective, aligning with the EIC's role in providing financial instruments to support the scaling of technologies.

Autonomous and connected vehicles

Another common element was the advance of autonomous vehicles and connected technologies.

Experts pointed out that connectivity technologies (e.g., 5G, 6G) are fundamental to the progression of automation in mobility. They suggested that the foundation for future mobility lies in connected vehicles, which not only facilitate automation but also enhance overall transportation efficiency. This connectivity is crucial for applications ranging from platooning in logistics to remote driving and advanced air mobility.

Healthcare applications in mobility solutions

The health domain emerged as a significant application area. Advanced mobility solutions, such as drones, have potential applications in healthcare delivery, emergency response, and improving access to medical services in remote areas.

Sustainability and new fuels

Participants noted the introduction of new fuels, including biofuels, hydrogen fuel cells, and green hydrogen, often linked with climate adaptation efforts. The environmental dimension is evident across various discussions, reflecting a commitment to sustainability and reducing environmental impacts within the mobility sector.

Importance of infrastructure and cybersecurity

The role of infrastructure, particularly IT infrastructure, was recognised as a critical factor in supporting advanced mobility technologies. Cybersecurity was identified as an enabler; however, it was noted that it also represents a significant challenge. Ensuring secure and resilient infrastructure is essential for the safe operation of connected and autonomous systems.

Data spaces and inter-modality

The concept of data spaces for mobility was introduced, suggesting that shared data platforms could serve as enablers for inter-modality and enhanced logistics efficiency. This idea points to the importance of data integration and sharing in creating cohesive and responsive transportation networks.

Urban planning and the polycentric city

The discussion also touched on urban planning concepts, with a shift from the 15-minute city model toward polycentric city designs. This approach envisions multiple centres within a city, each accessible within 15-20 minutes and connected by robust transportation options. Such concepts influence mobility needs and highlight the importance of adaptable and efficient transport systems in urban environments.

Defining mobility and social dimensions

An important point was raised regarding the definition of mobility, noting that without a shared understanding, discussions may lack alignment with individual experiences and needs. Participants emphasised a potential disconnection between individual behaviours and collective strategies, suggesting that a clearer, agreed-upon definition of mobility could enhance the effectiveness of planning and innovation.

The social dimension of mobility was further explored, acknowledging the importance of inclusive mobility and social acceptance of new technologies. Shifts in population patterns, such as migration to suburbs, present challenges that require consideration of social factors alongside technological advancements. Social acceptance can act as a driver or barrier to the adoption of new mobility solutions, emphasising the need to address public perceptions and inclusivity in mobility planning.

Climate mitigation and adaptation

It was stressed that climate mitigation and adaptation should be a stand-alone topic, distinct from general sustainability discussions. Recognising climate action as integral to the future of all mobility sectors—including rail, air, and urban mobility—highlights the urgency of integrating climate considerations into all aspects of mobility innovation and infrastructure development.

List of abbreviations and definitions

Abbreviations	Definitions
ADAS	Advanced Driver-Assistance Systems
AAM	Advanced Air Mobility
AI	Artificial intelligence
CCFOR	Competence Centre on Foresight
EC	European Commission
EHL	Enzymatic Hydrolysis Lignin
EIC	European Innovation Council
EISMEA	European Innovation Council and SMEs Executive Agency
EU	European Union
EV	Electric Vehicle
eVTOL	electric Vertical Take-Off and Landing
HS	Horizon Scanning
ICEs	Internal Combustion Engines
JRC	Joint Research Centre (the scientific service of the European Commission)
MaaS	Mobility as a Service
PM	Programme Manager
TIM	Tools for Innovation Monitoring
TRL	Technology Readiness Level
R&I	Research and Innovation
SAF	Sustainable Aviation Fuel
SMEs	Small and Midsize Enterprises
STEP	Strategic Technologies for Europe Platform
UAVs	Unmanned Aerial Vehicles
WP	Work package

List of figures

Annexes

Annex 1. Full list of signals sent to participants before the workshop.

The signals have non-sequential numbering because they were extracted from the project's common database, which is continuously updated and includes elements from other thematic areas. For more information on the signal collection, please see section 2.

NUMBER | TITLE

49 | Engineered bacteria in sustainable aviation fuel

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

The aviation industry, needing energy-dense fuels for long flights, lags behind in decarbonization. The American Society of Testing and Materials has sanctioned several Sustainable Aviation Fuels (SAFs) over the last 2 decades. The first one was made converting syngas—derived from biomass, waste, or captured CO2 and green hydrogen—into hydrocarbons. Others came from plant oil and animal fat, but faced challenges in raw material sourcing and the need for green hydrogen. Engineered microorganisms offer a potential solution by breaking down non-edible biomass, improving the SAF's energy profile and reducing reliance on traditional raw materials. One of the most recent experiments involved engineering bacteria for production of sustainable polycyclopropanated jet fuel alternatives, with a potential higher energy density than current aerospace fuels.

SOURCE

CCFOR
World Economic Forum
Top 10 Emerging Technologies of 2023
https://www3.weforum.org/docs/WEF_Top_10_Emerging_Technologies_of_2023.pdf;
https://www.sciencedirect.com/science/article/pii/S2542435122002380?via%3Dihub

NUMBER | TITLE

60 | Biomimetic Devices

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

This trend relates to Responsive Materials as it refers to a technology which is modeled after human nature. The aerospace industry is making technological and structural advancements based on the morphology and movement of various animals to enhance maneuverability, reduce drag, and suppress aerodynamic noise.

SOURCE

CCFOR
Itonics
Trends & Technologies Shaping The Aerospace Industry
https://www.itonics-innovation.com/blog/trends-and-technologies-aerospace

NUMBER | TITLE

63 | Mobility Ecosystems

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Mobility Ecosystems are more integrated and allows users to travel seamlessly using multiple modes of transport to reach their destination with ease. This includes on-demand ride and car shares, electric and autonomous vehicles, micro-mobility, and high-tech public transport systems.

SOURCE

CCFOR
Itonics
Forces shaping the future of the automotive industry
https://www.itonics-innovation.com/blog/trends-and-technologies-in-automotive-industry

NUMBER | TITLE

76 | Mass-market military drones

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

The military drones used to be saved for the premium market but now these types of drones or unmanned aerial vehicle as they are sometimes called, are becoming cheaper and available for larger mass, markets.

SOURCE

CCFOR
MIT
MIT Technology Review
https://www.technologyreview.com/2023/01/09/1066394/10-breakthrough-technologies-2023/#mass-market-military-drones

NUMBER | TITLE

77 | Solid state battery recycling

SUGGESTED MATURITY

Novel (TRL 1-3)

SUMMARY DESCRIPTION

Since solid state batteries (SSBs) have such new manufacturing processes, they have not yet reached their pinnacle; thus more scrap is expected to be generated in the ramp up of SSB factories. There are some innovations in the recycling of SSBs such as supramolecular electrolytes which enable high qulaity recycling but this is still at early stage. This is important as there is a potential for a much larger lithium (Li) content to be returned via recycling as the anode is typically made of Li metal. Lithium is listed as highly critical on the EU's critical raw materials list.

SOURCE

CCFOR
MIT
MIT Technology Review
https://www.technologyreview.com/2023/01/09/1066394/10-breakthrough-technologies-2023/#battery-recycling

NUMBER | TITLE

78 | Fleet platooning

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Fleet platooning is the linking of two or more trucks or other modes of transport in a fleet, using connectivity technology and automated driving support systems.

These vehicles automatically maintain a set, close distance between each other when they are connected for certain parts of a journey, for instance on motorways.

SOURCE

CCFOR
VTT
VTT Trend Report
https://publications.vtt.fi/julkaisut/muut/2023/VTT_Trend_Report_2023.pdf

NUMBER | TITLE

150 | Semi solid and solid state batteries

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Switching the traditionally liquid electrolyte in the lithium ion battery to semi-solid-state and solid-state to store more energy per kilogram of battery weight leads to advances in fast charging and energy density. This is important as it can help scale and reduce costs association with the electification transition for vehicles.

SOURCE

CCFOR
McKinsey
What would it take to scale critical climate technologies?
https://www.mckinsey.com/capabilities/sustainability/our-insights/what-would-it-take-to-scale-critical-climate-technologies

NUMBER | TITLE

151 | E-ammonia and e-methanol

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

E-ammonia and e-methanol part of the e-fuels family but are non-drop-in fuels that require engine or infrastructure retrofits. Both e-methanol and e-ammonia requires green hydrogen, but e-methanol also requires the addition of captured biogenic CO2. Both are emerging fuels which could be used to abate emissions in heavy transport like martime and aviation industry.

SOURCE

CCFOR
McKinsey
What would it take to scale up
https://www.mckinsey.com/capabilities/sustainability/our-insights/what-would-it-take-to-scale-critical-climate-technologies

NUMBER | TITLE

200 | Dual-mode ramjet (DMRJ) systems with Turbine-Based Combined Cycle propulsion

SUGGESTED MATURITY

Novel (TRL 1-3)

SUMMARY DESCRIPTION

Dual mode ramjet/scramjet which can be operated in both subsonic and supersonic combustion mode - overall this constitutes the main air breathing propulsion system of a jet. Combined cycle engines promise cost-effective human-crewed hypersonic flight.

SOURCE

CCFOR
NATO
Science and Technology Trends 2023-2043
https://www.nato.int/nato_static_fl2014/assets/pdf/2023/3/pdf/stt23-vol1.pdf

NUMBER | TITLE

269 | Lidar on a chip - more efficiency and reliability with shorter size and costs

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Lidar (Light Detection and Ranging) is increasingly seen as a crucial sensor for autonomous vehicles, offering distinct advantages over cameras and radars. Its ability to create detailed 3D maps of the environment with high fidelity exceeds what cameras can achieve. Lidar operates in the infrared spectrum, typically between 905 and 1,550 nanometers, which allows for much better spatial resolution than automotive radar, as its emitted waves can be more tightly focused.

Earlier lidars faced challenges like high costs, integration difficulties, reliability issues, and susceptibility to interference from direct sunlight or other lidars. However, recent developments in chip-scale, solid-state lidars are addressing these issues. These new lidars, built entirely on a photonic integrated circuit using ordinary silicon, have no moving parts and are compact enough to integrate seamlessly into the design of modern cars.

This evolution in lidar technology is expected to drastically reduce costs and simplify integration into vehicles, making it a more feasible option for widespread use in autonomous driving. Furthermore, the potential applications of lidar extend beyond automotive uses, including industrial automation, robotics, mobile devices, precision agriculture, surveying, and gaming.

SOURCE

CCFOR
IEEE
IEEE Spectrum - Lidar on a chip puts self-driving cars in the fast lane
https://spectrum.ieee.org/lidar-on-a-chip

NUMBER | TITLE

311 | Green Roads against drought and floods

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

"Green Roads for Water" are designed to mitigate the effects of droughts and floods by incorporating embankments, channels, and dikes. This initiative, led by MetaMeta, a Dutch consulting firm, aims to use road networks to capture and redirect water for agricultural use. In Makueni County, Kenya, the implementation of these green roads has resulted in significant benefits, such as increased agricultural yields and reduced road maintenance costs. The concept is gaining international attention and is being implemented in various countries, supported by organizations like the World Bank.

SOURCE

CCFOR
Undark
Undark news
https://undark.org/2024/01/02/green-roads/?mc_cid=426239d340&mc_eid=707370bde5

NUMBER | TITLE

328 | Quantum computing in routing and navigation

SUGGESTED MATURITY

Novel (TRL 1-3)

SUMMARY DESCRIPTION

The integration of quantum computing into routing and navigation is poised to revolutionize these fields, especially in addressing complex challenges in global supply chain management and urban traffic systems. Quantum computing, utilizing qubits capable of multiple states, significantly surpasses classical computing in processing vast data amounts. This advancement is particularly crucial for solving the Traveling Salesman Problem in logistics, allowing for simultaneous exploration of multiple routes and substantially reducing computation time. Quantum-enhanced GPS, with unprecedented precision, promises to improve accuracy in navigation systems for various industries, including aviation and autonomous vehicles. However, quantum computing is still emerging, facing challenges like quantum noise, scalability, and security concerns. For business leaders, especially in logistics, adopting quantum computing is essential for staying ahead, requiring a strategic approach that includes ethical considerations. Despite its nascent stage, quantum computing's potential in routing and navigation is immense, indicating a transformative future in these sectors.

SOURCE

CCFOR
Fast Company
Fast Company
https://www.fastcompany.com/90976690/quantum-routes-how-quantum-computing-is-set-to-revolutionize-navigation-and-optimization-in-logistics

NUMBER | TITLE

415 | Hydrogen-powered combustion aircraft

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Hydrogen, and oxygen captured from the air, are
combusted in modified engines to generate thrust and proplusion. Singicance is that it reduces majorly the climate impact of flights while keeping a relatively long range. However, the infrastructure at airports would need to change a lot.

SOURCE

CCFOR
Deloitte
Europe’s future aviation landscape
https://www2.deloitte.com/nl/nl/pages/consumer/articles/europe-aviation-landscape-in-2040.html

NUMBER | TITLE

416 | Hydrogen fuel cell electric aircraft

SUGGESTED MATURITY

Novel (TRL 1-3)

SUMMARY DESCRIPTION

Hydrogen is reacted in a fuel cell to provide electricity to electric motors than spin propellers or ducted fans to generate thrust. The significance is that the emissions are nearly zero and the range is still kept although a bit less than 1000km. Fuel cell industry still lacks adoption however so this is still a big hurdle.

SOURCE

CCFOR
Deloitte
Europe's future aviation landscape
https://www2.deloitte.com/nl/nl/pages/consumer/articles/europe-aviation-landscape-in-2040.html

NUMBER | TITLE

417 | Battery-powered electric aircraft

SUGGESTED MATURITY

Novel (TRL 1-3)

SUMMARY DESCRIPTION

Electric batteries are used to power electric motors
that spin propellers or ducted fans to generate thrust. This is significant because it will reduce environmental impacts to 0 but will be limited in terms of range unless improvements of battery technologies on the energy density side arrive. There's also issues with accessing massive amount of renewable energy to power these batteries.

SOURCE

CCFOR
Deloitte
Europe’s future aviation landscape
https://www2.deloitte.com/nl/nl/pages/consumer/articles/europe-aviation-landscape-in-2040.html

NUMBER | TITLE

422 | Wind-assisted propulsion for shipping such as rotor sails in conjunction with voyage optimization

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

There are several types of wind assisted propulsion systems in development. The main gain of these technologies is economic and environmental, that is, reducing costs by reducing fuel consumption and thereby reducing GHG emissions. One instance of this tech is rotor sails. Other examples include suction wings, kites, (kites being the less mature of all).

SOURCE

CCFOR
DNV
Potential of wind-assisted propulsion for shipping
https://www.emsa.europa.eu/publications/reports/item/5078-potential-of-wind-assisted-propulsion-for-shipping.html

NUMBER | TITLE

423 | On-board carbon capture & storage for maritime

SUGGESTED MATURITY

Novel (TRL 1-3)

SUMMARY DESCRIPTION

Generally, vessels run on heavy fuel oil and if a carbon capture unit and storage tank is implemented on board then that helps with decarbonizing this mode of transport. Generally these CCS systems are fitted with a scrubber fro sulfur oxides and exhaust pre-treatment.

SOURCE

CCFOR
DNV - Martime Impact
Can CO2 capture and nuclear get ships to net zero?
https://www.dnv.com/expert-story/maritime-impact/can-co2-capture-and-nuclear-get-ships-to-net-zero.html

NUMBER | TITLE

538 | Dirt-powered fuel cell runs forever

SUGGESTED MATURITY

Novel (TRL 1-3)

SUMMARY DESCRIPTION

New fuel cell harnesses naturally occurring microbes to generate electricity
Soil-powered sensors to successfully monitor soil moisture and detect touch
New tech was robust enough to withstand drier soil conditions and flooding
Fuel cell could replace batteries in sensors used for precision agriculture

SOURCE

CCFOR
https://news.northwestern.edu/stories/2024/01/dirt-powered-fuel-cell-runs-forever/?fj=1

NUMBER | TITLE

577 | Nuclear container ship as competitor to synthetic maritime fuels

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Shipping must slowly but surely go green. Nuclear vessels is the most far-reaching new type of vessel, but it is one to watch as it could be competitive with other emerging fuels based vessels such as hydrogen and methanol. What is most interesting about this signal is the type of nuclear reactor the ship builder, Jiangnan, would like to use is a molten salt reactor that runs on thorium. This type of nuclear reactor existed in the 1960s, but its development has not been continued for reasons of safety. However there is now a push to development research in this domain since it could be safer than uranium reactors for nuclear ships.

SOURCE

CCFOR
Energeia
Nuclear container ship on the drawing board in China
https://energeia.nl/nucleair-containerschip-op-de-tekentafel-in-china/

NUMBER | TITLE

589 | Revolutionary 50-Year Nuclear Battery for a Wide Array of Applications

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

The Chinese company Betavolt has introduced the BV100, a nuclear battery with a remarkable 50-year lifespan, leveraging nickel-63 isotope and diamond semiconductor materials for construction. This innovation targets a broad spectrum of applications, including aerospace, AI devices, medical systems, MEMS, intelligent sensors, drones, and robots, potentially revolutionizing the way smartphones are powered by eliminating the need for recharging. The BV100, sized at 15 x 15 x 5mm and producing 100 microwatts at 3 volts, is currently in the pilot stage with mass production in view.

Its safety features are noteworthy, as it poses no radiation leakage risk even under extreme conditions, marking a significant departure from earlier nuclear batteries that were large, hazardous, and expensive. Betavolt's unique method of doping large-size diamond semiconductor materials sets it apart, positioning the BV100 as a breakthrough product in atomic battery technology.

The company also hints at future advancements, exploring other isotopes for batteries with even longer lifespans and higher power outputs, up to 230 years.

SOURCE

CCFOR
Future US
Tom’s Hardware
https://www.tomshardware.com/

NUMBER | TITLE

691 | AI's Role in Driving Sustainability and Safety in the Mobility Sector

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Applied AI is revolutionizing the mobility sector, particularly in enhancing sustainability and safety. Companies are leveraging AI to simulate countless driving scenarios for autonomous vehicles (AVs), far beyond what's possible manually. This not only streamlines the development process but also significantly cuts costs by identifying and addressing potential safety issues without the need for physical reiterations. In procurement, AI is instrumental in scanning supply chains for environmental and social risks, thus promoting sustainable manufacturing practices critical to consumers, as evidenced by surveys indicating a strong preference for eco-friendly vehicles.

In manufacturing, AI technologies, including vision cameras and radar, are deployed for stringent quality control, ensuring vehicles meet high safety standards while reducing production lead times. Marketing strategies benefit from AI by identifying at-risk customers and enhancing loyalty through personalized incentives. Furthermore, AI integration into vehicle systems offers personalized infotainment recommendations, improving the driving experience. With the automotive industry's increasing focus on automation, significant investments in AI are anticipated, aiming to address labor shortages and enhance operational efficiency by automating mundane tasks. This holistic application of AI across the mobility ecosystem underscores its potential to drive forward both environmental sustainability and safety in the sector.

SOURCE

CCFOR
McKinsey
What technology trends are shaping the mobility sector?
https://www.mckinsey.com/features/mckinsey-center-for-future-mobility/our-insights/what-technology-trends-are-shaping-the-mobility-sector

NUMBER | TITLE

696 | Ultra-high density hydrogen storage holds twice as much as liquid H2

SUGGESTED MATURITY

Novel (TRL 1-3)

SUMMARY DESCRIPTION

A novel hydrogen storage system developed by a team of researchers in Australia. The system utilizes a new material called "pentinitride" to store hydrogen at significantly higher densities compared to conventional storage methods. The novel aspect lies in the material's ability to hold hydrogen at a high density under ambient conditions, bypassing the need for extreme pressures or temperatures. This breakthrough could potentially revolutionize hydrogen storage, making it safer, more efficient, and economically viable for various applications, including fuel cells and energy storage.

SOURCE

CCFOR
New Atlas
Ultra-high density hydrogen storage holds twice as much as liquid H2
https://newatlas.com/energy/high-density-hydrogen-storage/

NUMBER | TITLE

703 | Advanced Organic Electrode Materials for Electrochemical Energy Storage

SUGGESTED MATURITY

Novel (TRL 1-3)

SUMMARY DESCRIPTION

Organic battery materials per se are not that novel, but there has been extensive progress in the past few years to push this technology forward. In fact, one issue has been the introduction of the charge carrier ions in order to go for fully organic batteries. This has been recently achieved by two groups in France and Belgium. Additionally, the field of organic electrode materials is much more prone to benefit from further improvements based on AI and machine learning, as these materials can rather easily be chemically modified to optimize the redox potential, crystal structure etc. - which is different from commonly used inorganic electrode materials. A group in Sweden, for instance, has been carrying out excellent (preliminary) work in this regard already (not published, yet). Accordingly, organic batteries may (i) pave the way for meaningfully combining AI/machine learning and experimental research much faster than for inorganic materials and (ii) enable the development of truly sustainable rechargeable batteries - a field in which Europe is currently leading worldwide (far ahead of, e.g., China, Korea, Japan or the US).

SOURCE

External experts
https://www.nature.com/articles/s41563-020-00869-1

NUMBER | TITLE

710 | Hybrid energy storage with aluminium

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

The latest technologies for aluminium oxid reduction in a smelter produce aluminium without CO2 emissions and are associated with a significant reduction in costs. As a result, aluminium can be used as a hybrid energy store. The use of steam at 900 degrees Celsius enables the oxidation of aluminium, which produces hydrogen, pressure and heat. One m^3 of aluminium provides approx. 330 kg of hydrogen, electricity and heat. The costs for the production and long-term storage of hydrogen would amount to about 4-6 €/kg hydrogen. The waste is aluminum oxid, which will be reused. The process supports by 100% the circulur economy. There are no geographical restrictions on its use, the storage capacity is virtually unlimited, no further critical raw materials are used and no poisonous materials are used. Aluminium is the third most abundant element in the earth's crust.

SOURCE

External experts
https://www.elysis.com/sites/default/files/newsfiles/lmaelysisfeb2022.pdf
https://onlinelibrary.wiley.com/doi/10.1002/ente.202000233

NUMBER | TITLE

713 | Organic batteries for sustainable energy storage

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

In 2019, the European Union proposed the ambitious vision of a fossil-fuel-free society by 2050. Achieving this goal will require a massive use of batteries for electric mobility and energy storage from renewable sources. Although rechargeable batteries have several desirable characteristics, the rapid expansion of their market have raised concerns about the availability of the raw materials used, particularly Lithium, Nickel, Manganese, with projections predicting a shortage of critical raw materials in less than ten years. Therefore, the conventional battery electrode, based on the insertion of Li, should be revolutionized and a new type of device should be developed, in which organic molecules with redox functionality can be the active part of the battery and are able to reversibly and efficiently absorb and release electrons. This will contribute to technology advance, addressing the problems of safety and sustainability of conventional energy storage systems.

SOURCE

External experts
https://www.nature.com/articles/s41578-022-00478-1

NUMBER | TITLE

721 | Organic batteries

SUGGESTED MATURITY

Novel (TRL 1-3)

SUMMARY DESCRIPTION

Organic batteries have benefited from more than a decade of research, mainly focused on the search for increasingly efficient materials in terms of redox potential, specific capacity,...

This technology holds out a number of promising prospects: elements are abundant (low cost), available throughout the world (sovereignty issue) and are easily recyclable by combustion (heat) or selective dissolution.

To date, several laboratory prototypes have emerged (TRL3), but there is still a great deal of research to be carried out, not only to improve the lifespan of these batteries, but also to enhance their intrinsic performance.

SOURCE

External experts
https://www.sciencedirect.com/science/article/pii/S0378775320311186

NUMBER | TITLE

776 | Quantum Lidar

SUGGESTED MATURITY

SUMMARY DESCRIPTION

Quantum LiDAR represents a significant advancement in light detection and ranging technology, utilizing quantum phenomena such as entanglement and single-photon detection for enhanced performance. Developments in this field involve the application of Single-Photon Avalanche Diodes (SPADs) designed in CMOS technology, offering better performance, miniaturization, cost-effectiveness, and scalability. Recent studies show that quantum LiDAR systems can achieve a higher signal-to-noise ratio, enhance target visibility, and improve image contrast, even in the presence of environmental noise and transmission losses. Applications for this technology are expansive, ranging from quantum random number generators to super-resolution microscopy and reconnaissance systems. Furthermore, advancements in quantum LiDAR technology have demonstrated potential in improving depth imaging through complex environments, enabling isolation of the LiDAR signal from spurious sources, making it a promising technology for robust and secure imaging applications.

SOURCE

TIM
Sources used in the signal's detection and description include, but are not limited to:
http://doi.org/10.1038/s41565-023-01360-z ; http://doi.org/10.1117/12.2560184 ;
http://doi.org/10.1126/sciadv.aay2652 ; http://doi.org/10.1103/PhysRevLett.131.033603

NUMBER | TITLE

815 | New Battery Diagnostics of Batteries and Beyond

SUGGESTED MATURITY

Novel (TRL 1-3)

SUMMARY DESCRIPTION

Integrating timescale characterization with the distribution of relaxation times (DRT) analysis represents a major breakthrough in electrolysis and battery technologies. This approach enables a deeper understanding and optimization of the kinetic processes critical for energy storage and conversion. This method provides a precise diagnosis of phenomena such as ion transport and charge transfer mechanisms within these systems. Using non-destructive impedance characterizations allows for real-time monitoring, ultimately leading to the development of more efficient, durable, and faster-charging batteries and electrolyzers. Furthermore, it can be used to accelerate experimentation potentially integrating with high-throughput experiments.

This emerging technology has the potential to disrupt current practices in energy storage and conversion. Particularly in electrolysis, applying timescale characterization could revolutionize hydrogen production efficiency and overall energy system performance, supporting sustainability goals. This signals a shift towards data-driven techniques in materials science and energy technology, promising to shape the future of the industry and open new avenues for research and development.

SOURCE

External experts
https://doi.org/10.1016/j.joule.2022.05.005

NUMBER | TITLE

821 | Optical signal recovery by Photonic neural network

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Miniature photonic 'brains' restore integrity in optical networks:
ALPI aims at the integration of a photonic neural network within an optical transceiver to increase the transmission capacity of the optical link. Based on a deep learning approach, the new compact device provides real time compensation of fiber nonlinearities which degrade optical signals. In fact, the tremendous growth of transmission bandwidth both in optical networks as well as in data centers is baffled by the optical fiber nonlinear Shannon capacity limit. Nowadays, computational intensive approaches based on power hungry software are commonly used to mitigate fiber nonlinearities. Here, we propose to integrate in the optical link the neuromorphic photonic circuits which we are currently developing in the ERC-AdG BACKUP project. Specifically, the proposed error-correction circuit implements a small all-optical complex-valued neural network which is able to recover distortion on the optical transmitted data caused by the Kerr nonlinearities in multiwavelength optical fibers. Network training is realized by means of efficient gradient-free methods using a properly designed data-preamble.
A new neuromorphic transceiver demonstrator realized in active hybrid Si/InP technology will be designed, developed and tested on a 100 Gbps 80 km long optical link with multiple-levels symbols. The integrated neural network will mitigate the nonlinearities either by precompensation/autoencoding at the transmitter TX side or by data correction at the receiver RX side or by concurrently acting on both the TX and RX sides. This achievement will bear to the second ALPI’s goal: moving from the demonstrator to the industrialization of the improved transceiver. For this purposes, patents will be filed and a business plan will be developed in partnership with semiconductor, telecom and IT companies where a path to the commercialization will be individuated. The foreseen market is the big volume market of optical interconnection in large data centers or metro networks.

SOURCE

External experts
https://cordis.europa.eu/project/id/963463

NUMBER | TITLE

826 | Electrically rechargeable liquid fuel

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Electrically rechargeable liquid fuel is an advanced material technology that employs electricity to regenerate spent fuel for re-use. This technology uses the electrical power to trigger chemical reactions that convert waste products back into usable fuel, thus enabling a circular energy system. It has the potential to significantly improve energy efficiency as well as environmental sustainability by reducing the need for the extraction and refining of new fuels. The novelty of the electrically rechargeable liquid fuel lies in its capability to transform our energy systems by creating a sustainable and closed-loop fuel cycle. Instead of continuously extracting and burning fuels, this technology allows us to reuse the same fuel multiple times, reducing environmental damage and resource depletion. Recent developments show a promising future for this technology, with potential applications in various sectors such as transportation and power generation. However, further research and development are required to overcome current limitations and to bring this innovative technology to commercial reality.

SOURCE

TIM
Sources used in the signal’s detection and description include, but are not limited to:
http://doi.org/10.1016/j.scib.2019.01.014; http://doi.org/10.1016/j.xcrp.2020.100102;
http://doi.org/10.1016/j.jpowsour.2021.230023; http://doi.org/10.1016/j.apenergy.2021.117145;
http://doi.org/10.1016/j.jpowsour.2021.230198; http://doi.org/10.1021/acsam

NUMBER | TITLE

828 | Sustainable Ammonia fuel

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Sustainable Ammonia fuel refers to the use of ammonia as a carbon-free alternative to fossil fuels. It involves the production of ammonia using sustainable methods, such as electrochemical synthesis, and harnessing it as a source of hydrogen for fuel cells. This technology seeks to address the global need for clean, renewable energy sources and reduce carbon emissions.

The novelty of Sustainable Ammonia fuel lies in its potential to serve as a carbon-free, renewable energy source. Unlike traditional fuels, the combustion of ammonia does not release carbon dioxide, making it environmentally friendly. Recent developments have focused on improving the efficiency and scalability of sustainable ammonia production. Potential applications span across various industries, notably in power generation and transportation, where it can be used in fuel cells for electric vehicles. However, challenges remain in the safe storage and transportation of ammonia.

SOURCE

TIM

Sources used in the signal's detection and description include, but are not limited to: http://doi.org/10.1039/c9ee02873k; http://doi.org/10.1002/eem2.12268; http://doi.org/10.1038/s41586-022-05409-2; http://doi.org/10.1039/d2ee04095f; http://doi.org/10.1007/978-3-031-32041-5_12; http://doi.org/10.1016/j.ijhydene.2023.06.309; http://doi.org/

NUMBER | TITLE

835 | Closed loop battery recycling

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Closed loop battery recycling is a sustainable technology aimed at managing the lifecycle of batteries by extracting and reusing valuable materials. This technology addresses the environmental and health concerns associated with battery disposal, and is crucial in the context of growing demand for lithium-ion batteries in electric vehicles and renewable energy storage. Closed loop recycling involves several steps, including collection, sorting, mechanical treatment, hydrometallurgical or pyrometallurgical processes, and purification of the extracted materials for reuse in battery production.

The novelty of closed loop battery recycling lies in its comprehensive approach to battery waste management. Unlike traditional recycling methods, which focus on extracting a few key materials and generally discard the rest, closed loop recycling aims to recover and reuse as many materials as possible, reducing waste and making the process more economically viable. This technology also aligns with the circular economy model, promoting sustainability and resource efficiency. Despite these advantages, challenges such as technical complexity and high initial investment costs must be addressed to enable wider adoption of this technology.

SOURCE

TIM

Sources used in the signal's detection and description include, but are not limited to: http://doi.org/10.1007/s10479-020-03888-y; http://doi.org/10.1016/j.jhazmat.2021.127900; http://doi.org/10.1016/j.ensm.2021.12.013; http://doi.org/10.1038/s43246-020-00095-x; http://doi.org/10.1016/j.cej.2022.139258; http://doi.org/10.1016/j.ensm.2022.09.

NUMBER | TITLE

838 | Sustainable aviation fuel

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Sustainable aviation fuel (SAF) is a technology aiming to decrease the environmental impact of aviation by substituting conventional jet fuels with more environmentally friendly alternatives. SAFs are typically produced from renewable resources such as waste oils, agricultural residues, and non-food energy crops, and can significantly reduce greenhouse gas emissions compared to fossil-based jet fuels.

The novelty of SAF technology resides in its potential to significantly reduce the carbon footprint of the aviation sector, traditionally a major contributor to global emissions. Recent advancements include improvements in fuel production processes, with an emphasis on optimizing efficiency and sustainability, and the development of new feedstocks, particularly those that do not compete with food production. However, despite these promising developments, the cost, scalability, and availability of SAFs remain ongoing challenges that need to be addressed to fully realize the potential of this technology.

SOURCE

TIM

Sources used in the signal’s detection and description include, but are not limited to: http://doi.org/10.1039/c3ee43846e; http://doi.org/10.1016/j.fuel.2022.126294; http://doi.org/10.1038/s41893-022-01046-9; http://doi.org/10.1080/03036758.2023.2212174; http://doi.org/10.4271/2023-01-0263; http://doi.org/10.1016/j.fuel.2023.129557; http://d

NUMBER | TITLE

842 | Direct recycling of batteries

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Direct recycling of batteries is a technology in the field of advanced materials that focuses on recovering and reusing the active materials in spent batteries. This process involves disassembling the battery and directly reusing the recovered materials in new batteries. This method can potentially enhance the sustainability of battery production and reduce environmental impacts associated with battery disposal.

The novelty of this technology lies in its departure from traditional recycling methods that involve energy-intensive smelting processes and harmful chemical treatments. Direct recycling of batteries allows for the preservation of the material's original structure, thereby reducing energy consumption and waste generation. Furthermore, this technology has the potential to address the growing demand for battery materials in a sustainable manner. However, it may pose challenges in terms of ensuring the quality and performance of the recycled materials. Recent developments have focused on addressing these issues and further optimizing the process for different types of batteries.

SOURCE

TIM

Sources used in the signal’s detection and description include, but are not limited to: http://doi.org/10.1007/978-3-030-92563-5_49; http://doi.org/10.1002/cey2.231; http://doi.org/10.1002/gch2.202200212; http://doi.org/10.1021/acsnano.3c00270; http://doi.org/10.1016/j.esci.2023.100091; http://doi.org/10.1016/j.procir.2023.02.032; http://doi

NUMBER | TITLE

990 | New Biofuel Process for Potentially Cost-Effective Sustainable Aviation Fuel

SUGGESTED MATURITY

Novel (TRL 1-3)

SUMMARY DESCRIPTION

Researchers in Oak Ridge National Laboratory and the University of California, Riverside have developed a new process to transform waste lignin, a by product of corn and wood production, in to sustainable aviation fuel (SAF) at a lower rate than the current cost (February 2024) of jet fuel in the U.S. The researchers claim that this process is much higher yielding (up to 18%) than the enzymatic hydrolysis lignin (EHL) process that have been trial in Europe.

SOURCE

CCFOR
World Bio Market Insights
Innovative CELF biorefinery tech boosts biofuel competitiveness with petroleum
https://worldbiomarketinsights.com/innovative-celf-biorefinery-tech-boosts-biofuel-competitiveness-with-petroleum/

NUMBER | TITLE

1083 | AI for urban air mobility

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

AI for urban air mobility is a technology harnessing artificial intelligence (AI) and machine learning (ML) to enhance and automate operations in urban air mobility (UAM) such as air taxis, unmanned aerial vehicles, and delivery services. The technology integrates complex algorithms and data-driven approaches to predict system health, detect faults, optimize propeller design, and mitigate cyber-attacks. It relies on real-time data from sensors and historical data to implement predictive integrity and intelligent decision-making, enhancing safety, reliability, and efficiency. Potential applications include urban logistics services, air taxi demand prediction, and enhancing cybersecurity in UAM. Through the application of AI and ML, these systems can operate autonomously, reducing the need for human intervention and increasing operational efficiency; The novelty of AI for urban air mobility lies in its application of AI and ML for autonomous air traffic management and system health management, which is a significant leap from traditional manual and semi-automated systems. This technology introduces an advanced level of automation and predictive capability into the aerospace industry, enabling early detection of system failures and estimation of remaining useful life. It also offers a new approach to propeller design optimization and noise reduction using AI and ML, which is innovative compared to traditional methods. Furthermore, the technology addresses the safety and security concerns inherent in autonomous operations, such as the risk of cyber-attacks, making it a groundbreaking advancement in urban air mobility. Unique features such as multi-agent reinforcement learning for cooperative navigation and the use of AI for jamming and spoofing attack detection and mitigation further distinguish this technology from established ones. The technology also confronts the challenge of verifying machine learning algorithms, emphasizing its cutting-edge nature in the field of aerospace.

SOURCE

TIM
Sources used in the signal's detection and description include, but are not limited to:
http://doi.org/10.1109/TSG.2018.2808247 ; http://doi.org/10.1109/JIOT.2021.3084923 ; http://doi.org/10.1016/j.apenergy.2021.118139 ; http://doi.org/10.1016/j.energy.2022.123217 ; http://doi.org/10.1109/IRASET52964.2022.9738115 ; http://doi.org/10.1145/353

NUMBER | TITLE
1112 | Humanoid robot drives a car
SUGGESTED MATURITY
Emerging (TRL 4-6)
SUMMARY DESCRIPTION
Kento Kawaharazuka at the University of Tokyo and his colleagues have developed a humanoid robot, called Musashi, that can drive a car in the same way as a human. It has a human-like “skeleton” and “musculature”, as well as cameras in each of its eyes and force sensors in its hands and feet. Artificial intelligence systems work out what actions are needed to drive the car and react to events such as traffic lights changing colour or a person stepping in front of the car.
SOURCE
CCFOR New Scientist https://www.newscientist.com/article/2435826-watch-a-humanoid-robot-driving-a-car-extremely-slowly/

NUMBER | TITLE
1117 | Personal flying machines close to coming to market
SUGGESTED MATURITY
Close to market (TRL 7-9)
SUMMARY DESCRIPTION
Several personal ultralight aircraft, run on electric batteries, are expected to hit the market in 2024/5
SOURCE
CCFOR Axios https://www.axios.com/2023/10/06/personal-flying-machines-jetsons

NUMBER | TITLE
1118 | Fully electric 90-passenger plane could fly 500 miles
SUGGESTED MATURITY
Emerging (TRL 4-6)
SUMMARY DESCRIPTION
Dutch startup Elysian has plans for a fully electric regional aircraft, with a range of 500 miles (805 kilometers) and space for 90 passengers, capable of reducing emissions by 90% — which it aims to fly commercially within a decade.
SOURCE
CCFOR CNN https://edition.cnn.com/travel/elysian-electric-plane-90-passenger-spc

NUMBER | TITLE

1119 | UK government tests unjammable quantum navigation system

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

In a first-of-its-kind achievement, the UK has successfully completed commercial flight trials of advanced quantum-based navigation systems that cannot be jammed or spoofed by hostile actors.

While GPS jamming is currently relatively rare and does not directly impact an aircraft's flight path, new quantum-based Positioning, Navigation, and Timing (PNT) systems could, over time, offer one part of a larger solution to providing highly accurate and resilient navigation that complements current satellite systems – which could help ensure that the thousands of flights that take place around the world daily, proceed without disruption.

SOURCE

CCFOR
UK government
UK govenrment website
https://www.gov.uk/government/news/un-jammable-quantum-tech-takes-flight-to-boost-uks-resilience-against-hostile-actors

NUMBER | TITLE

1120 | Planes are under attack from GPS jamming - possible fixes

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Disruptions to GPS signals, which began near war zones in Europe and the Middle East, are now affecting the busiest oceanic airspace in the world. More than 1700 transatlantic flights cross the North Atlantic between Europe and North America each day. In recent months, a small but growing number of these flights have lost reliable GPS service over Europe or the Middle East and failed to recover it before the ocean crossing. Such interference comes in two forms. GPS jamming transmits powerful signals to overwhelm the weaker radio signals coming from global navigation satellites in space. Another intervention involves spoofing GPS signals, which misleads GPS receivers into falsely reporting that they are hundreds or thousands of miles away from their actual location.

SOURCE

CCFOR
New Scientist
New Scientist
https://www.newscientist.com/article/2439560-planes-are-under-attack-from-gps-jamming-can-we-find-a-fix

NUMBER | TITLE

1124 | Tiny solar-powered drones could stay in the air forever

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

A drone weighing just 4 grams is the smallest solar-powered aerial vehicle to fly yet, thanks to its unusual electrostatic motor and tiny solar panels that produce extremely high voltages. Although the hummingbird-sized prototype only operated for an hour, its makers say their approach could result in insect-sized drones that can stay in the air indefinitely.

Tiny drones are an attractive solution to a range of communications, spying and search-and-rescue problems, but they are hampered by poor battery life, while solar-powered versions struggle to generate enough power to sustain themselves.

Qi and his colleagues developed a simple circuit that scales up the voltage produced by solar panels to between 6000 and 9000 volts. Rather than using an electromagnetic motor like those in electric cars, quadcopters and various robots, they used an electrostatic propulsion system to power a 10-centimetre rotor.

SOURCE

CCFOR
New Scientist
New Scientist
https://www.newscientist.com/article/2439277-tiny-solar-powered-drones-could-stay-in-the-air-forever

NUMBER | TITLE
1132 | The Future of Transportation: Smart Mobility and Electric Vehicles
SUGGESTED MATURITY
Close to market (TRL 7-9)
SUMMARY DESCRIPTION
Smart mobility and electric vehicles (EVs) are revolutionizing urban transportation, enhancing city efficiency and sustainability. Smart mobility uses advanced technologies for seamless, efficient transport, including connected vehicles, Mobility as a Service (MaaS), autonomous vehicles, and smart infrastructure. These innovations optimize routes, reduce emissions, improve safety, and provide convenient travel options. EVs, crucial to smart mobility, offer environmental benefits, energy efficiency, lower operating costs, and superior performance. Market trends show rising global EV adoption, battery technology advancements, expanding charging networks, and supportive government policies. However, challenges remain, such as developing robust charging infrastructure, managing battery recycling, reducing costs, and increasing consumer acceptance. The future of transportation involves smart mobility and EVs, driven by urban planning, technological advancements, and collaborative efforts. These innovations promise a cleaner, safer, and more efficient transportation system, essential for sustainable urban development and addressing climate change.
SOURCE
CCFOR BIS Infotech The Future of Transportation: Smart Mobility and Electric Vehicles Read more at: https://www.bisinfotech.com/the-future-of-transportation-smart-mobility-and-electric-vehicles/ https://www.bisinfotech.com/the-future-of-transportation-smart-mobility-and-electric-vehicles/

NUMBER | TITLE
1133 | Flying Car Market Soars to New Heights
SUGGESTED MATURITY
Emerging (TRL 4-6)
SUMMARY DESCRIPTION
The vision of personal airborne transportation, once confined to the realms of science fiction, is rapidly becoming a reality as the flying car market takes flight. According to a comprehensive market research report, the global flying car market, valued at a mere $116.96 million in 2023, is poised for exponential growth, projected to reach a staggering $1.37 billion by 2031. The flying car market represents a transformative shift in personal mobility, promising to revolutionize urban transportation, alleviate traffic congestion, and unlock new horizons of convenience and efficiency. As technological advancements converge with innovative engineering solutions, the once-elusive dream of taking to the skies in a personal flying vehicle is rapidly becoming a tangible reality.
SOURCE
CCFOR einpresswire Flying Car Market Soars to New Heights, Projected to Reach $1.37 Billion by 2031

NUMBER | TITLE

1134 | Sustainable, autonomous, and connected vehicles are changing digital mobility business models

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

The article discusses the transformative impact of sustainable, autonomous, and connected vehicles on the business models within the digital mobility sector. The focus is on how these technologies are shifting the primary income sources for carmakers from traditional sales to services such as remote electric driving, autonomous deliveries, and car-sharing. The study highlights the integration of advanced technologies in vehicles to enhance efficiency and sustainability, emphasizing the potential for significant energy savings and improved urban transportation systems. Additionally, it examines the challenges and opportunities that arise with the adoption of these innovative mobility solutions, particularly in terms of regulatory frameworks, technological infrastructure, and societal acceptance. The paper underscores the need for a strategic approach to fully realize the benefits of autonomous and connected vehicle technologies in creating a sustainable future for urban mobility.

SOURCE

CCFOR
European Research on Management and Business Economics
Revolutionizing the road: How sustainable, autonomous, and connected vehicles are changing digital mobility business models
https://www.sciencedirect.com/science/article/pii/S2444883423000177?via%3Dihub

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NUMBER | TITLE

1135 | Harnessing the power of digital transformation in automotive value chains

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

The digital age is revolutionizing the automotive industry by transitioning from traditional manufacturing to an interconnected ecosystem driven by technologies such as AI, blockchain, and IoT.

This shift brings significant advancements, including autonomous factories, decentralized supply chains, connected vehicles, predictive maintenance, and personalized customer experiences.

The article highlights the importance of ecosystem collaboration and innovative business models, emphasizing the transformative potential of advanced materials and autonomous driving.

These emerging trends are set to shape the future of mobility, creating new opportunities and challenges for the industry.

SOURCE

CCFOR
Automotive World
The digital age offers boundless possibilities for mobility
https://www.automotiveworld.com/articles/the-digital-age-offers-boundless-possibilities-for-mobility/

NUMBER | TITLE

1136 | Blockchain-Driven Transformation of Malaysia's EV Infrastructure

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Aco Tech, in collaboration with Geno Group and MARii, is set to transform Malaysia's EV infrastructure using blockchain technology. The partnership aims to enhance the E-Mobility Service Platform (EMSP) with solutions like smart contracts, supply chain digital traceability, and privacy protection. This initiative aligns with Malaysia's National Energy Transition Roadmap, targeting substantial EV adoption by 2050. Blockchain integration promises improved data privacy, reduced costs, and enhanced user experience through decentralized, tamper-proof systems, supporting the nation's goals for a sustainable and advanced EV ecosystem.

SOURCE

CCFOR
CoinTrust
Aco Tech Collaborates with Geno Group and MARii to Revolutionize Malaysia’s EV Infrastructure with Blockchain
https://www.cointrust.com/market-news/aco-tech-collaborates-with-geno-group-and-marii-to-revolutionize-malaysias-ev-infrastructure-with-blockchain

NUMBER | TITLE

1137 | Air France and Parker Aerospace Enhance Aircraft Parts Tracking with Blockchain

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Air France Industries KLM Engineering & Maintenance and Parker Aerospace have launched a blockchain platform to enhance tracking and tracing of aircraft parts. This initiative, using SkyThread’s technology, allows real-time monitoring and comprehensive event histories of parts in the 787 fleets. The platform ensures data transparency, reduces repair turnaround times, and improves supply chain efficiency. This collaboration signifies a major advancement in aviation, setting a new standard for part authenticity and operational reliability. Future expansion aims to include more entities and broaden the platform’s capabilities.

SOURCE

CCFOR
Cointrust
https://www.cointrust.com/market-news/air-france-and-parker-aerospace-revolutionize-aircraft-parts-tracking-with-blockchain
https://www.cointrust.com/market-news/air-france-and-parker-aerospace-revolutionize-aircraft-parts-tracking-with-blockchain

NUMBER | TITLE

1138 | Dynamic on-demand shared transport solutions with autonomous vehicles

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Liftango and May Mobility have announced a partnership to develop dynamic, on-demand shared transport solutions using autonomous vehicles (AV). The collaboration leverages Liftango's expertise in shared mobility solutions and May Mobility's autonomous driving technology to optimize transit services across cities and corporate campuses. By integrating demand-responsive scheduling and routing optimization, the partnership aims to create a safe, inclusive, and efficient transit system that caters to diverse community needs. This initiative will enhance transportation accessibility, particularly for individuals in rural or underserved areas, and improve overall transportation reliability. The partnership marks a significant step towards making autonomous vehicle technology a viable solution for both urban and rural mobility challenges, potentially reducing congestion and improving environmental sustainability.

SOURCE

CCFOR
PR Newswire
Liftango and May Mobility partner to deliver dynamic on-demand shared transport solutions with autonomous vehicles
https://www.prnewswire.com/news-releases/liftango-and-may-mobility-partner-to-deliver-dynamic-on-demand-shared-transport-solutions-with-autonomous-vehicles-301966762.html

NUMBER | TITLE

1139 | Passenger Drones

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Passenger Drones are autonomous aerial vehicles that represent an effective alternative mobility solution to congested land-based transportation. They rely on technological advances in fields like LiDAR, sensors, 5G, artificial intelligence (AI), and machine learning (ML). This technology could quickly emerge as the urban mobility solution of choice due to its ability to reduce travel time, avoid traffic congestion, and reduce noise pollution and emissions compared to traditional forms of land-based transportation. However, safety and affordability concerns will determine adoption, and there is a need for lighter, more energy-dense battery technologies for electric Passenger Drones to become viable.

SOURCE

CCFOR
How to Geek
Are Passenger Drones the Flying Cars We Were Promised?
https://www.howtogeek.com/785906/are-passenger-drones-the-flying-cars-we-were-promised/

NUMBER | TITLE

1140 | EHang's Passenger Drone Achieves Historic Certification

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

EHang Holdings has achieved a groundbreaking milestone in urban air mobility by receiving the type certificate for its EH216-S passenger UAV from the Civil Aviation Administration of China (CAAC). This certification is the first of its kind for an unmanned electric vertical take-off and landing (eVTOL) aircraft. The certification process involved extensive testing to ensure the aircraft's airworthiness, safety, performance, and reliability. This accomplishment positions EHang as a leader in the urban air mobility market, projected to grow to $1 trillion by 2040 and $9 trillion by 2050.

SOURCE

CCFOR
Interesting Engineering
China grants type certificate to EH216-S passenger drone
https://interestingengineering.com/transportation/china-eh216-s-passenger-drone

NUMBER | TITLE

1141 | Autonomous Mobile Retail

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Robomart introduces an innovative retail solution featuring autonomous, hail-able mobile shops. These mobile shops are designed to be more labor-efficient and cost-effective compared to traditional delivery services and brick-and-mortar stores. Equipped with temperature control and auto-checkout systems, Robomart's mobile retail units aim to meet the increasing consumer demand for convenience and self-service options. This approach leverages advanced autonomous technology to provide a seamless, on-demand shopping experience directly to consumers' doorsteps.

SOURCE

CCFOR
Pymnts
Autonomous Technology Will Speed the Rise of ‘Mobile Retail’
https://www.pymnts.com/news/retail/2024/robomart-ceo-autonomous-technology-will-speed-rise-mobile-retail

NUMBER | TITLE

1142 | Cargo drones: The future of parcel delivery

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Cargo drones are set to transform parcel delivery by offering faster, more flexible, and environmentally friendly solutions compared to traditional methods. They can decongest urban streets and reach otherwise inaccessible areas. Various use cases include automation of intralogistics, first/last mile parcel delivery, medical goods supply, and transportation of air freight. Despite regulatory and infrastructural challenges, the development of a collaborative ecosystem involving authorities and industry players is crucial for large-scale implementation, promising significant advancements in the logistics sector.

SOURCE

CCFOR
Roland Berger
Cargo drones: The future of parcel delivery
https://www.rolandberger.com/en/Insights/Publications/Cargo-drones-The-future-of-parcel-delivery.html

NUMBER | TITLE

1144 | Volocopter Secures Approval for Serial Production

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Volocopter has received Production Organisation Approval (POA) extension from the German Federal Aviation Office, allowing it to begin serial production of its VoloCity electric vertical takeoff and landing (eVTOL) aircraft. This makes Volocopter the first company to hold both Design and Production Organisation Approvals. This milestone marks a significant advancement in urban air mobility, as Volocopter prepares to meet commercial production standards, enabling efficient, quiet, and safe aerial transportation in urban areas, aligning with global sustainability goals.

SOURCE

CCFOR
volocopter
Volocopter Receives Green Light for VoloCity Serial Production
https://www.volocopter.com/en/newsroom/vc-poa-extension

NUMBER | TITLE

1145 | Innovating Connected Car Security: Enhancing Head Unit Protection, Implementing Manual Kill Switches, and Legal Accountability for Automakers

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

The article "The Connected Car Is the Next Attack Vector" from Forbes highlights the growing cybersecurity risks associated with connected cars. These vehicles, which rely heavily on interconnected systems for functions like infotainment and navigation, are becoming prime targets for cyberattacks. Hackers can exploit vulnerabilities in these systems to remotely control critical aspects of the vehicle, such as acceleration, braking, and steering. This poses significant risks not only to individual drivers but also to entire fleets, potentially leading to large-scale incidents and casualties.

The main vulnerability lies in the vehicles' "head" units, which connect to the Controller Area Network (CAN) bus. This network, designed before the internet era, is now exposed to new risks from internet connectivity. Despite efforts by automakers to enhance security through measures like bug bounty programs, the industry still faces challenges in fully securing these systems.

Experts recommend immediate actions, such as installing manual "kill switches" to disconnect vehicles from networks during a cyberattack, and holding automakers legally accountable for cybersecurity lapses. This approach aims to mitigate the risks and ensure the safety of connected car users.

SOURCE

CCFOR
Forbes
The Connected Car Is The Next Attack Vector
https://www.forbes.com/sites/tanium/2022/09/07/the-connected-car-is-the-next-attack-vector/?sh=4220b89b46e8

NUMBER | TITLE

1146 | Europe's Longest Hyperloop Track: Paving the Way for Future Transportation

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

The recent opening of Europe's longest hyperloop track has reignited enthusiasm for futuristic transportation solutions. Located in the Netherlands, this 2.7-kilometer track is set to revolutionize high-speed travel by using magnetic levitation and low-pressure tubes to achieve speeds up to 700 km/h. This milestone demonstrates significant progress in sustainable and efficient travel, potentially transforming urban mobility and reducing reliance on traditional rail and air travel. The hyperloop's success could pave the way for widespread adoption, driving innovations in infrastructure, energy consumption, and transportation policies.

SOURCE

CCFOR
The Guardian
Europe’s longest hyperloop test track revives futuristic tube transport hype
https://www.theguardian.com/technology/2024/mar/27/opening-europe-longest-hyperloop-track-reignites-future-of-transport-hype

NUMBER | TITLE

1147 | Innovations in Battery Technology

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Innovations in battery technology are poised to transform the electric vehicle (EV) industry. Researchers and car companies are developing alternatives to traditional lithium-ion batteries, such as solid-state, sodium, glass, wood-pulp, and gold nanowire batteries. These advancements promise improved performance and reduced costs, essential for the widespread adoption of EVs. Additionally, new cobalt-free batteries address environmental, ethical, and supply chain concerns. The integration of recycled materials into battery production will mitigate dependency on imported raw materials and promote a circular economy, reshaping the global supply chain for EV batteries.

SOURCE

CCFOR
Futures Platform
Electric Vehicle Battery Revolution

NUMBER | TITLE

1148 | Decline in Vehicle Dependability Signals Need for Innovation in Automotive Industry

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

The latest J.D. Power 2024 U.S. Vehicle Dependability Study reveals a concerning decline in vehicle dependability, with a notable increase in problems reported by vehicle owners after three years of ownership. The study shows an industry average rise to 190 problems per 100 vehicles (PP100), highlighting significant issues with infotainment systems, driver assistance alerts, and electric vehicles (EVs). Infotainment systems are the most problematic, with connectivity and voice recognition issues topping the list. The increased reliance on advanced technology in vehicles is identified as a major factor contributing to these dependability issues. This trend underscores the urgent need for automakers to innovate and enhance the reliability of new technologies to meet long-term consumer expectations. Addressing these challenges is crucial for maintaining consumer trust and ensuring the longevity of modern vehicles.

SOURCE

CCFOR
Auto Remarketing
JD Power study shows decline in vehicle dependability
https://www.autoremarketing.com/ar/jd-power-study-shows-decline-in-vehicle-dependability/

NUMBER | TITLE

1149 | Transformative Potential of Applied AI in Mobility: A Paradigm Shift

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Applied Artificial Intelligence (AI) is emerging as a game-changer in the mobility sector, poised to disrupt and enhance multiple facets of the industry. AI's ability to automate processes, optimize operations, and address longstanding challenges makes it a leading trend in mobility innovation. In engineering and R&D, applied AI creates virtual worlds for training autonomous driving algorithms, allowing extensive scenario testing that saves time and costs. This technology also strengthens procurement by identifying environmental, social, and governance risks, thereby improving supply chain sustainability.

In manufacturing, AI integrates with vision cameras, lidar, and radar to elevate quality control. AI-controlled robots are reducing lead times while maintaining high standards. Marketing and sales benefit from AI's capability to identify at-risk customers and personalize incentives, boosting customer retention and loyalty. Additionally, AI enhances life cycle services by providing real-time, personalized recommendations to drivers based on their habits. As Original Equipment Manufacturers (OEMs) increase their investment in AI, the focus on automation and digital twins in R&D is expected to grow, further revolutionizing manufacturing processes. This strategic adoption of AI not only bridges labor gaps but also streamlines operations, positioning applied AI as a cornerstone of future mobility advancements.

SOURCE

CCFOR
McKinsey
What technology trends are shaping the mobility sector?
https://www.mckinsey.com/features/mckinsey-center-for-future-mobility/our-insights/what-technology-trends-are-shaping-the-mobility-sector#/

NUMBER | TITLE

1150 | Revolutionizing Mobility with Cloud and Edge Computing

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

The integration of cloud and edge computing is transforming the mobility sector by enabling real-time data processing and enhanced connectivity. Cloud computing allows for vast amounts of data to be stored and analyzed, providing valuable insights for improving vehicle performance, traffic management, and route optimization. Edge computing complements this by processing data closer to the source, such as in vehicles or roadside infrastructure, reducing latency and enhancing real-time decision-making. This synergy is crucial for autonomous vehicles, which require instantaneous data processing to navigate safely. Companies are leveraging these technologies to create smarter transportation systems, improve safety, and reduce congestion.

SOURCE

CCFOR
McKinsey
What technology trends are shaping the mobility sector?
https://www.mckinsey.com/features/mckinsey-center-for-future-mobility/our-insights/what-technology-trends-are-shaping-the-mobility-sector#/

NUMBER | TITLE

1151 | Generative AI: Pioneering Innovations in Mobility

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Generative AI is at the forefront of mobility innovation, offering unprecedented capabilities in design and simulation. By generating complex models and simulations, this technology aids in developing more efficient and safer autonomous vehicles. For instance, generative AI can create millions of driving scenarios to train self-driving algorithms, enhancing their ability to handle diverse real-world situations. Additionally, it enables the creation of custom vehicle designs tailored to specific consumer preferences and requirements. As the technology evolves, it is expected to drive significant advancements in vehicle R&D, manufacturing processes, and personalized mobility services.

SOURCE

CCFOR
McKinsey
What technology trends are shaping the mobility sector?
https://www.mckinsey.com/features/mckinsey-center-for-future-mobility/our-insights/what-technology-trends-are-shaping-the-mobility-sector#/

NUMBER | TITLE

1152 | Transforming Mobility with Immersive-Reality Technologie

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Immersive-reality technologies, such as augmented reality (AR) and virtual reality (VR), are reshaping the mobility landscape by enhancing user experiences and operational efficiency. AR is being used in navigation systems to overlay real-time information onto the driver's view, improving safety and convenience. VR is employed in vehicle design and testing, allowing engineers to create and refine prototypes in a virtual environment. Additionally, immersive-reality tech is revolutionizing driver training programs by providing realistic simulations, which enhance learning and reduce risks. These technologies are set to become integral in delivering superior user experiences and optimizing mobility operations.

SOURCE

CCFOR
McKinsey
What technology trends are shaping the mobility sector?
https://www.mckinsey.com/features/mckinsey-center-for-future-mobility/our-insights/what-technology-trends-are-shaping-the-mobility-sector#/

NUMBER | TITLE

1153 | Machine Learning: Driving Industrialization in Mobility

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

The industrialization of machine learning (ML) is revolutionizing the mobility sector by automating processes and improving decision-making. ML algorithms analyze vast datasets to optimize supply chains, predict maintenance needs, and enhance vehicle performance. In manufacturing, ML-driven robots ensure precision and efficiency, reducing errors and lead times. The technology also plays a critical role in developing advanced driver-assistance systems (ADAS) and autonomous driving capabilities by continuously learning from real-world data. As ML becomes more entrenched in mobility operations, it promises to drive significant efficiency gains and foster continuous innovation.

SOURCE

CCFOR
McKinsey
What technology trends are shaping the mobility sector?
https://www.mckinsey.com/features/mckinsey-center-for-future-mobility/our-insights/what-technology-trends-are-shaping-the-mobility-sector#/

NUMBER | TITLE

1154 | Quantum Technology: The Next Frontier in Mobility

SUGGESTED MATURITY

Novel (TRL 1-3)

SUMMARY DESCRIPTION

Quantum technology is poised to revolutionize the mobility sector by solving complex problems that are currently beyond the reach of classical computing. Quantum computers can optimize traffic flow, improve battery efficiency for electric vehicles, and enhance route planning for logistics operations. Quantum sensors offer unprecedented precision in navigation and positioning, which is critical for autonomous driving. As research and development in quantum tech progress, it is expected to unlock new levels of efficiency, sustainability, and innovation in mobility.

SOURCE

CCFOR
McKinsey
Quantum Technology: The Next Frontier in Mobility
https://www.mckinsey.com/features/mckinsey-center-for-future-mobility/our-insights/what-technology-trends-are-shaping-the-mobility-sector#/

NUMBER | TITLE

1156 | Building Trust in Mobility with Digital Identity Solutions

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Trust architecture and digital-identity tools are becoming essential in the mobility sector to ensure security and privacy. These technologies provide secure authentication and authorization mechanisms, protecting vehicles and infrastructure from cyber threats. Digital identities enable seamless and secure access to mobility services, from ride-sharing platforms to connected vehicle ecosystems. By enhancing data integrity and user privacy, trust architecture fosters consumer confidence and supports the safe integration of advanced mobility technologies.

SOURCE

CCFOR
McKinsey
What technology trends are shaping the mobility sector?
https://www.mckinsey.com/features/mckinsey-center-for-future-mobility/our-insights/what-technology-trends-are-shaping-the-mobility-sector#/

NUMBER | TITLE

1157 | Web3: The Decentralized Future of Mobility

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Web3 technologies could potentially transform the mobility sector by enabling decentralized, peer-to-peer services. Blockchain, a core component of Web3, might provide transparent and secure transaction records, which are essential for applications such as decentralized ride-sharing and vehicle leasing platforms. Smart contracts could automate and enforce agreements without intermediaries, reducing costs and increasing efficiency. Additionally, Web3 might facilitate the creation of decentralized autonomous organizations (DAOs) that manage mobility services through collective decision-making. This paradigm shift has the potential to democratize mobility, making it more accessible, efficient, and user-centric. While the full impact of Web3 on mobility is yet to be demonstrated, its potential applications and benefits are being actively explored by industry innovators

SOURCE

CCFOR
McKinsey
What technology trends are shaping the mobility sector?
https://www.mckinsey.com/features/mckinsey-center-for-future-mobility/our-insights/what-technology-trends-are-shaping-the-mobility-sector#/

NUMBER | TITLE

1158 | European Railways Outpace Hyperloop with Faster and More Efficient Systems

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

European railways are set to surpass Elon Musk's hyperloop concept with faster and more practical solutions for future transportation. Countries like the Netherlands and Germany are pioneering advancements in high-speed rail technology, integrating cutting-edge infrastructure and sustainable practices. The new European Hyperloop Center in the Netherlands and the Technical University of Munich's Hyperloop test track demonstrate Europe's commitment to revolutionizing transport. These initiatives focus on low-emission, high-speed travel, aiming to achieve speeds exceeding those of Musk's hyperloop, while also addressing economic and practical deployment challenges. This shift highlights Europe's potential to lead in next-generation transport innovations.

SOURCE

CCFOR
Forbes
European Railways Of The Future Are Faster Than Elon Musk’s Hyperloop
https://www.forbes.com/sites/zengernews/2023/10/11/european-railways-of-the-future-are-faster-than-elon-musks-hyperloop/?sh=4265b53a7e36

NUMBER | TITLE

1159 | Levitating Trains on Existing Tracks

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Nevomo has achieved a groundbreaking milestone in rail technology with the successful testing of its MagRail system, demonstrating that trains can levitate on existing railway infrastructure. During trials on a 720-meter section in Nowa Sarzyna, Poland, MagRail vehicles reached speeds of 135 km/h, showcasing stable levitation and magnetic guidance. This innovation allows for high-speed travel up to 550 km/h, significantly reducing travel times and doubling rail capacity. MagRail integrates seamlessly with current rail systems, offering a scalable and environmentally friendly solution without the need for new infrastructure. This advancement is set to transform rail transport, aligning with the European Green Deal's objectives and paving the way for commercial applications by 2024.

SOURCE

CCFOR
Railtech
Nevomo tests succesfull: MagRail trains can levitate on existing tracks
https://www.railtech.com/innovation/2023/09/08/nevomo-tests-succesfull-magrail-trains-can-levitate-on-existing-tracks/?gdpr=accept&gdpr=accept

NUMBER | TITLE

1160 | EuroTube's DemoTube Hyperloop Facility

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

EuroTube has commenced the assembly of its DemoTube hyperloop test facility at the Switzerland Innovation Park Zurich. This project aims to advance hyperloop technology, which promises emission-free travel at speeds up to 900 km/h using magnetic levitation and vacuum tubes. The DemoTube will include a 120-meter vacuum-tight tube and will host tests and demonstrations, including the European Hyperloop Week in Zurich. This initiative marks a significant step towards sustainable high-speed transportation, showcasing Switzerland's commitment to technological innovation and sustainability.

SOURCE

CCFOR
EinPressWire
EuroTube prepares launch of hyperloop test facility DemoTube near Zurich
https://www.einpresswire.com/article/712023587/eurotube-prepares-launch-of-hyperloop-test-facility-demotube-near-zurich?ref=rss&code=3ZlqwaSGYRX99U8j

NUMBER | TITLE

1161 | First Commercial Autonomous Trucking Lane

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Maersk and Kodiak Robotics have launched the first commercial autonomous trucking lane between Houston and Oklahoma City. Operating 24/7, four days a week, the collaboration marks a significant step in integrating autonomous technology into supply chains, enhancing efficiency and safety. These autonomous trucks, equipped with advanced sensors, aim to address driver shortages and reduce human error, which causes most trucking accidents. This initiative is part of Maersk's strategy to provide innovative, sustainable logistics solutions.

SOURCE

CCFOR
Maersk
Maersk and Kodiak Robotics Launch the First Commercial Autonomous Trucking Lane Between Houston and Oklahoma City
https://www.maersk.com/news/articles/2023/10/05/maersk-and-kodiak-robotics-launch-the-first-commercial-autonomous-trucking-lane

NUMBER | TITLE

1163 | Algae biofactory

SUGGESTED MATURITY

Novel (TRL 1-3)

SUMMARY DESCRIPTION

A species of algae that was found in a pond at the University of California in San Diego has been transformed through selective breeding and genetic engineering to survive and produce fuel in environments that would kill most organisms. The research is a step towards using algae-based “biofactories” to make sustainable alternatives to fossil fuels. A company in Australia has already asked for the strain to be sent for commercial evaluation.

SOURCE

CCFOR
New Scientist
https://www.newscientist.com/article/2442136-algae-transformed-into-a-biofactory-for-green-fuel-and-plastics/

NUMBER | TITLE

1168 | Nissan developing vehicle-cooling paint

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Nissan has partnered with radiative cooling metamaterials production company Radi-Cool to develop a ‘cool paint’ that significantly reduces vehicle temperatures.

Six times the thickness of regular automotive paint, the cooling paint reflects sunlight and emits electromagnetic waves to deflect heat away from vehicles, lowering roof-panel temperatures by up to 12°C (53°F) and interiors by 5°C (41°F).

In a bid to create cooler cars amid rising temperatures without increasing energy consumption, the paint reduces air-conditioning usage and eases the strain on engines and electric vehicle batteries.

SOURCE

CCFOR
LS:N Global
https://www.lsnglobal.com/news/article/31104/nissan-develops-vehicle-cooling-paint

NUMBER | TITLE

1169 | Ubiquitous Connectivity

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Economic Growth and Sustainability powered by 5G connectivity. The terrestrial ground based networks are emerging to provide secure and safe connectivity to 5000+ meters from the ground and the Satellite industry is gearing to provide 5G from the skies. This confluence of Space, Aviation and Telecom shall catalyse Drones, AirTaxis, Mission Critical Missions and Airlines industries. Europe could be at the forefront of making this thinking, a near Reality!

SOURCE

External experts
https://www.ericsson.com/en/blog/2023/6/what-is-digital-airspace

NUMBER | TITLE

1170 | Intermediary vehicles

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Novel, light, electric vehicles that are between an bicycle and a classical car.

SOURCE

External experts
https://youtu.be/7NxFBbLSOzs?si=sCAVOG2HWj5nSGKg

NUMBER | TITLE

1171 | Battery swapping

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Battery swapping is a technology applied in the mobility sector, specifically for electric vehicles (EVs), to address the challenges of recharging time and range anxiety. It involves replacing a depleted battery with a fully charged one at a swapping station, significantly reducing the "refuelling" time compared to traditional charging methods. The integration of battery swapping stations in local energy systems (LESs) supports the integration of renewable energy sources and contributes to peak load shaving. Moreover, battery swapping stations can be part of an optimization strategy in electric vehicle routing problem with time windows, backup batteries, and battery swapping stations (EVRPTW-BB-BSS), enhancing the efficiency of modern logistics. They can also enhance the self-sustainability and reliability of radial distribution systems (RDS). Furthermore, the combination of battery swapping and charging stations (BSCSs) can optimize battery management in large cities.The novelty of the battery swapping technology lies in its potential to address the limitations of existing EV charging infrastructure, such as long charging times and range anxiety issues. Unlike traditional charging methods, battery swapping provides a unique solution that significantly reduces the waiting time for EV users. Moreover, the incorporation of battery swapping stations into local energy systems, routing optimization tasks, and radial distribution systems presents a novel approach towards managing peak loads, logistics, and energy distribution. However, the implementation of this technology also introduces new challenges, such as the need for industry-wide standardization and the management of surplus batteries, which are not present in traditional home charging systems.

SOURCE

TIM
Sources used in the signal’s detection and description include, but are not limited to:
http://doi.org/10.1109/TSG.2022.3186931 ; http://doi.org/10.1016/j.scs.2022.104312 ; http://doi.org/10.1016/j.est.2022.106533 ; http://doi.org/10.1088/1742-6596/2479/1/012001 ; http://doi.org/10.3390/app13106016 ; http://doi.org/10.1109/CEEPE58418.2023.10

NUMBER | TITLE

1174 | Mobile energy storage

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Mobile energy storage, particularly in the form of electric vehicles (EVs) with Vehicle-to-Grid (V2G) capability, is a technology that offers flexible and high-quality demand-side resources. These mobile power sources can be used as mobile emergency generators, truck-mounted mobile energy storage systems, and grid-support resources during power grid emergencies. Moreover, through V2G technology, EVs can act as mobile energy storage devices, facilitating rational energy distribution using bidirectional charging stations. Such technology can mitigate negative impacts on the distribution grid caused by EV charging, ensure stable system operation, and enhance the resilience of power distribution systems. Additionally, shared electric vehicles (SEVs) can be utilized as mobile energy storage resources to shift energy between microgrids, maximizing the revenues of SEV service centers. Mobile energy storage can also be used in multimicrogrid systems to improve reliability and stability, and in large industrial energy hubs to improve power system resilience.The novelty of mobile energy storage lies in its ability to provide grid-level applications, improve power grid management, facilitate more flexible energy generation and consumption, and promote open sharing and flexible trading of energy production. The technology also enables large-scale integration and distributed applications with multi-objective collaboration. Furthermore, innovative methods such as the use of high-order Markov chain-based EV aggregation models have been proposed to predict the load of EV charging stations more accurately. Additionally, the integration of charging stations with the grid, forming a connected vehicle network, is considered a future direction of EV development. Despite these advancements, there are still barriers to the wide implementation of V2G systems that need to be addressed.

SOURCE

TIM
Sources used in the signal's detection and description include, but are not limited to:
http://doi.org/10.1016/j.epsr.2023.109899 ; http://doi.org/10.1109/TIA.2020.2972854 ;
http://doi.org/10.17775/CSEEJPES.2019.00160 ; http://doi.org/10.1016/j.ijepes.2022.108765 ;
http://doi.org/10.1109/PIECON56912.2023.10085813 ; http://doi.org/10.1109/AEE

NUMBER | TITLE

1175 | EV thermal management

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

EV thermal management technology seeks to regulate the temperature of lithium-ion batteries in electric vehicles (EVs) to ensure optimal performance, longevity, and safety. This technology involves the use of phase change materials, metal foam, and fins to maintain acceptable battery surface temperatures under varying conditions. Different cooling strategies include air-cooled systems with control tactics based on temperature differences among battery cells, and hybrid nano/dielectric fluid cooling systems employing indirect/direct coolant cooling strategies. Some studies have also explored the use of heat pipes and physics-informed neural networks (PINNs) for temperature estimation. These thermal management methods are crucial in preventing thermal runaway, which can lead to short circuits, combustion, and explosions in batteries.The novelty of the current EV thermal management technology lies in the integration of different strategies and materials, including phase change materials, metal foam, and fins, and the use of computational fluid dynamics and numerical methods in devising effective thermal management systems. For instance, models that employ PINNs integrate physics-based models with data-driven neural networks to estimate battery temperature accurately and efficiently. Moreover, the use of different coolant materials and geometrical changes in battery design also presents a novel approach. The technology also includes the development of control strategies that reduce energy consumption of EVs by optimizing the use of heat sources such as motor waste heat, air, and positive temperature coefficient heaters. This multi-pronged approach, combining both passive and active cooling techniques, represents an advancement over traditional thermal management methods.

SOURCE

TIM
Sources used in the signal's detection and description include, but are not limited to:
http://doi.org/10.1016/j.applthermaleng.2016.01.123 ; http://doi.org/10.1016/j.energy.2021.121652 ;
http://doi.org/10.1016/j.applthermaleng.2023.120320 ; http://doi.org/10.4271/2023-01-0990 ;
http://doi.org/10.1109/GlobConET56651.2023.10150156 ; http://do

NUMBER | TITLE

1176 | Batteries - retired batteries

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Retired batteries from electric vehicles (EVs), also known as second-life batteries, can be repurposed for various applications, addressing the rising issue of battery waste due to the escalation of EV production. The potential applications for these batteries include their integration with renewable energy sources like photovoltaic solar energy for EV charging stations, or their use in battery energy storage systems (BESS). Another significant application is their incorporation into battery swapping and charging stations as a demand-side flexibility resource for power grid operations. New technological advancements like blockchain technology can aid in creating efficient recycling networks for these batteries, contributing to a more sustainable supply chain. Moreover, novel techniques like machine learning based physical features-driven methods are being developed for in-situ battery life prediction and classification, providing accurate remaining useful life (RUL) estimates, which facilitates efficient sorting of retired batteries. The novel aspects of this technology stem from the application of advanced techniques in managing retired batteries. For instance, the use of blockchain technology for recycling operations is a recent development that enhances efficiency and profitability. Additionally, the employment of machine learning for real-time battery life prediction and classification is a groundbreaking advancement in battery health management. The use of electrochemical impedance spectroscopy (EIS) for assessing the state of health (SoH) of the batteries is also a novel approach that increases the accuracy of battery health characterization. Furthermore, the integration of retired batteries with renewable energy sources for EV charging stations, and their use in BESS, represent innovative applications that maximize the utility of retired batteries. The development of these technologies combined with suitable regulatory measures can significantly contribute towards carbon neutrality in EV supply chains.

SOURCE

TIM

Sources used in the signal’s detection and description include, but are not limited to:
http://doi.org/10.1109/TPEL.2020.2991879 ; http://doi.org/10.1016/j.procir.2022.02.076 ;
http://doi.org/10.1109/TII.2022.3175718 ; http://doi.org/10.1016/j.joule.2022.05.005 ;
http://doi.org/10.1016/j.measurement.2023.112597 ; http://doi.org/10.1016/j.ens

NUMBER | TITLE

1177 | Vehicle trajectory prediction

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Vehicle trajectory prediction refers to the technology that estimates the future path of vehicles using machine learning and deep neural networks. This is critical for autonomous vehicles and advanced driver assistance systems as it allows them to anticipate the actions of surrounding vehicles and plan their own movements accordingly. The technology uses an encoder-decoder architecture to construct graphs from various traffic scenes, employing methods such as Graph Attention Networks (GAT), Convolutional Gated Recurrent Units (ConvGRU), and Long Short-Term Memory (LSTM) networks. These methods analyze the temporal behavior and predict the future coordinates of surrounding vehicles. The technology also considers inter-vehicular interaction, social interactions, and driver's lane-change intentions to improve prediction accuracy. The novelty of this technology lies in its ability to predict vehicle trajectories without relying on map information, overcoming the limitations of previous models. By using an attention mechanism, it is able to learn and quantify the social interactions between vehicles, thereby improving the accuracy of its predictions. The technology also leverages edge features efficiently through a graph convolution method, which is a significant advancement over traditional hand-crafted methods. Furthermore, it combines the interpretability of a discrete choice model with the high accuracy of a neural network-based model, addressing the lack of interpretability in previous methods. The technology's ability to predict multi-vehicular trajectories simultaneously and its improved prediction accuracy underscore its advancement over conventional trajectory prediction techniques.

SOURCE

TIM

Sources used in the signal’s detection and description include, but are not limited to:
http://doi.org/10.1109/IROS.2013.6696982 ; http://doi.org/10.1109/ITSC.2017.8317943 ;
http://doi.org/10.1109/IVS.2018.8500658 ; http://doi.org/10.1109/CVPRW.2018.00196 ;
http://doi.org/10.1109/ITSC48978.2021.9564929 ; http://doi.org/10.1109/TIV.2022.31552

NUMBER | TITLE

1178 | Green hydrogen

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Green hydrogen is a sustainable energy carrier that can be used in mobility applications. It is produced through electrolysis of water, powered by renewable energy sources like wind, solar, or biomass, which reduces the carbon footprint compared to conventional fuels. The technology can utilize excess renewable energy, making it a viable solution for maintaining energy balance. Green hydrogen can be stored and transported in compressed, liquefied, or chemically bound forms, and can be produced offshore with wind energy at a competitive cost. Storage methods involve cryogenic and adsorptive techniques, with nano-materials playing a crucial role in enhancing the storage capacity. The hydrogen can also be transported as liquefied ammonia, making it a viable option for long-distance transport. The technology also supports power-hydrogen co-production frameworks, which involve coupling gas turbines with geothermal assisted Rankine units for efficient hydrogen production.The novelty of green hydrogen lies in its potential to utilize excess renewable energy, and its role in facilitating a transition to a low-carbon economy. Compared to conventional fuels, green hydrogen offers a reduced carbon footprint and the ability to maintain balance between energy generation and demand. The utilization of nano-materials for enhancing the production and storage of hydrogen signifies a new direction in the field. Furthermore, the concept of offshore production of green hydrogen using wind energy, and the use of liquefied ammonia for long-distance transport, represent innovative advancements. The coupling of power generation and hydrogen production, using a gas turbine and a geothermal assisted Rankine unit, is another novel aspect. Technologies like microwave-assisted pyrolysis for green hydrogen production from biomass waste are promising new developments. In the future, green hydrogen could offer an alternative decarbonization pathway to electrification for homes connected to the gas grid. However, public acceptance and transparent communication about the benefits, costs, and risks of the transition to green hydrogen will be crucial.

SOURCE

TIM

Sources used in the signal's detection and description include, but are not limited to:
http://doi.org/10.1016/j.ijhydene.2022.07.113 ; http://doi.org/10.1016/j.ijhydene.2023.01.344 ;
http://doi.org/10.1016/j.ijhydene.2023.02.066 ; http://doi.org/10.1016/j.ijhydene.2023.04.231 ;
http://doi.org/10.1016/j.ijhydene.2023.05.172 ; http://doi.org/

NUMBER | TITLE

1179 | Drone delivery

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Drone delivery technology uses unmanned aerial vehicles (UAVs) to transport goods, particularly in last-mile delivery scenarios. These drones can be launched from trucks and operate in parallel to traditional delivery methods, serving a wider area and not being restricted to specific customer locations. Drone delivery takes into account factors such as delivery time intervals, cost, drone battery life, and the compatibility of each drone with the assigned task. The technology is also adaptable to different scenarios, including those necessitated by emergencies or pandemics, where contactless delivery is essential. It can be particularly transformative in areas with limited access to traditional transportation infrastructure, facilitating delivery of crucial items like healthcare supplies. Furthermore, drone delivery can reduce environmental impact and delivery time, thereby optimizing e-commerce logistics.The novelty of drone delivery lies in its potential to bypass traditional logistical challenges, such as road inaccessibility or customer density. Unlike conventional delivery methods, drones can undertake multiple trips, optimize routes based on energy consumption, and adapt to varying payload weights. In the context of a pandemic, drone delivery offers a contactless solution, reducing customer risk. The technology also allows for the simultaneous use of multiple drones, potentially from multiple trucks, optimizing the delivery process further. It introduces the possibility of trucks and drones working in tandem, with drones having the flexibility to return to any nearby truck, not necessarily the one they were dispatched from. Advanced algorithms and mathematical models are used to manage and optimize these complex delivery networks, marking a significant advancement from traditional delivery methods.

SOURCE

TIM

Sources used in the signal's detection and description include, but are not limited to:
http://doi.org/10.1109/TSMC.2016.2582745 ; http://doi.org/10.1080/23249935.2022.2107729 ;
http://doi.org/10.1109/TEM.2022.3181251 ; http://doi.org/10.1145/3571306.3571411 ;
http://doi.org/10.1109/PerComWorkshops56833.2023.10150322

NUMBER | TITLE

1180 | Pedestrian trajectory prediction

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Pedestrian trajectory prediction is a technology aimed at predicting the future movements of pedestrians, considering their individual behaviors and interactions with others. It uses advanced algorithms and machine learning techniques, such as Generative Adversarial Networks (GAN) and Graph Neural Networks (GNN), to model the multi-modality of human behaviors and their spatial-temporal dependencies. In addition, recent developments have started incorporating scene layouts and transfer learning for better prediction performances. Applications include autonomous driving, robotics, security systems, and surveillance, where reliable and accurate pedestrian movement predictions are essential for safety and efficiency.The novelty of this technology lies in its approach to modeling human behavior, moving from traditional stochastic methods to more complex machine learning models. The use of GANs and GNNs allows for the modeling of multiple potential future trajectories, which better represents the unpredictable nature of human behavior. Moreover, recent advancements like the integration of scene layouts, sparse graph convolution networks, and transfer learning techniques have further improved the technology's accuracy by accounting for environmental factors and distribution differences among different trajectory domains. Despite its complexity, the technology has shown promise in matching or exceeding the performance of state-of-the-art methods, making it a novel and significant development in the field of mobility.

SOURCE

TIM
Sources used in the signal’s detection and description include, but are not limited to:
http://doi.org/10.1109/WACV.2018.00135 ; http://doi.org/10.1109/CVPRW.2019.00359 ;
http://doi.org/10.1109/CVPR.2019.01236 ; http://doi.org/10.1007/978-3-030-58610-2_30 ;
http://doi.org/10.1109/CVPR46437.2021.00888 ; http://doi.org/10.1109/CVPR52688.2022.0

NUMBER | TITLE

1181 | Smart logistics

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Smart logistics is a technology application that harnesses advancements in areas like the Internet of Things (IoT), Artificial Intelligence (AI), edge and fog computing, blockchain, and digital platforms to significantly improve supply chain and delivery processes. It integrates digital and physical supply chains, enhancing the efficiency of multimodal cargo delivery, particularly for special categories of cargo. Smart logistics technologies allow for data-rich supply chain ecosystems to optimize material wastage, inventory, and manufacturing systems, thereby reducing costs. They also enable improved real-time collaboration between on-site and off-site employees, predictive analysis for equipment monitoring, and enhanced data privacy and security through decentralized encryption schemes. The technology is also leveraged for effective and sustainable management of resources in smart cities, and it has significant potential in improving supply chain sustainability.The novelty of smart logistics lies in its ability to digitally mirror and connect an entire physical supply chain, something that wasn't possible with traditional logistics technologies. It makes use of advanced technologies such as AI, IoT, blockchain, and edge computing, which were not conventionally used in logistics and supply chain management. Moreover, it enables a level of real-time collaboration, data privacy, security, and predictive analysis that surpasses what was achievable with older technologies. The integration of smart logistics with other Industry 4.0 technologies allows for the creation of smart factories, smart warehouses, and smart supply chains, marking a significant departure from traditional practices. The technology is also novel in its application in smart cities and its potential to significantly enhance supply chain sustainability.

SOURCE

TIM
Sources used in the signal’s detection and description include, but are not limited to:
http://doi.org/10.1109/SCSP.2016.7501015 ; http://doi.org/10.1108/BIJ-03-2018-0056 ;
http://doi.org/10.1016/j.resconrec.2020.105064 ; http://doi.org/10.1109/COMST.2020.3009103 ;
http://doi.org/10.1016/j.matpr.2021.01.585 ; http://doi.org/10.1016/j.trpro.2

NUMBER | TITLE

1182 | Autonomous buses

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Autonomous buses operate using advanced technologies such as Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communication. They can be deployed in mixed traffic, for last-mile uses, in closed systems, or for special uses. These buses are expected to enhance safety, sustainability, and technological advancement within urban areas. They could potentially solve some of the mobility challenges related to traffic congestion and public transport inefficiency. Autonomous buses also have the ability to predict pedestrian movements, ensuring safe navigation in complex urban environments. They could be integrated within a city's existing transport network to ensure large-scale mobility.The novelty in autonomous buses lies in their ability to drive themselves using artificial intelligence and various sensors. Unlike traditional buses, they don't require a human driver, which can significantly reduce human error-related accidents. Autonomous buses can also adapt to changing traffic conditions and reroute themselves in real-time, which is not a common feature in regular buses. Furthermore, the integration of autonomous buses into a city's transportation network could create a multi-modal transport system, providing a more efficient and seamless travel experience. Another novel aspect of autonomous buses is their potential to be powered by renewable energy sources, making them more sustainable compared to traditional buses. However, the successful implementation of these buses is dependent on various factors including user acceptance, technological advancements, and regulatory support.

SOURCE

TIM

Sources used in the signal’s detection and description include, but are not limited to:
http://doi.org/10.1155/2018/5382192 ; http://doi.org/10.1080/23249935.2021.2005181 ; http://doi.org/10.1016/j.ijtst.2022.02.001 ; http://doi.org/10.1177/03611981221093632 ; http://doi.org/10.1177/03611981221104455 ; http://doi.org/10.1109/TITS.2022.320211

NUMBER | TITLE

1183 | Batteries - Organic Flow

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Organic Flow Batteries (OFBs) are a type of energy storage and distribution technology that utilize organic redox-active compounds as charge carriers. These compounds are dissolved in water and circulated through a cell where they undergo charge-discharge cycles. Key advantages include high energy density, extreme long-term stability, and low crossover. OFBs can achieve high energy efficiency and capacity utilization at high current densities, making them suitable for large-scale energy storage applications. They can be used to balance intermittent renewable energy sources, such as solar or wind power. Recent innovations in membrane design and electrolyte materials have improved the efficiency and durability of OFBs while reducing costs.OFBs are a novel technology compared to traditional metal-based batteries. They offer several unique benefits including the ability to independently scale power and energy components, environmentally friendly nature, and the use of inexpensive, abundant materials. Recent developments have focused on enhancing the chemical stability and charge-carrying capacity of the electrolyte materials, and designing membranes that allow fast and selective ion transport. For example, the use of 2-2PEAQ and DHDMBS as electrolyte materials has been shown to improve the energy density and stability of OFBs. Another innovation is the development of cobweb bionic flow field design which enhances mass transfer behaviors and improves battery performance. Overall, OFBs represent a promising direction for realizing cost-effective, large-scale energy storage.

SOURCE

TIM

Sources used in the signal’s detection and description include, but are not limited to:
http://doi.org/10.1038/nature12909 ; http://doi.org/10.1002/aenm.201501449 ; http://doi.org/10.1149/2.0351704jes ; http://doi.org/10.1021/acsenergylett.7b00019 ; http://doi.org/10.1038/s41563-019-0536-8 ; http://doi.org/10.1002/adfm.202211338 ; http://doi

NUMBER | TITLE

1184 | Micromobility

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Micromobility refers to shared, short-term access to small, often electric, vehicles such as bicycles, e-scooters, and even small cars. Enabled by smartphone apps, these services are part of a larger ecosystem of shared mobility. Micromobility services are often used for short trips, especially in urban areas, and can act as a connection to public transportation or as a standalone transportation option. The services are predominantly used for non-commute related travel, but can also be used for commuting. Micromobility services are also used in last mile package and food delivery. As these services are becoming more popular, urban spaces are being re-designed to accommodate these new forms of mobility, and new safety, access, and integration rules are being set. Another promising application of micromobility is in the creation of 15-minute cities, where all daily needs can be reached within a 15-minute walk or cycle ride.The novelty of micromobility lies in its ability to fill in the gaps in traditional urban transportation and to offer a more sustainable alternative to car ownership. Unlike traditional transportation networks, micromobility services can be accessed on-demand through smartphone apps, and can therefore provide more flexible and convenient transportation options. The use of electric vehicles also makes micromobility a greener alternative. Furthermore, micromobility supports the idea of 15-minute cities, a new urban planning concept aimed at enhancing quality of life by reducing commuting time. Another novelty is the use of micromobility in the last mile delivery service, which traditional logistics companies often find challenging. However, the widespread use of micromobility also poses new challenges, such as the need for new infrastructure and safety regulations, and the need to understand the different usage patterns of different micromobility services.

SOURCE

TIM

Sources used in the signal's detection and description include, but are not limited to: http://doi.org/10.1016/B978-0-12-815167-9.00013-X ; http://doi.org/10.1016/j.trpro.2021.12.004 ; http://doi.org/10.1016/j.trpro.2021.12.058 ; http://doi.org/10.1016/j.jtrangeo.2023.103545 ; http://doi.org/10.1016/j.trpro.2023.02.189 ; http://doi.org/10.10

NUMBER | TITLE

1185 | Mobility as a service

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Mobility as a Service (MaaS) is a burgeoning concept in the field of urban mobility, leveraging advancements in information and communication technologies to provide integrated and efficient transport solutions. MaaS, fundamentally, shifts the paradigm from ownership of transport means to consumption of mobility services, based on individual needs. By integrating different modes of transport (public, shared, on-demand) and offering a single-access digital platform for planning, booking, and payment, MaaS provides a seamless door-to-door travel experience. The concept is anticipated to significantly alter current transport practices, potentially leading to more sustainable urban transport systems. Its applications range from travel demand modelling and supply-side analysis to business model design, with the potential to influence governance and sustainability aspects of urban mobility.The novelty of MaaS lies in its transformative approach to transport, which contrasts with traditional, segmented, and ownership-based systems. It integrates various transport services into a single, user-centric solution, enabled by digital platforms and advanced data analytics. Unlike established technologies, MaaS promotes intermodality and shared mobility, thereby potentially reducing reliance on private vehicles and contributing to environmental sustainability. Additionally, the concept of MaaS aligns with broader shifts in societal attitudes towards access over ownership and sharing economy, thereby presenting a novel way to address contemporary transport challenges. As an emerging concept, MaaS also offers a fertile ground for further research and innovation, including the development of sophisticated AI models for enhancing service delivery and customer experience.

SOURCE

TIM

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NUMBER | TITLE

1186 | EVTOL aircraft

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

EVTOL (Electric Vertical Takeoff and Landing) aircraft are an emerging technology in the field of mobility, particularly in the context of Urban Air Mobility (UAM). These vehicles utilize electric propulsion systems to vertically takeoff, hover, and land, and are being designed for use in congested urban environments as a solution to road traffic congestion. The aircraft operate primarily on fully electrical flight control systems with rotary output. EVTOL aircraft are also being developed with a hybrid power plant combining hydrogen fuel cells and lithium-ion batteries, aimed at improving the limited range and endurance associated with battery-powered flight. They are being tested for aerodynamic, acoustic, and flight dynamics, with a focus on safety and efficiency. Research is being conducted on their integration into existing airspace, their structural design, and flight control algorithms. EVTOL aircraft are being built using modular designs and 3-D printing, allowing for easy changes in design and comparative evaluation of alternate designs.The novelty of EVTOL aircraft lies in their electric propulsion and vertical takeoff and landing capability, offering a new approach to urban air mobility. Unlike conventional aircraft, EVTOL aircraft combine the aerodynamic characteristics of both fixed-wing and rotary-wing aircraft, as well as vehicle-specific phenomena such as propeller-wing interactions and high incidence angle propeller aerodynamics. This presents new challenges for aerodynamic modeling and system identification. Additionally, the use of 3-D printing in prototype construction is a relatively novel approach in the field of aircraft design, facilitating rapid adjustment of design elements. The implementation of a hybrid power plant, merging hydrogen fuel cells with lithium-ion batteries, is also a novel solution aimed at improving the range and endurance limitations of electric flight. Finally, EVTOL aircraft represent a novel application of electric propulsion technology in the field of mobility.

SOURCE

TIM

Sources used in the signal’s detection and description include, but are not limited to: http://doi.org/10.2514/6.2018-3676 ; http://doi.org/10.3390/aerospace6030026 ; http://doi.org/10.2514/6.2021-1188 ; http://doi.org/10.4050/JAHS.66.012009 ; http://doi.org/10.2514/6.2022-2409 ; http://doi.org/10.21741/9781644902431-34 ; http://doi.org/10.1

NUMBER | TITLE

1187 | Urban air mobility

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Urban Air Mobility (UAM) is an innovative technology aimed at transforming transportation within urban areas through the use of unmanned aircraft systems and manned aircraft. UAM incorporates advanced computing technologies such as Digital Twin (DT), edge computing, federated learning (FL), and blockchain to manage traffic, maintain vehicles, and ensure security. The DT technology provides a virtual-physical asset system that evolves over time, while edge computing facilitates the processing of massive data from numerous devices and vehicles. The FL approach addresses performance and security issues by decentralizing data collection and training. Blockchain technology enhances the security and scalability of decentralized computing patterns. Furthermore, algorithms based on deep reinforcement learning are proposed to manage efficient air transportation services, providing a promising solution for autonomous air transportation management systems in urban areas.The novelty of UAM lies in its integration of various advanced computing technologies to create a coordinated, efficient, and secure system for urban air transportation. Unlike traditional transportation systems, UAM embraces the use of unmanned aircraft systems and manned aircraft, offering a new dimension of mobility. The use of FL provides a marked departure from traditional centralized AI techniques, offering a decentralized and cooperative data training pattern. The adoption of blockchain technology also introduces an unprecedented level of security and scalability. Furthermore, the proposed algorithm based on deep reinforcement learning presents a novel approach to managing air transportation services. It's also worth noting the use of hybrid hydrogen-fueled powerplants for UAM rotorcraft, which potentially reduces energy consumption and emission footprint, representing a significant step forward compared to conventional turboshaft engines.

SOURCE

TIM

Sources used in the signal’s detection and description include, but are not limited to: http://doi.org/10.2514/6.2018-3847 ; http://doi.org/10.2514/6.2021-1627 ; http://doi.org/10.4050/JAHS.67.032001 ; http://doi.org/10.1007/978-981-19-2635-8_69 ; http://doi.org/10.2514/6.2018-1266 ; http://doi.org/10.1016/j.ijhydene.2023.07.076

NUMBER | TITLE

1188 | Cellular V2X

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Cellular Vehicle-to-Everything (Cellular V2X) is a technology that enables real-time communication between vehicles and other entities such as infrastructure facilities, pedestrians, and other vehicles. The technology, introduced in the 3rd generation partnership project (3GPP) release 14 standard, is gaining substantial attention due to its ability to address scalability and reliability requirements of vehicular safety applications. In particular, the emerging 6th generation (6G) cellular networks propose dynamic resource allocation methods for V2X communications, which are critical for applications that require ultra low latency, high data rate, and high reliability. The application of fuzzy-logic-Assisted learning models is suggested to intelligently and dynamically allocate resources, thereby maximizing network throughput and minimizing interference from concurrent transmissions. Furthermore, Cellular V2X is crucial to the development of smart cities, in which vehicles communicate in real time with other vehicles, roadside infrastructure, and pedestrians to enable not only road safety services but also time-constrained Internet of Things (IoT) applications.The novelty of Cellular V2X is its ability to overcome challenges faced by existing technologies such as dedicated short-range communications (DSRC). While DSRC-based V2X is already in the deployment phase, Cellular V2X offers better support for efficient V2X communications. Compared to DSRC, Cellular V2X is perceived to offer better scalability and reliability, which are critical for vehicular safety applications. Additionally, Cellular V2X can support advanced vehicular applications characterized by high reliability, low latency, and high throughput requirements, which are believed to be essential for enabling fully autonomous vehicles. The integration of Cellular V2X in the newer generations of cellular networks, such as 6G, also introduces innovative features like intelligent and dynamic resource allocation, which are expected to enhance the performance of vehicular communications significantly. Furthermore, the development of Cellular V2X is contributing to the evolution of vehicle-to-everything (V2X) technologies towards the Internet of Vehicles (IoV), thus paving the way for large-scale and ubiquitous automotive network access.

SOURCE

TIM
Sources used in the signal’s detection and description include, but are not limited to:
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http://doi.org/10.1109/COMST.2020.3029723 ; http://doi.org/10.1109/COMST.202

NUMBER | TITLE

1189 | Blockchain for connected vehicles

SUGGESTED MATURITY

Novel (TRL 1-3)

SUMMARY DESCRIPTION

Blockchain for connected vehicles is a promising technology that integrates the decentralized, transparent, and secure features of blockchain with the telematics, communication, and automation capabilities of intelligent transportation systems. Using the features of blockchain, such as smart contracts and distributed ledgers, this technology facilitates secure data sharing, firmware updates, and energy trading for connected vehicles. For instance, autonomous vehicles (AVs) can use blockchain to ensure the authenticity and integrity of firmware updates, and electric vehicles (EVs) can leverage blockchain for secure energy trading with the grid. Moreover, blockchain can provide a secure environment for device-to-device (D2D) communication in the Internet of Things (IoT) enabled industrial automation, including in the transport sector. The novelty of blockchain for connected vehicles lies in its decentralized nature, which eliminates the single point of failure risk associated with centralized systems. Unlike traditional technologies, blockchain does not rely on a central authority for operations such as authentication, data sharing, or transaction validation. Instead, it operates on a peer-to-peer (P2P) network where every participant can validate and record transactions. This decentralization, coupled with cryptographic security, enhances the privacy, security, and trust in connected vehicle systems. Moreover, blockchain's integration with other emerging technologies, such as 5G, IoT, and Artificial Intelligence, provides new possibilities for the advancement of connected vehicles, making it a game-changer in the mobility industry.

SOURCE

TIM
Sources used in the signal’s detection and description include, but are not limited to:
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NUMBER | TITLE

1190 | Charging demand prediction

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Charging demand prediction technology employs sophisticated machine learning (ML) and artificial intelligence (AI) techniques to forecast the charging needs of electric vehicles (EVs). This technology uses a variety of data inputs, including vehicular traffic flow data, temporal and spatial travel patterns, and historical charging data, to predict both short-term and long-term EV charging demands. It helps optimize the layout of charging infrastructure, manage electricity grids more efficiently, and plan for the impacts of large-scale EV adoption on overall electricity demand. The technology can also simulate EV travel activities and charging decisions, considering factors like driving patterns and EV models, to generate accurate charging demand predictions.The novelty of charging demand prediction technology lies in its use of advanced AI and ML models, like long short-term memory (LSTM) neural networks and Transformer models, to predict EV charging demand. This technology goes beyond traditional forecasting methods, which are less accurate due to the random and volatile nature of EV charging demand. Moreover, this technology integrates various data sources and considers multiple factors that influence EV charging needs, providing a more comprehensive and precise prediction. The use of a two-layer hybrid stacking ensemble learning method, which combines multiple ML algorithms, and the application of the Transformer model for EV charging demand prediction, are recent advancements in this technology. Furthermore, the technology's ability to predict EV charging demand at the station level for the next few hours and to simulate EV travel activities for a whole day is a significant improvement over previous methods.

SOURCE

TIM

Sources used in the signal’s detection and description include, but are not limited to:
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http://doi.org/10.1016/j.est.2022.106294 ; http://doi.org/10.1016/j.energy.2023.126647 ;

NUMBER | TITLE

1193 | Multi modal fusion

SUGGESTED MATURITY

Novel (TRL 1-3)

SUMMARY DESCRIPTION

Multi-modal fusion is a technology used in mobility, particularly in autonomous vehicles, which uses multiple sensors to improve environmental perception and the detection of surrounding objects. It uses LiDARs and cameras to collect data, with algorithms then merging these different data modalities to compensate for the limitations of individual sensors. The technology is used for tasks such as 3D object detection, depth completion, and scene understanding, combining the benefits of different sensor modalities to improve the accuracy and reliability of autonomous vehicle operations. Applications of multi-modal fusion include enabling autonomous vehicles to understand complex driving scenes, handle traffic from multiple directions, and detect drivable roads and obstacles. The novelty of multi-modal fusion lies in its ability to combine data from different sensor modalities, compensating for the limitations of individual sensors and improving overall detection performance. Compared to mono-modal methods, multi-modal fusion offers significant advantages in terms of performance and reliability. Recent advancements in the field include the development of new algorithms and frameworks for effective multi-modal data fusion, such as the Painting Adaptive Instance-prior for 3D object detection (PAI3D), the Multi-Modal Fusion Transformer (TransFuser), and the adaptive-mask fusion Network (AMFNet). These new methods offer improved performance and versatility, allowing for the effective integration of data from different sensor modalities and enhancing the capabilities of autonomous vehicles. However, as a relatively new field, multi-modal fusion still presents challenges and research opportunities, including the need for in-depth analysis of fusion methods and the development of strategies for integrating data from sensors with drastically different ranging/imaging mechanisms.

SOURCE

TIM

Sources used in the signal’s detection and description include, but are not limited to:
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http://doi.org/10.1007/978-3-031-25072-9_32 ; http://doi.org/10.1109/TIV.2

NUMBER | TITLE

1194 | Autonomous delivery robot

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Autonomous delivery robots (ADRs) are an innovative technology in the mobility field, designed to facilitate efficient and sustainable delivery services. They are programmed to navigate in various environments, leveraging sensors and algorithms to ensure safe and accurate route execution. ADRs can operate with minimal human supervision, optimizing their functionality based on specific customer requests and operational guidelines. The technology has a wide spectrum of applications, from urban logistics to healthcare facilities, where they can be integrated into existing workflows, contributing to reducing traffic congestion, pollution, and operational costs. Moreover, inspired by plant motions, these robots can be equipped with shape-morphing systems, allowing them to adapt to environmental stimuli and dynamically change their conformation.The novelty of autonomous delivery robots lies in their ability to operate independently, navigate safely, and adjust their operations based on specific requirements. Unlike traditional delivery methods, ADRs can execute deliveries with increased efficiency and lower operational costs. Additionally, these robots employ advanced sensor technologies that make them vulnerable to adversarial control, necessitating the development of defense methods against potential sensor input spoofing attacks. The integration of shape-morphing systems represents another innovative aspect of this technology, enabling ADRs to adapt their shape in response to environmental conditions. The design of ADRs also considers different stakeholder requirements, including customer satisfaction, safety, and cost-effectiveness, further distinguishing them from established technologies.

SOURCE

TIM

Sources used in the signal’s detection and description include, but are not limited to:
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http://doi.org/10.1145/3583131.3590459

NUMBER | TITLE

1195 | Smart ports

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Smart ports are an emerging technology in the field of mobility that leverages advancements in telecommunications, Internet of Things (IoT), and unmanned aerial vehicles (UAVs) to optimize maritime activities. These ports integrate maritime IoT networks, enabling end-to-end connectivity for vessels, buoys, platforms, and sensors through UAVs. This technology enhances maritime communication, providing broadband, low-delay, and reliable wireless connectivity, overcoming the limitations of shore-based base stations and satellite links. Smart ports also utilize complex event processing techniques and microservice architecture for real-time data processing and to provide smart services efficiently. Moreover, they can significantly reduce CO2 emissions by optimizing port operations. Smart ports also incorporate advanced cybersecurity measures to safeguard IoT and Cyber-Physical Systems (CPS), ensuring safe and secure activities.The novelty of smart ports lies in their integration of advanced technologies, including IoT, UAVs, and microservice architecture, to create an efficient and sustainable maritime ecosystem. This is a significant departure from traditional ports that rely on shore-based base stations with limited coverage and satellite links with high latency. The use of UAVs introduces an aerial dimension to maritime communications, enhancing connectivity and performance. Additionally, smart ports' focus on minimizing environmental impact and optimizing resource use is a novel approach to port design and operation. Furthermore, their emphasis on robust cybersecurity measures to protect IoT and CPS infrastructure is a critical innovation given the increasing digitalization of maritime activities.

SOURCE

TIM

Sources used in the signal’s detection and description include, but are not limited to:
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http://doi.org/10.1109/TII.2022.3170424 ; http://doi.org/10.1080/03088839.2022.2074161 ;
http://doi.org/10.1016/j.rtbm.2022.100862 ; http://doi.org/10.1080/03088839.2022.

NUMBER | TITLE

1196 | Green ammonia

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Green ammonia, produced from renewable sources with little to no carbon emissions, is emerging as a potential carbon-free energy source. This technology hinges on the electrocatalytic nitrate reduction reaction (NO3RR) to synthesize ammonia (NH3) under ambient conditions. Recent developments have shown that Au nanoclusters anchored on TiO2 nanosheets can efficiently catalyze this conversion process. Green ammonia is a promising hydrogen carrier due to its high energy density, comparatively low cost, and ease of liquefaction and storage. It has potential applications in three key sectors: electricity, transport, and heating. Moreover, it can be used as fuel for fuel cells, specifically ammonia molten carbonate fuel cells (MCFCs), which can help reduce dependency on fossil fuels. What sets green ammonia apart from established technologies is its environmentally sustainable production process and its direct application in various sectors without causing carbon emissions. Traditional methods of ammonia production are energy-intensive and contribute significantly to carbon emissions. In contrast, green ammonia utilizes renewable sources like wind and solar power for its production, thereby offering a more eco-friendly alternative. The development of novel catalysts for the efficient conversion of nitrate to ammonia, as well as the application of advanced techniques such as neural-network quantum molecular dynamics (NNQMD) simulations and machine learning, further highlight the novelty of this technology. The use of green ammonia as a direct fuel in MCFCs is also a relatively unexplored area, adding to its innovative potential.

SOURCE

TIM

Sources used in the signal's detection and description include, but are not limited to: http://doi.org/10.1039/c9ee02873k ; http://doi.org/10.1021/jacs.2c02262 ; http://doi.org/10.1007/978-3-031-32041-5_12 ; http://doi.org/10.1016/j.apcatb.2023.123057 ; http://doi.org/10.1016/j.ijhydene.2023.06.309 ; http://doi.org/10.1007/s12274-023-5997-z

NUMBER | TITLE

1199 | Vehicle repositioning

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Vehicle repositioning is a dynamic management technique utilized in shared mobility systems, such as bike-sharing services, ride-hailing platforms, and shared autonomous electric mobility. It involves the strategic relocation of vehicles within a network to balance supply and demand, enhance user satisfaction, and reduce operational costs. Key components of this technology include prediction of vehicle numbers and positions, decision support systems for relocation, and learning frameworks that adapt to real-time fluctuations in demand. It can be enhanced by integrating transit systems, optimizing charging strategies for electric vehicles, and using reinforcement learning approaches. Potential applications extend to improving transport efficiency, reducing travel times, and increasing profitability for mobility service providers.The novelty of vehicle repositioning technology lies in its ability to address the imbalance between supply and demand in shared mobility systems, a major challenge not adequately addressed by traditional transport management strategies. It employs data-driven approaches and machine learning algorithms to dynamically adjust to changes in demand. Compared to traditional methods, this approach allows for more flexible, efficient, and cost-effective transportation services. The integration of vehicle charging in the repositioning strategy is also a novel aspect, particularly relevant for electric vehicle fleets. Furthermore, the technology can adapt to complex interactions and large-scale problems, providing robust solutions for the highly dynamic environment of urban mobility.

SOURCE

TIM

Sources used in the signal's detection and description include, but are not limited to: http://doi.org/10.1016/j.trc.2018.01.001 ; http://doi.org/10.1080/23249935.2018.1523249 ; http://doi.org/10.1007/s10479-018-3076-8 ; http://doi.org/10.1016/j.tre.2019.07.002 ; http://doi.org/10.1287/msom.2019.0851 ; http://doi.org/10.1145/3447548.3467096

NUMBER | TITLE

1200 | Autonomous delivery

SUGGESTED MATURITY

n/a

SUMMARY DESCRIPTION

Autonomous delivery refers to the use of automated machines (drones, delivery robots, and autonomous vehicles) to transport goods from a central point to the end customer. This technology has primarily been developed to mitigate the logistical challenges brought about by the growth in e-commerce and reduce the negative impacts of excess traffic in urban areas. Autonomous Delivery Robots (ADRs) and Unmanned Aerial Vehicles (UAVs) are loaded with goods and launched from a central truck, they then autonomously navigate to the delivery location, drop-off the goods, and return to a depot. The technology leverages GPS for approximate location and visual navigation for precise drop-off points. It has been applied in various urban environments, with the potential to reduce delivery costs significantly, reduce energy consumption and CO2 emissions, and improve collision prediction and detection for safer navigation.The novelty of autonomous delivery lies in its potential to revolutionize last-mile delivery, which is traditionally done by human-operated vehicles. Unlike traditional methods, autonomous delivery incorporates advanced technologies such as GPS, visual navigation, and machine learning algorithms to ensure precise and safe delivery. The use of drones and autonomous robots offers an innovative approach to minimize traffic congestion and environmental impact. Furthermore, the technology's adaptability to various urban environments and potential for significant cost and energy savings presents a breakthrough in the field of logistics service provision. Despite its novelty, however, customer acceptance of this technology is influenced by factors such as price sensitivity, performance expectancy, perceived risk, and social influence, which need to be addressed to ensure its widespread adoption.

SOURCE

TIM

Sources used in the signal’s detection and description include, but are not limited to:
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http://doi.org/10.1016/j.ejor.2021.02.027 ; http://doi.org/10.1002/net.22030 ;

NUMBER | TITLE

1201 | Connected automated vehicles

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Connected Automated Vehicles (CAVs) are a revolutionary technology in the mobility field that combines advanced automation and connectivity to enhance safety, improve traffic efficiency, and reduce fuel consumption and emissions. A key feature of CAVs is platooning control that enables a group of vehicles to be maneuvered cooperatively with desired speeds and spacings on roads. Advanced algorithms such as HYDRO-3D and V2X-ViT, employing cooperative perception and historical object tracking information, are used to enhance object detection and overcome challenges such as occlusion, sparse point clouds, and out-of-range issues. CAVs also leverage vehicle-to-everything connectivity to access the state of traffic behind them, mitigating evolving congestions. Moreover, safety measures like the coefficient of variation of vehicle speed, time exposed time-to-collision, and time-integrated time-to-collision have been adopted to evaluate the safety of mixed traffic flow. The novelty of CAV technology lies in its ability to improve traffic efficiency, driving safety, fuel economy, and mitigate traffic congestions in a way that traditional vehicles cannot. The incorporation of advanced algorithms for object detection, such as HYDRO-3D, offers a novel approach to tackling vision challenges in CAVs. Moreover, the development of event-triggered control approaches for CAVs is a novel solution to guaranteeing the feasibility of the Control Barrier Functions (CBFs) method within each discretized time interval. This approach enhances computational efficiency and handles measurement uncertainties and noise better than time-driven control while guaranteeing safety. Furthermore, the dynamic event-triggered scheduling mechanism for inter-vehicle data transmissions is another novel feature that optimizes communication efficiency. In addition, the application of control barrier function (CBF) theory for the safety of connected cruise control strategies is a new approach in ensuring the safe operation of CAVs. Finally, the development of safety charts for existing connected cruise controllers to identify safe choices of controller parameters represents an innovative approach to controller design.

SOURCE

TIM

Sources used in the signal’s detection and description include, but are not limited to:
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http://doi.org/10.1109/JAS.2023.123507 ; http://doi.org/10.1016/j.trc.2023.10412

NUMBER | TITLE

1202 | Solar-powered EV charging station

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

A Solar-powered EV charging station works by harnessing energy from the sun through photovoltaic (PV) panels, converting this energy into electricity and using it to charge electric vehicles (EVs). The stations can either be grid-connected or standalone, with the potential for integration with energy storage units (ESUs) for times when solar generation is low or absent. The stations can also be equipped with smart energy management systems for optimal power distribution, as well as bidirectional converters for vehicle-to-grid (V2G) operation, which allows the charged EVs to feed energy back into the grid. These stations are particularly beneficial in locations with long periods of parking such as workplaces, or in regions with high solar potential.The novelty of this technology lies in its sustainable and eco-friendly approach to EV charging, contrasting with traditional methods that often rely on fossil fuels. Innovations include the use of multi-port converters for charging multiple EVs from a single charger, the integration of fuzzy logic controllers for decentralized power distribution, and the application of advanced control strategies for optimal power management. Additionally, the integration of a solar carport canopy is a new development, providing a dual purpose of vehicle protection and solar energy generation. The technology also addresses key challenges in the EV sector such as range anxiety, grid stress, and the high cost of EVs, by providing a cost-effective and environmentally friendly charging solution. The potential for V2G operation adds another layer of novelty, transforming EVs into mobile power sources and further promoting the transition to a sustainable energy future.

SOURCE

TIM

Sources used in the signal's detection and description include, but are not limited to:
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NUMBER | TITLE

1203 | Solid state batteries EV

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Solid state batteries for electric vehicles (EVs) represent a significant shift from conventional lithium-ion batteries (LIBs), replacing liquid electrolytes with solid-state electrolytes. This change promises higher energy density, superior safety, and increased lifespan. Solid state batteries can handle more charge capacity and offer improved electrode stability. They also mitigate the safety risks posed by the flammability of liquid electrolytes in LIBs. These batteries are considered ideal for long-range EVs and electric aviation due to their high energy density. However, they face challenges related to interfacial impedance, thermal stability, and manufacturing costs.The novelty of solid state batteries for EVs lies in their potential to deliver higher energy density and enhanced safety compared to traditional LIBs. Unlike LIBs, they are not prone to the thermal runaway phenomenon and do not pose a risk of explosion due to the nonflammable nature of solid electrolytes. This technology also opens up possibilities for the use of new electrode materials, such as silicon and nickel-rich layered oxides, which offer ultra-high energy densities. Moreover, novel strategies like in situ solidification and B doping and coating of electrodes show promise for improving battery performance and safety. Despite these advances, the technology still faces hurdles related to interfacial stability, room temperature ionic conductivity, and cost-effective mass production, which need to be addressed for their wider adoption in EVs and other applications.

SOURCE

TIM

Sources used in the signal's detection and description include, but are not limited to:
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NUMBER | TITLE

1204 | Last mile delivery

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Last mile delivery (LMD) refers to the final stage of the supply chain where goods are delivered to the end consumer. Due to the growth of e-commerce and increased demand for home deliveries, LMD has become a crucial aspect of urban logistics. Technological innovations in LMD include the use of unmanned aerial vehicles (drones) or autonomous delivery robots, environmentally friendly and small vehicles, professional delivery fleets supplemented with crowdshipping (ordinary people participating in delivery), and automated parcel stations. Other developments focus on the strategic placement of parcel lockers and the development of algorithms for parcel consolidation and route optimization to ensure fast, cheap, and reliable deliveries. The novelty of LMD technology lies in its integration of digital advancements with traditional delivery methods to improve efficiency and sustainability. The use of drones and autonomous delivery robots represents a significant departure from conventional human-operated vehicles. Crowdshipping is a novel concept that leverages the power of the crowd to supplement professional delivery fleets. The development of sophisticated algorithms for parcel consolidation, UAV routing, and selection of locker locations represents a significant innovation in logistics planning. Furthermore, the concept of incentivizing customers to accept delayed deliveries, thereby enabling more efficient use of vehicle capacity and anticipation of future demand, introduces a significant novelty approach in last-mile delivery research. However, these innovations also present new challenges such as the need to develop effective decision-making models for various delivery scenarios and understanding consumer behavior towards new delivery concepts.

SOURCE

TIM

Sources used in the signal's detection and description include, but are not limited to: http://doi.org/10.1016/j.trpro.2016.02.018 ; http://doi.org/10.1108/IJLM-12-2016-0302 ; http://doi.org/10.1007/s00291-020-00607-8 ; http://doi.org/10.1109/TFUZZ.2022.3164053 ; http://doi.org/10.1016/j.trpro.2023.02.207 ; http://doi.org/10.1016/j.eswa.2023

NUMBER | TITLE

1205 | Vertiport

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Vertiport technology serves as a critical component of Urban Air Mobility (UAM), enabling vertical take-off and landing (VTOL) of autonomous aircraft in urban environments. Vertiports are integrated with advanced algorithms for autonomous UAM network management, continuous trajectory management, and aircraft separation services. They utilize various technologies such as vision-aided navigation systems, Inertial Measurement Units, GNSS receivers, and Convolutional Neural Networks for safe and efficient aircraft operations. Moreover, vertiports play a crucial role in the scheduling of UAM fleets, with the use of Markov Decision Process for optimal aircraft operations. They also incorporate Network-based Augmentation System architecture to enhance navigation accuracy and integrity. Potential applications of vertiports include efficient transportation of goods and passengers in urban areas, integration with existing transportation ecosystems, and serving as nodes in city-wide air transportation networks. They also hold promise in reducing urban congestion and providing alternative transportation means, particularly around large airports.The novelty of vertiport technology lies in its ability to support high-density, autonomous aircraft operations in urban environments, which is a significant departure from traditional aviation. Vertiports leverage advanced neural networks and machine learning algorithms for autonomous operations, a feature not common in conventional airports. Moreover, the integration of vertiports with UAM infrastructure, including air corridors and U-space structures, represents a significant innovation compared to established technologies. Vertiports also introduce a new dimension to urban planning and infrastructure development, enabling the design of air transportation networks within congested urban spaces. The technology also has the potential to significantly reduce travel times and provide new modes of transportation, thus revolutionizing urban mobility.

SOURCE

TIM

Sources used in the signal's detection and description include, but are not limited to: http://doi.org/10.1109/TIV.2023.3283235 ; http://doi.org/10.33012/2023.18603 ; http://doi.org/10.2514/6.2018-3365 ; http://doi.org/10.2514/6.2019-0526 ; http://doi.org/10.4050/JAHS.66.032004 ; http://doi.org/10.2514/6.2021-2372 ; http://doi.org/10.2514/6.

NUMBER | TITLE

1208 | Blue hydrogen

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Blue hydrogen is a form of low-carbon energy produced from natural gas with the implementation of carbon capture and storage (CCS) processes. This technology is particularly relevant to the field of mobility, as it may be used to power hydrogen fuel cell (HFC) vehicles, contributing to a reduction in greenhouse gas emissions. Blue hydrogen has the potential to be an economical and environmentally-friendly alternative to gray hydrogen, which is produced from fossil fuels without CCS, and green hydrogen, which is generated from renewable energy sources and generally has higher production costs. Key factors impacting the effectiveness of blue hydrogen include the methane emission rate of the natural gas supply chain, the CO2 removal rate at the hydrogen production plant, and the global warming metric applied.The novelty of blue hydrogen technology lies in its ability to produce hydrogen in a more cost-effective and environmentally sustainable way compared to traditional methods. However, it is not without controversy. Current research has questioned the life-cycle climate impacts of blue hydrogen, as it still involves the use of fossil fuels. However, with state-of-the-art reforming and natural gas supply featuring low methane emissions, blue hydrogen could indeed allow for substantial reduction of greenhouse gas emissions compared to direct combustion of natural gas. Furthermore, it is being compared to green hydrogen, which is produced from renewable sources but at a higher cost. The continued development and optimization of blue hydrogen technology, as well as changes in the economic and regulatory environment, will determine its future role in the energy mix.

SOURCE

TIM
Sources used in the signal’s detection and description include, but are not limited to:
http://doi.org/10.1016/j.ijhydene.2023.01.346 ; http://doi.org/10.1016/j.ijhydene.2021.04.016 ;
http://doi.org/10.1002/ese3.956 ; http://doi.org/10.1039/d1se01508g ;
http://doi.org/10.1016/j.enconman.2022.115245 ; http://doi.org/10.1016/j.ijhydene.2022.02

NUMBER | TITLE

1209 | Marine fuel - Hydrogen

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Marine fuel - Hydrogen technology involves the use of hydrogen as a clean energy source for powering marine vessels. This technology largely revolves around high-pressure hydrogen storage and fuel cells, and it's considered for its potential to achieve zero-local-emission shipping. Hydrogen can be produced through various methods, such as steam methane reforming, coal gasification, coke oven gas, propane dehydrogenation, water electrolysis, and biomass gasification. The technology also involves the development of safety monitoring systems, efficient filling processes for hydrogen storage tanks, and optimized operation models for propulsion systems. Additionally, the combustion of hydrogen in marine engines can be improved by adding water and biofuels, presenting an efficient, low carbon and clean combustion.The novelty of Marine fuel - Hydrogen technology lies in its potential to significantly reduce carbon emissions in the maritime industry, offering a sustainable alternative to conventional fossil fuels. The technology also explores new approaches to optimize the performance of hydrogen-powered vessels, such as the use of superconductivity for cost and energy savings in settings where liquid hydrogen can be both a coolant and fuel. The development of safety monitoring systems for hydrogen fuel cells in ships is another novel aspect, as well as the exploration of the influence of different parameters, such as PEMFC, LIB, and hydrogen costs, on the optimal operation of a hydrogen-powered ferry. However, issues such as high NOx emissions and the need for efficient control measures remain challenges to be addressed.

SOURCE

TIM
Sources used in the signal’s detection and description include, but are not limited to:
http://doi.org/10.2478/IJNAOE-2013-0153 ; http://doi.org/10.1109/IPEC51340.2021.9421231 ;
http://doi.org/10.1080/25725084.2020.1840859 ; http://doi.org/10.1016/j.ijhydene.2021.10.271 ;
http://doi.org/10.1088/1742-6596/2160/1/012061 ; http://doi.org/10.396

NUMBER | TITLE

1210 | Digit Twin connected vehicle simulation

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Digit Twin connected vehicle simulation is an emerging technology in the mobility sector that leverages Artificial Intelligence (AI), cloud computing, and 5G networks to create a virtual replica of various mobility entities like humans, vehicles, and traffic. Through a seamless integration of physical and digital realms, the technology collects and processes data in real-time, enabling effective monitoring, learning, simulation, and prediction. Applications include user management and driver type classification, cloud-based advanced driver-assistance systems, traffic flow monitoring, and variable speed limit. It also enables the testing and evaluation of autonomous driving algorithms in a cost-effective manner, optimizing the delivery system for automated vehicles, and facilitating predictive analyses for various scenarios. The novelty of the Digit Twin connected vehicle simulation technology lies in its ability to create a holistic, AI-based data-driven cloud-edge-device framework for mobility services, something that is not systematically addressed in any previous research. Unlike traditional autonomous vehicles that operate independently, this technology allows for cooperative optimization of the entire system. It also pushes the boundaries by offering a virtual testing environment for autonomous vehicles, reducing costs and improving efficiency. Moreover, it capitalizes on the power of 5G networks, blockchain, Web 3.0, and non-fungible tokens (NFTs) to create a metaverse where physical and digital entities can interact, transact, and socialize seamlessly. This is a significant advancement from the established technologies.

SOURCE

TIM
Sources used in the signal's detection and description include, but are not limited to:
http://doi.org/10.1109/VTC2020-Spring48590.2020.9128938 ; http://doi.org/10.1109/ITSC45102.2020.9294422 ; http://doi.org/10.1109/JIOT.2022.3156028 ; http://doi.org/10.1088/1742-6596/2170/1/012039 ; http://doi.org/10.1109/SPAWC51304.2022.9833928 ; http://d

NUMBER | TITLE

1212 | Charging strategy for electric buses

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

The technology of charging strategy for electric buses involves developing and implementing energy consumption models and optimal charging schedules for electric buses, taking into account various physical, financial, institutional, and managerial constraints. This technology helps to minimize the total charging cost and time of an electric bus fleet by determining the optimal set of charging location and time decisions. The charging strategy includes the use of both plug-in fast charging and battery-swapping charging modes at a single charging station, as well as the possibility of dynamic wireless power transfer (DWPT) technology, which allows for the charging of buses in motion. The technology also factors in uncertain factors such as energy consumption rates, electricity charging rates, time-based charging windows, battery state-of-charge (SOC) bounds, time-of-use (TOU) charging tariffs, and station-specific electricity load capacities in its scheduling model.The novelty of this technology lies in its comprehensive approach to electric bus charging strategy, which integrates multiple factors and constraints to optimize charging schedules. Compared to traditional charging strategies, this technology allows for partial and flexible recharging, as well as the coordination of charging activities across multiple bus lines and charging depots and terminals. Furthermore, it employs advanced algorithms, such as a mixed linear integer programming model with binary charging slot choice and continuous state-of-charge (SOC) variables, a Lagrangian relaxation framework, and a bi-criterion dynamic programming algorithm, to efficiently solve the complex charging scheduling problem. These features make the technology much more efficient and cost-effective than traditional charging strategies.

SOURCE

TIM
Sources used in the signal's detection and description include, but are not limited to:
http://doi.org/10.1109/ITSC.2014.6958135 ; http://doi.org/10.1109/RTSS.2018.00015 ; http://doi.org/10.1080/23249935.2021.2023690 ; http://doi.org/10.1109/TITS.2022.3165876 ; http://doi.org/10.1016/j.multra.2022.100006 ; http://doi.org/10.1016/j.energy.202

NUMBER | TITLE

1213 | Truck platooning

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Truck platooning is a technology in the mobility sector that uses automated driving and vehicle-to-vehicle communication to enable groups of trucks to travel together in formation. It operates through computer vision, radar, lidar, laser scanners, GNSS-based localization and inter-vehicle communication. This technology aims to enhance transportation capacity and energy efficiency by reducing aerodynamic drag, thus saving fuel. Current experimental setups allow automated trucks to travel with a minimal gap of 4-10 meters at speeds of 80 km/h. To ensure safety, lateral control is based on lane marker detection and longitudinal control on gap measurement, with radar and lidar acting as obstacle detectors. Additionally, the technology is being improved to enable safe interaction with surrounding traffic and prevent platoon decoupling during mandatory lane changes.Compared to traditional freight transportation, truck platooning is a novel approach that leverages automation and connectivity to optimize vehicle performance. While the concept of automated driving has been explored since the 1950s, its application in heavy trucks is relatively recent, starting in the mid-1990s. This technology offers a potential reduction in personnel costs by unmanned operation of following vehicles. Its measurable progress in fuel economy, with studies showing fuel savings of up to 15%, and CO2 reduction of 2.1% along an expressway, demonstrates its novelty. Another innovative aspect is the focus on cooperative strategies, enabling the platoon to adapt to dynamic traffic conditions and maintain formation during lane changes. Future developments in communication technologies, such as 5G, could further enhance platooning's effectiveness by reducing latency and thus enabling closer vehicle spacing, potentially further decreasing energy consumption.

SOURCE

TIM

Sources used in the signal’s detection and description include, but are not limited to:
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http://doi.org/10.1109/IVS.2014.6856400 ; http://doi.org/10.4271/2018-01-1181 ;
http://doi.org/10.1109/TIV.2016.2577499 ; http://doi.org/10.1080/15472450.2022.211

NUMBER | TITLE

1214 | Super-fast charging

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Super-fast charging technology in mobility primarily concerns the rapid charging of electric vehicle (EV) batteries. It encompasses advanced power electronic converters, high-performance off-board chargers, and innovative electrolyte design principles, enabling extreme fast charging (XFC) of batteries without causing lithium plating. Applications include the development of high-power, low-cost, and reliable charging solutions for EV batteries, as well as the integration of multiport EV chargers with photovoltaics, energy storage, and grid systems. The technology also involves efficient thermal management strategies to dissipate the heat generated during high-rate charging, ensuring effective cooling of battery packs. Additionally, super-fast charging has the potential to facilitate vehicle-to-grid (V2G) support and ancillary services, enabling EVs to function as mobile storage units. The novelty of super-fast charging technology lies in its ability to drastically reduce charging times while maintaining battery integrity and safety. Traditional charging methods are limited by the graphite anode's slow kinetics in lithium-ion batteries. However, new electrolyte design principles have been established to overcome these limitations, enabling high ionic conductivity and protective solid electrolyte interphase (SEI). This bolsters the charging speed by a factor of up to ten times that of conventional electrolyte. Moreover, super-fast charging employs advanced off-board chargers to reduce the volume and weight of EVs significantly. The technology also introduces novel solid-state transformers (SSTs) in charging stations, replacing conventional line-frequency transformers. This, coupled with innovative thermal management strategies, enhances the efficiency and safety of the charging process. Furthermore, the technology's potential for V2G support represents a significant advancement, potentially transforming EVs from mere consumers to contributors in the power grid.

SOURCE

TIM

Sources used in the signal’s detection and description include, but are not limited to:
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NUMBER | TITLE

1216 | Internet of Connected Vehicles

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

The Internet of Connected Vehicles (IoV) is a technology that allows vehicles to collect real-time traffic conditions and offload computing tasks to edge computing devices (ECDs). This technology is strengthened by the use of fifth-generation (5G) wireless systems and vehicular ad-hoc networks (VANET), which enable vehicle-to-vehicle (V2V) or vehicle-to-infrastructure communication. IoV is also connected to the Internet of Things (IoT), enhancing traffic control systems. However, issues such as privacy leakage, cyber-attacks, congested communication channels, and intermittent network connectivity present challenges. To tackle these, several measures have been proposed, including privacy-preserving offloading methods, adaptive event-triggered mechanisms against cyber-attacks, in-network caching schemes, and robust security architectures.The novelty of the IoV lies in its ability to revolutionize the way vehicles operate and interact with the environment. Unlike traditional systems, IoV enables vehicles to absorb information from the surroundings and other cars, contributing to safer navigation, pollution control, and traffic management. Furthermore, the use of edge computing, 5G wireless systems, and VANETs is a significant advancement. These technologies allow vehicles to offload computing tasks, benefit from faster and more reliable communication, and access content more efficiently. In addition, recent measures to enhance privacy protection, mitigate cyber threats, and improve network connectivity represent innovative approaches to ensure the security and effectiveness of IoV systems.

SOURCE

TIM
Sources used in the signal's detection and description include, but are not limited to:
http://doi.org/10.1109/WF-IoT.2014.6803166 ; http://doi.org/10.1016/j.future.2019.01.012 ;
http://doi.org/10.1109/TITS.2020.2970276 ; http://doi.org/10.1109/TITS.2020.2982186 ;
http://doi.org/10.1109/TMC.2021.3137219 ; http://doi.org/10.1117/12.2679253 ;

NUMBER | TITLE

1217 | Digital twin in transportation

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Digital twin technology in transportation involves the creation of dynamic, virtual models of physical transportation systems, such as railways, highways, bridges, tunnels, and maritime systems. These digital replicas utilize real-time data from embedded sensors and other information sources to mirror and predict the state and performance of their physical counterparts. The technology has found applications in various areas including real-time traffic management, planning and analysis, safety performance assessment, optimization of energy management within a city, and providing a basis for intelligent and secure maritime transportation. The digital twin models also support the development of advanced driver assistance systems (ADAS) for connected vehicles, improving mobility and environmental sustainability. Furthermore, digital twin technology can assist in addressing challenges related to job shop scheduling in discrete manufacturing enterprises, by considering the constraints of actual transportation conditions.The novelty of digital twin technology in transportation lies in its ability to provide a real-time, dynamic and comprehensive understanding of transportation systems, something traditional modelling and simulation methods could not provide. It marks a significant evolution from the conventional offline microscopic simulation approaches, introducing a technology dimension that enables simulation-based control optimization during system run-time. This real-time predictive capability forms the foundation for safety-critical decision making in traffic management, which was previously unattainable. The technology also presents a unique solution to data management challenges in the power grid, by offering a powerful tool for real-time data management and analysis. Moreover, the application of digital twin technology in vehicular metaverses represents an innovative blend of the automotive industry with the metaverse, opening up new possibilities in the field of intelligent transportation systems.

SOURCE

TIM
Sources used in the signal's detection and description include, but are not limited to:
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http://doi.org/10.1109/TITS.2021.3122566 ; http://doi.org/10.1016/j.jag.2022.102833 ;
http://doi.org/10.1016/j.aei.2022.101858 ; http://doi.org/10.1109/TITS.2022.3

NUMBER | TITLE

1220 | Reinforcement learning adaptive traffic

SUGGESTED MATURITY

Novel (TRL 1-3)

SUMMARY DESCRIPTION

Reinforcement learning adaptive traffic technology is an innovative approach to traffic control that uses deep learning and multi-agent reinforcement learning methodologies to create adaptive traffic signal control systems. This technology leverages the principles of reinforcement learning, deep neural networks, and multi-agent systems to optimize traffic signal timings in real-time, based on current traffic conditions. The technology works by having each traffic light controller (or agent) monitor its environment and adjust its actions to minimize vehicle delays. This system can operate independently or in an integrated mode where controllers coordinate with each other to optimize overall traffic flow. Key potential applications include managing mixed traffic involving connected and autonomous vehicles, reducing traffic congestion in dense urban areas, and improving road safety by reducing accidents at intersections.The novelty of reinforcement learning adaptive traffic lies in its use of cutting-edge reinforcement learning algorithms and deep learning techniques for traffic signal control. Unlike traditional traffic control methods that primarily use pre-timed or fixed sequences, this approach dynamically adapts to real-time traffic conditions to optimize signal timings. The use of multi-agent systems allows for decentralized control of traffic signals, making it more scalable and efficient for large-scale urban networks. Furthermore, the incorporation of safety standards into the learning algorithms is a unique feature aimed at reducing accidents at intersections, which has not been a primary focus of traditional traffic signal control systems. This technology also leverages Vehicle-to-Vehicle, Vehicle-to-Infrastructure and Infrastructure-to-Vehicle communications, enhancing the ability to manage traffic efficiently and safely.

SOURCE

TIM

Sources used in the signal's detection and description include, but are not limited to:
http://doi.org/10.1109/ITSC.2010.5625066 ; http://doi.org/10.1109/TITS.2013.2255286 ; http://doi.org/10.1049/iet-its.2017.0153 ; http://doi.org/10.1109/TITS.2019.2901791 ; http://doi.org/10.1117/12.2647866 ; http://doi.org/10.23919/OFC49934.2023.10117077

NUMBER | TITLE

1221 | Demand response strategy for EV charging

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Demand response strategy for EV charging is a technology that aims to mitigate the potential strain on power grids due to the increasing penetration of electric vehicles (EVs). It focuses on managing the timing and rate of EV charging to prevent overloads and minimize peak demand. This strategy is often implemented in smart grids and microgrids, incorporating elements such as distributed generation, energy storage, and advanced energy management systems. The strategy allows for bidirectional energy flow and integrates plug-in electric vehicles and renewable distributed generators. Consumers are given the flexibility to control their load, sell back energy, and adjust their load scheduling. The strategy also incorporates different demand response programs, such as dynamic pricing and peak power limiting, to optimize energy usage and cost. The novelty of the demand response strategy for EV charging lies in its holistic and integrated approach to managing the impact of EVs on power grids. Unlike traditional methods, this strategy gives consumers more control over their energy usage, respects their preferences and privacy, and considers the potential for back-selling energy. It also incorporates advanced optimization techniques and utilizes intelligent energy management systems. Furthermore, it can accommodate diverse charging modes, variations in battery capacities, and fluctuations in customer demand patterns. The strategy also acknowledges the potential of EVs as distributed energy storage facilities and seeks to harness this potential for demand-side management, peak shaving, and valley filling. This technology goes beyond simply managing EV charging; it aims to optimize the entire energy ecosystem in the context of increasing EV use.

SOURCE

TIM

Sources used in the signal's detection and description include, but are not limited to:
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NUMBER | TITLE

1222 | Lidar odometry

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Lidar odometry is a technology that uses lasers to measure distances and build a detailed, 3D map of the surrounding environment, enabling accurate, real-time mobile robot trajectory estimation and map-building. It is particularly beneficial in autonomous vehicles and drones, where it plays a crucial role in localizing the robot's pose and planning safe paths. The technology works by combining visual odometry and lidar odometry, starting with visual odometry to estimate the ego-motion and register point clouds at a high frequency but low fidelity, then refining this with scan matching based lidar odometry. It also involves extracting and matching features from each scan input to a local map, with an optimization process to reduce computational cost and improve efficiency. In addition, the technology incorporates a multi-modal sensor fusion approach to improve the reliability of the pose estimation process in diverse operational environments.The novelty of lidar odometry lies in its robustness and accuracy in various challenging environments, its capacity to work in real-time with low computational cost, and its strong generalization abilities when applied to different environments. This technology shows significant improvements over existing technologies, particularly in its robustness to aggressive motion and temporary lack of visual features. It also achieves a competitive localization accuracy with a processing rate of more than 10 Hz, demonstrating a good trade-off between performance and computational cost for practical applications. Furthermore, it is one of the most accurate and fastest open-sourced SLAM systems in KITTI dataset ranking, and it has been proven to be highly effective in a variety of subterranean environments, large-scale environments, and in environments with significant ambient lighting changes.

SOURCE

TIM
Sources used in the signal’s detection and description include, but are not limited to:
http://doi.org/10.1109/ICRA.2015.7139486 ; http://doi.org/10.1109/IROS.2018.8594299 ; http://doi.org/10.1109/ICRA40945.2020.9197440 ; http://doi.org/10.1109/ICUAS48674.2020.9213865 ; http://doi.org/10.1109/IROS45743.2020.9341176 ; http://doi.org/10.1109/I

NUMBER | TITLE

1223 | Traffic signs recognition

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Traffic sign recognition (TSR) is a critical component of vehicle safety and navigation, particularly in relation to autonomous vehicles. This technology utilizes deep learning models, such as the Residual Neural Network (ResNet) and YOLOv8, to identify and classify traffic signs in real time, providing essential information for vehicle operation. Recent developments have seen the application of federated learning and model sparsification to optimize TSR in the Internet of Vehicles (IoV), allowing for decentralized learning while preserving data privacy and reducing communication costs. Other advancements include techniques to test the safety of deep learning networks against adversarial attacks, and query-based attack methods to assess network robustness. Furthermore, through image preprocessing and reshaping, the performance of these deep learning architectures can be significantly improved.The novelty of these developments lies in addressing privacy concerns and network restrictions in the IoV environment, as well as improving the efficiency of communication. The use of federated learning and model sparsification in optimizing TSR is a new approach, as is the application of the Adam optimizer for local training, which ensures efficient model optimization on each vehicle. Additionally, the feature-guided black-box approach to test the safety of deep neural networks against adversarial attacks is a novel development in ensuring the reliability of TSR systems. Further innovation is seen in the application of Modified Simple black-box attack (M-SimBmethods to overcome the use of a white-box source in transfer-based attack methods. Lastly, the use of image preprocessing and reshaping to improve the performance of deep learning architectures in TSR is a significant advancement in the field.

SOURCE

TIM
Sources used in the signal’s detection and description include, but are not limited to:
http://doi.org/10.1109/41.649946 ; http://doi.org/10.1007/978-3-642-21227-7_23 ; http://doi.org/10.1007/978-3-319-89960-2_22 ; http://doi.org/10.1109/AIPR50011.2020.9425267 ; http://doi.org/10.1109/ISIE51582.2022.9831717 ; http://doi.org/10.1109/IDCIoT567

NUMBER | TITLE

1225 | Non-line-of-sight imaging

SUGGESTED MATURITY

Novel (TRL 1-3)

SUMMARY DESCRIPTION

Non-line-of-sight (NLOS) imaging is an emerging technology that enables the visualization of scenes or objects that are not directly visible to the camera. By capturing light reflected off surfaces, like doorways or walls, NLOS imaging can recreate the hidden scene in two dimensions. Advances in the field have resulted in techniques that require only consumer-level hardware and significantly reduce computation times, expanding the method's applicability. Given its potential, NLOS imaging holds promise in a variety of fields, such as autonomous driving, security monitoring, and medical imaging. NLOS imaging is novel in its ability to reconstruct hidden scenes that traditional imaging methods cannot perceive. Unlike conventional imaging, NLOS does not require a direct line of sight, using instead indirect light reflected off surfaces. Its novelty also lies in the development of efficient algorithms that enable faster computation times and are suitable for use with consumer hardware. Furthermore, advances in NLOS imaging have resulted in improved image quality, even in challenging conditions such as low thermal contrast or inhomogeneous scattering surfaces. Finally, some recent methods also offer the potential for real-time and robust pose estimation, further enhancing the technology's usability and applicability.

SOURCE

TIM

Sources used in the signal’s detection and description include, but are not limited to:
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http://doi.org/10.1109/JSTQE.2023.3283150 ; http://doi.org/10.1109/ICASSP49357.

NUMBER | TITLE

1226 | Monocular 3D object detection

SUGGESTED MATURITY

Novel (TRL 1-3)

SUMMARY DESCRIPTION

Monocular 3D object detection is a technology application in the field of mobility and autonomous driving that utilizes single-camera imagery to identify and spatially locate objects in three dimensions, a task that is inherently challenging due to the lack of depth information. The technology works by transforming 3D targets to the image domain and decoupling them into 2D and 3D attributes. Advanced algorithms then distribute the objects to different feature levels based on their 2D scales and assign them according to the projected 3D-center for the training procedure. Some methods also utilize depth-aware features with auxiliary supervision, integrating context- and depth-aware attributes, and incorporate positional encodings to inject depth positional hints into the process. Potential applications extend to autonomous vehicles, infrastructure-less navigation, and other fields requiring 3D object detection and localization from 2D imagery.The novelty of monocular 3D object detection lies in its single-camera setup, which simplifies the configuration and reduces costs compared to multi-sensor systems. Recent advancements have seen the development of frameworks like the fully convolutional single-stage detector FCOS3D, the SparseViT that revisits activation sparsity for window-based vision transformers, or the Categorical Depth Distribution Network (CaDDN) that uses a predicted categorical depth distribution for each pixel. These innovations have led to notable improvements in accuracy and real-time detection capabilities, without the need for extra data or a refinement stage. However, the technology continues to face challenges in terms of depth inaccuracy and the complexity of translating 2D detection into a 3D task.

SOURCE

TIM

Sources used in the signal’s detection and description include, but are not limited to:
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http://doi.org/10.1109/CVPR46437.2021.00845 ; http://doi.org/10.1109/ICCVW54120.2021.00107 ;
http://doi.org/10.1109/ICCV48922.2021.00313 ; http://doi.org/10.1109/CVPR526

NUMBER | TITLE

1227 | Robo taxi

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Robo taxis are autonomous vehicles that offer transportation services without a human driver. They rely on advanced sensors like Lidar and RTK GPS, together with high-resolution maps, for accurate localization and navigation. User experience and perception play a crucial role in the acceptance of this technology, with safety being the major determinant. The integration of AI and machine learning models is enhancing functionalities in autonomous automotive systems and enabling new business models like robo taxi services. However, the adoption of AI and ML also presents cybersecurity challenges. With the progress of this technology, it is also possible to reduce costs by using low-cost cameras and compact visual semantic maps for localization, which can be updated by sensor-rich vehicles in a crowd-sourced way. Robo taxis are a novel approach to mobility, differing significantly from traditional taxi services which rely on human drivers. The use of advanced sensors and AI-driven decision-making processes distinguishes this technology from established methods. The integration of AI and ML models for autonomous transportation also represents a new trend. However, these advancements increase the system's vulnerability to cybersecurity threats, thereby necessitating robust security mechanisms. Furthermore, the use of crowd-sourced data for updating semantic maps is a novel approach to keeping localization data up-to-date and reducing costs. Another novelty is the use of robust statistical models and real-world experiments for user experience analysis, providing valuable insights into user acceptance and behavior.

SOURCE

TIM
Sources used in the signal’s detection and description include, but are not limited to:
http://doi.org/10.1145/3409120.3410662 ; http://doi.org/10.1109/ICRA48506.2021.9561663 ;
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http://doi.org/10.1155/2022/8461212 ; http://doi.org/10.1109/LCSYS.2022.318

NUMBER | TITLE

1228 | Autonomous racing

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Autonomous racing involves the use of advanced robotics and artificial intelligence (AI) to control racing vehicles, such as drones or cars, with the goal of optimizing speed, agility, and maneuverability. The technology relies on reinforcement learning (RL), a type of machine learning, to train the control system to respond to various racing conditions and scenarios. In contrast to traditional optimal control (OC) methods, RL can directly optimize task-level objectives and cope with model uncertainty, leading to superior control responses. This technology can also incorporate neural network controllers, model predictive control approaches, and Gaussian process regression to predict and manage the vehicle's dynamics effectively. Autonomous racing technology can also handle complex aspects such as overtaking maneuvers, rule-based speed limits, multi-agent racing, and trajectory tracking at high speeds.The novelty of autonomous racing stems from its use of advanced AI and machine learning techniques to push the boundaries of autonomous vehicle control. Traditional methods typically separate the process into planning and control, with a set trajectory serving as an interface. However, this approach limits the range of behaviors the system can express, particularly in unmodeled scenarios. Autonomous racing overcomes this limitation by using RL to directly optimize a task-level objective, enabling the system to handle a wider array of behaviors and scenarios, including high-speed and aggressive trajectories that have been challenging for existing systems. Additionally, the integration of multi-agent racing, real-time planning, and model predictive control methods represent significant advancements over established technologies. The technology has demonstrated superior performance in terms of speed and agility, achieving superhuman control levels within minutes of training, and offering significant improvements in both performance and safety compared to current state-of-the-art controllers.

SOURCE

TIM
Sources used in the signal’s detection and description include, but are not limited to:
http://doi.org/10.1109/ICRA.2019.8793887 ; http://doi.org/10.1109/TCST.2019.2949757 ;
http://doi.org/10.1109/IROS51168.2021.9636053 ; http://doi.org/10.1109/ITSC55140.2022.9922239 ;
http://doi.org/10.1109/IV55152.2023.10186744 ; http://doi.org/10.1126/sci

NUMBER | TITLE

1229 | Marine fuel - Ammonia

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Marine fuel - Ammonia is an alternative marine fuel that promises to reduce the environmental impact of shipping operations. The use of ammonia as a marine fuel is being studied because of its potential benefits, which include no carbon emissions, lower global warming potential, and ease of storage as compared to other alternative fuels like LNG and methanol. It can be produced using renewable resources, thus aiding in achieving net-zero emissions by 2050. Moreover, its storage in liquid form at relatively low pressure or temperature makes it a practical energy source. Green ammonia, produced from renewable energy, can also contribute to various sustainable development goals, including clean energy, climate action, and responsible consumption.The novelty of marine fuel - Ammonia lies in its potential to significantly decarbonize the maritime sector. Unlike traditional fossil fuels, ammonia has zero carbon content, thus eliminating CO2 emissions. It is a significant shift from established marine fuels, which have high environmental impacts and contribute to global warming. The production methods for green ammonia are still being optimized, with a focus on improving efficiency, reducing costs, and minimizing environmental impacts. Current developments indicate that ammonia could represent 99% of marine fuel by 2050, contributing to the sustainable transformation of the shipping industry. However, the transition to this new fuel will require significant investment in new technologies and infrastructure, consensus-building in the maritime community, and regulatory adjustments to manage the specific risks associated with alternative-fuel-powered ships.

SOURCE

TIM
Sources used in the signal’s detection and description include, but are not limited to:
http://doi.org/10.1016/j.jclepro.2021.126651 ; http://doi.org/10.1016/j.jclepro.2021.128871 ; http://doi.org/10.1038/s41560-021-00957-9 ; http://doi.org/10.1016/j.pecs.2022.101055 ; http://doi.org/10.1016/j.trd.2022.103547 ; http://doi.org/10.1016/j.encon

NUMBER | TITLE

1230 | Truck drone

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Truck drone technology in the field of mobility refers to the integration of unmanned aerial vehicles (UAVs) or drones for last-mile package deliveries in tandem with traditional trucks. In this system, drones are launched from trucks to deliver packages, thereby exploiting the drones' ability to bypass road traffic and geographical obstacles. The novelty of this technology lies in its flexibility: the truck can stop at non-customer locations (flexible sites) for drone launch and recovery operations (LARO) and drones can serve multiple customers and provide both pickup and delivery services in a single flight. This system also considers three key decisions: assignment of each customer location to a vehicle, routing of truck and UAVs, and scheduling drone LARO and truck operator activities at each stop. The primary objective is to minimize the delivery completion time.The novelty of truck drone technology lies in its departure from traditional delivery methods. Previously, UAV launch and recovery operations were restricted to customer locations. The new approach allows trucks to stop at flexible sites for LARO, enabling the drones to serve a wider area along the route. Moreover, the drones can serve multiple customers, perform both pickup and delivery services on each flight, and dock to the same or different truck from where it launched, thereby increasing delivery efficiency and reducing costs. The technology is also adaptive to advances such as improved drone energy capacity and speed, providing more flexibility in planning routes and operations. This is a significant shift from the conventional methods, where trucks alone are used for delivery, and it presents great potential for optimizing last-mile delivery solutions in e-commerce logistics.

SOURCE

TIM
Sources used in the signal’s detection and description include, but are not limited to:
http://doi.org/10.1049/iet-its.2017.0227 ; http://doi.org/10.1016/j.cie.2019.01.020 ; http://doi.org/10.1016/j.ijpe.2019.107598 ; http://doi.org/10.1111/itor.13154 ; http://doi.org/10.1016/j.tre.2022.102788 ; http://doi.org/10.1016/j.tre.2022.102990 ; htt

NUMBER | TITLE

1231 | 3D multi-object tracking

SUGGESTED MATURITY

Novel (TRL 1-3)

SUMMARY DESCRIPTION

3D multi-object tracking (3D MOT) is a pivotal technology in the mobility sphere, especially for applications like autonomous driving and assistive robotics. This technology works by obtaining 3D detections from a LiDAR point cloud and using a combination of a 3D Kalman filter and the Hungarian algorithm for state estimation and data association. It enables the tracking and identification of multiple objects in a three-dimensional space over time, which is crucial for understanding and predicting the dynamic behavior of traffic participants in real-world scenarios. The technology also incorporates features from 2D images and 3D LiDAR point clouds to capture the appearance and geometric information of objects. Furthermore, 3D MOT tools can evaluate the performance of these methods, providing a standardized benchmark for advancements in the field.The novelty of 3D MOT technology lies in its real-time operation, high computational efficiency, and low system complexity. Unlike conventional tracking systems that focus on accuracy, this technology places greater emphasis on practical considerations. Surprisingly, despite not using any 2D data inputs, this technology achieves competitive performance on various benchmarks. Another innovative aspect of 3D MOT is the introduction of new metrics for comprehensive evaluation of 3D MOT methods and the proposal of novel techniques for discriminative feature learning. Additionally, the technology uses a data-driven approach for data association, leveraging the power of deep learning to handle noisy detections and varying numbers of targets. This represents a significant shift from traditional methods that rely heavily on designing complex cost functions or formulating optimization problems. The technology's ability to effectively fuse features from different modalities and interactively learn features for different objects also sets it apart from previous methods.

SOURCE

TIM

Sources used in the signal’s detection and description include, but are not limited to:
http://doi.org/10.1109/IVS.2018.8500454 ; http://doi.org/10.1109/ICRA.2019.8793925 ;
http://doi.org/10.1109/IVS.2019.8813779 ; http://doi.org/10.1109/CVPR42600.2020.00653 ;
http://doi.org/10.1109/IROS45743.2020.9341164 ; http://doi.org/10.1109/ICRA48506.2

NUMBER | TITLE

1232 | Place recognition

SUGGESTED MATURITY

Novel (TRL 1-3)

SUMMARY DESCRIPTION

Place recognition comprises techniques that enable autonomous vehicles to identify previously visited locations, an essential component for tasks like loop closing in Simultaneous Localization And Mapping (SLAM) or global localization. This technology uses visual information, 3D LiDAR scans, or radar data to distinguish and match places under varying appearance conditions and viewpoint changes. Recent advancements have seen the development of novel lightweight neural networks and transformer networks that enhance the speed and performance of place recognition. Visual place recognition (VPR) and multi-modal descriptors using sensor data have particularly grown, benefiting from advances in camera hardware and deep learning techniques. There are also emerging trends in multi-vehicle SLAM and place recognition in challenging environments like varying weather conditions or high-frequency dynamic scenarios.The novelty in place recognition technology lies in its increased integration with machine learning and deep learning techniques, improving the ability to recognize places under varying conditions and viewpoints. The use of transformer-based networks and lightweight neural networks, for instance, has significantly enhanced the speed and accuracy of place recognition. Furthermore, the development of comprehensive open-source frameworks for assessing VPR techniques' performance has addressed the lack of standardisation in the field. The emergence of multi-vehicle SLAM and the use of advanced sensors, like LiDAR and radar, for place recognition also represent significant advances. However, despite these innovations, the technology still faces challenges such as performance in perceptually-aliased and less-structured environments, viewpoint variance, and illumination change effects.

SOURCE

TIM

Sources used in the signal’s detection and description include, but are not limited to:
http://doi.org/10.1109/LRA.2020.2969917 ; http://doi.org/10.1109/TIV.2017.2749181 ;
http://doi.org/10.1109/LRA.2021.3052439 ; http://doi.org/10.1007/s11263-021-01469-5 ;
http://doi.org/10.1109/IJCNN52387.2021.9533373 ; http://doi.org/10.1109/LRA.2022.3178

NUMBER | TITLE

1233 | Smart contract for ride sharing

SUGGESTED MATURITY

Novel (TRL 1-3)

SUMMARY DESCRIPTION

Smart contracts for ride sharing utilize blockchain technology to decentralize ride sharing services. This technology provides a secure, transparent and efficient platform for drivers and riders to share trips without the need for a centralized authority. By leveraging the benefits of blockchain, such as immutability and fault tolerance, the system can provide a secure communication network with low latency and high throughput. Additionally, the system utilizes coalition game theory to optimize the payoff for both vehicle owners and customers. Privacy concerns are addressed through encryption and the use of pseudonyms, while a reputation system helps users make informed choices about their ride partners. The system also includes features to deter malicious behavior, such as time-locked deposits and proof of driving protocols.This approach to ride sharing represents a significant departure from traditional centralized ride-sharing systems. Traditional systems rely on a third-party service provider, which can create a single point of failure, privacy concerns, and high service fees. By contrast, blockchain-based ride sharing is decentralized, transparent, and can better protect user privacy. It also introduces innovative concepts such as reputation models and proof of driving to improve the reliability and security of the system. The use of beyond fifth-generation (5G) as a communication network also marks an advancement compared to established technologies. Furthermore, the ability to handle multiple transactions and data sharing between vehicle owners and customers in a secure and efficient manner offers a novel approach in the mobility field.

SOURCE

TIM

Sources used in the signal’s detection and description include, but are not limited to:
http://doi.org/10.1109/ITSC.2016.7795984 ; http://doi.org/10.23919/FRUCT.2017.8071359 ; http://doi.org/10.1109/TNSE.2019.2959230 ; http://doi.org/10.1109/VTC2020-Spring48590.2020.9129197 ; http://doi.org/10.1016/j.ins.2020.07.060 ; http://doi.org/10.1109/

NUMBER | TITLE

1234 | AI for smart charging

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

AI for smart charging involves intelligent algorithms designed to efficiently schedule and manage the charging of electric vehicles (EVs) to reduce costs and mitigate strain on the power grid. The technology can adapt to uncertainties such as EV arrival and departure times, and charging demand, learning optimal charging strategies through methods like actor-critic learning. This smart charging can also incorporate real-time and predictive management via Digital Twins, facilitating planning strategies in urban energy systems. Forecasting technologies are also used, predicting charging behaviors to facilitate smart charging strategies. Integration with other systems such as photovoltaic (PV) systems can also enhance the efficiency of EV charging. Furthermore, machine learning models can predict user behavior and parameters like energy consumption and session duration, improving the effectiveness of smart charging scheduling.The novelty of AI for smart charging lies in its ability to adapt to uncertainties and predict future behaviors using sophisticated machine learning algorithms. Traditional charging systems lack this level of adaptability and predictive capability. Moreover, the integration with other systems such as PV and the use of Digital Twins for real-time and predictive management represent significant advancements in the field. The technology also advances beyond simple charging scheduling by optimizing energy management, potentially reducing reliance on external power sources, and extending battery life. Furthermore, the AI for smart charging technology is also capable of handling fault predictions, a feature not commonly found in traditional technologies. Overall, AI for smart charging presents a comprehensive approach that brings substantial improvements in energy efficiency, cost reduction, and grid reliability over established technologies.

SOURCE

TIM

Sources used in the signal’s detection and description include, but are not limited to:
http://doi.org/10.1109/TSG.2018.2808247 ; http://doi.org/10.1016/j.apenergy.2021.118139 ; http://doi.org/10.1016/j.energy.2022.123217 ; http://doi.org/10.1109/IRASET52964.2022.9738115 ; http://doi.org/10.1145/3538637.3538850 ; http://doi.org/10.1109/GlobConHT56829.2023.10087780 ; http://doi.org/10.1109/JIOT.2023.3285206 ; http://doi.org/10.1109/MetroLivEnv56897.2023.10164035 ; http://doi.org/10.1016/j.suscom.2023.100943

NUMBER | TITLE

1235 | Fleet Electrification

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Fleet electrification involves replacing vehicles powered by internal combustion engines (ICEs) with electric vehicles (EVs) in an effort to reduce greenhouse gas emissions and achieve sustainability goals. It is a critical component of the broader mobility sector's transition towards more environmentally friendly practices. Fleet electrification encompasses plug-in hybrid electric vehicles (PHEVs), battery-powered electric vehicles (BEVs), and fuel cell electric vehicles (FCEVs). Its application spans public transport systems, private companies, and individual car owners. Notably, electrification is being used to transition city bus fleets from diesel to electric power. The total cost of ownership (TCO) is a key criterion in the decision-making process, taking into account factors such as fuel prices, technology costs, mileage requirements, efficiency improvements, depreciation, and maintenance costs. Fleet electrification also involves strategic decisions about charging infrastructure and operational planning, including vehicle and crew scheduling for public transport systems.The novelty of fleet electrification lies in its potential to significantly reduce CO2 emissions and shift the transport sector towards more sustainable practices. Compared to traditional ICE vehicles, EVs offer improved energy efficiency and lower emissions. Moreover, the technology and infrastructure for EVs are rapidly advancing, making them increasingly cost-competitive. For instance, improvements in battery technology are reducing the TCO for BEVs. However, the pace and extent of fleet electrification vary depending on local conditions and policies. It's also noteworthy that fleet electrification creates new challenges, such as the need for charging infrastructure and the management of used EV batteries. The latter has led to innovative solutions like the reuse of second-life car batteries for energy storage. Furthermore, the transition to EVs has implications for power generation, potentially increasing the demand for low-carbon electricity. Therefore, fleet electrification should be considered as part of a broader strategy for energy transition and decarbonisation.

SOURCE

TIM

Sources used in the signal’s detection and description include, but are not limited to:
http://doi.org/10.1038/s41893-019-0398-8 ; http://doi.org/10.1016/j.trc.2019.10.012 ;
http://doi.org/10.1016/j.enpol.2019.111224 ; http://doi.org/10.4271/2022-37-0030 ;
http://doi.org/10.23919/SpliTech55088.2022.9854223 ; http://doi.org/10.1016/j.trd.2022

NUMBER | TITLE

1236 | Vehicular edge computing

SUGGESTED MATURITY

n/a

SUMMARY DESCRIPTION

Vehicular Edge Computing (VEC) is a technology that integrates mobile edge computing with vehicular networks to enhance data processing and sharing capabilities. It utilizes powerful computing and storage resources to manage the increasing volume and types of data generated by vehicular services. VEC employs technologies like consortium blockchain and smart contract for secure data storage and sharing, and a reputation-based data sharing scheme to ensure high-quality data sharing among vehicles. It also uses physical layer security techniques and spectrum sharing architectures to secure the offloading process and improve system delay performance. Moreover, VEC leverages idle resources from smart vehicles and servers deployed in proximity to minimize task execution time and prevent system overload. The technology also addresses challenges caused by high vehicle mobility, such as intermittent connectivity, by exploiting multi-hop vehicle computation resources based on mobility analysis.The novelty of VEC lies in its ability to provide powerful computing and massive storage resources for vehicular services in the face of limited resources with vehicles. Unlike traditional technologies, VEC can handle high volume and diverse data types through a secure, efficient data sharing system. It offers a unique solution to system delay issues by jointly optimizing transmit power, frequency spectrum selection, and computation resource allocation. It also introduces an innovative task offloading strategy that collaborates both edges and cloud resources to minimize total time surpassing the quality baseline of each task. Additionally, VEC is equipped to deal with the high mobility of vehicles that can disrupt ongoing task processing by using a task offloading scheme based on mobility analysis. VEC's unique combination of different technologies and strategies to address the challenges of vehicular services makes it a novel technology in the field of mobility.

SOURCE

TIM

Sources used in the signal’s detection and description include, but are not limited to: http://doi.org/10.1109/ICC.2017.7997360 ; http://doi.org/10.1109/JIOT.2018.2875542 ; http://doi.org/10.1109/TITS.2022.3142566 ; http://doi.org/10.1109/TITS.2022.3210405 ; http://doi.org/10.1109/JSTSP.2022.3221271 ; http://doi.org/10.1109/TMC.2022.3225239

NUMBER | TITLE

1237 | Shared autonomous electric vehicle

SUGGESTED MATURITY

n/a

SUMMARY DESCRIPTION

Shared Autonomous Electric Vehicles (SAEVs) are self-driving, electrically-powered cars that can be shared among users. They operate within an autonomous mobility-on-demand (AMoD) system, where the vehicles are coordinated to offer optimal service across a network. The technology uses queueing-theoretical methods for modeling, analysis, and control, and leverages an optimal rebalancing algorithm to ensure vehicle availability and minimize congestion. The system can also incorporate solar energy components for additional sustainability. Real-time vehicle scheduling and routing is handled by a model predictive control (MPC) algorithm, taking into account various constraints such as electric vehicle charging requirements. SAEVs can also operate jointly with public transit systems, thereby maximizing social welfare. The novelty of SAEVs lies in the integration of several advanced technologies: autonomous driving, electric powertrains, and shared mobility services. Unlike traditional taxis or car rental services, SAEVs do not require a human driver and can be rebalanced autonomously to meet demand. The use of electric powertrains and potential integration of solar energy set them apart from conventional internal combustion engine vehicles. Furthermore, the use of a model predictive control algorithm for real-time vehicle scheduling and routing is a significant advancement over traditional routing methods. The technology also allows for the joint operation with public transit systems, a feature absent in current autonomous vehicle applications. Finally, SAEVs address some of the limitations of non-autonomous electric vehicles, such as range anxiety and access to charging infrastructure.

SOURCE

TIM

Sources used in the signal’s detection and description include, but are not limited to: http://doi.org/10.1177/0278364915581863 ; http://doi.org/10.1109/ICRA.2016.7487272 ; http://doi.org/10.1016/j.tra.2016.08.020 ; http://doi.org/10.1109/ITSC.2018.8569381 ; http://doi.org/10.1016/B978-0-12-817696-2.00001-9 ; http://doi.org/10.1109/TMC.2022.

NUMBER | TITLE

1239 | First-mile/last-mile solution

SUGGESTED MATURITY

n/a

SUMMARY DESCRIPTION

First-mile/last-mile (FM/LM) solutions in mobility address the challenge of connecting individuals to main public transport networks, especially for the initial and final stretches of their journeys. Emerging mobility services, such as shared autonomous vehicles, e-scooters, ride-hailing services, and tech-enhanced bike-sharing systems, have been proposed to solve this problem. They aim to provide accessibility, flexibility, and efficiency while reducing costs to the environment. These solutions can also be tailored to cater to various demographic groups, including the elderly and people with disabilities. Furthermore, they have the potential to enhance public transit ridership by bridging the gap between transit stops and individuals' origins or destinations, thereby improving the overall effectiveness of public transport systems.The novelty of FM/LM solutions lies in their ability to leverage advanced technologies and innovative business models to tackle long-standing issues in public transportation. Unlike traditional transit modes, these solutions provide on-demand, flexible, and potentially more efficient services. However, these new technologies are not without challenges. For example, ride-hailing services might increase vehicle miles traveled, and e-scooters may not necessarily be perceived as the preferred solution for FM/LM problems. Battery range limitations and travel speed constraints are also hurdles for the deployment of shared autonomous vehicles. Moreover, these solutions may inadvertently encourage patrons to switch from more sustainable modes such as public transportation, walking, or biking. Therefore, strategic deployment and intelligent management are crucial for these technologies to truly contribute to sustainable urban mobility.

SOURCE

TIM

Sources used in the signal's detection and description include, but are not limited to:
http://doi.org/10.1016/j.ijtst.2017.05.004 ; http://doi.org/10.1016/j.jue.2018.09.003 ;
http://doi.org/10.1016/j.scs.2020.102624 ; http://doi.org/10.1016/j.tranpol.2020.12.015 ;
http://doi.org/10.3390/su13137084 ; http://doi.org/10.1016/j.tra.2021.11.007

NUMBER | TITLE

1241 | Hydrogen wankel engine

SUGGESTED MATURITY

n/a

SUMMARY DESCRIPTION

Hydrogen Wankel rotary engines (HWREs) are a promising technology in the field of mobility. They work by employing hydrogen as a fuel source, which is combusted within a uniquely designed rotary engine, the Wankel engine. Compared to traditional reciprocating piston engines, HWREs are able to achieve higher power per displacement, making them an efficient alternative. They also have a potential for zero-carbon emissions, aligning with the global push towards carbon neutrality. However, they face challenges in terms of lower brake thermal efficiency and significant nitric oxide emissions. The latter issue can be mitigated through various methods such as direct water injection or cooled exhaust gas recirculation. Machine learning and genetic algorithms have also been used to optimize intake and exhaust phases to improve performance and reduce emissions. The novelty of HWREs lies in their superior power density and unique rotary design, which distinguishes them from traditional piston engines. Their use of hydrogen as a fuel source aligns them with emerging trends in sustainable energy. However, they present new challenges, such as managing abnormal combustion and nitric oxide emissions. Innovative solutions, such as machine learning optimization, direct water injection, and the use of cooled exhaust gas recirculation, are contributing to the development and optimization of this technology. It's worth noting that the use of hydrogen in Wankel engines is a fairly recent development and is still subject to ongoing research and refinement. This suggests that while the technology has a promising future, there is still much to learn and many improvements to be made.

SOURCE

TIM

Sources used in the signal's detection and description include, but are not limited to:
http://doi.org/10.1016/j.fuel.2021.122005 ; http://doi.org/10.1016/j.fuel.2021.122371 ;
http://doi.org/10.1016/j.fuel.2022.123675 ; http://doi.org/10.1016/j.fuel.2022.123662 ;
http://doi.org/10.1016/j.energy.2022.123828 ; http://doi.org/10.1016/j.energy.2

NUMBER | TITLE

1242 | Mobility as a service - blockchain

SUGGESTED MATURITY

n/a

SUMMARY DESCRIPTION

The technology, Mobility as a Service (MaaS) - Blockchain, represents a decentralized approach to managing transportation systems. Leveraging blockchain's distributed ledger technology, this system eliminates the need for a central MaaS operator, thereby fostering trust, transparency, and efficiency among stakeholders. It operates by distributing computing power and resources across different transportation providers, thereby decentralizing trust. The blockchain-based MaaS platform uses crypto-tickets as a means of service ownership, with smart contracts enabling customers to exchange service ownership in a privacy-preserved manner. This technology has been applied to various sectors, including supply chain management, transit tariff unions, and healthcare, among others.The novelty of this technology lies in its decentralization, transparency, and application of smart contracts. Traditional MaaS systems rely on a central operator to manage connections between transportation providers and passengers. However, the blockchain-based MaaS eliminates this need, distributing power and resources across the network instead. This approach fosters trust and transparency among stakeholders, as all transactions are recorded on the blockchain, which is immutable and tamper-resistant. The use of smart contracts further enhances this system, as they automate the execution of agreements when certain conditions are met, thereby reducing the need for intermediaries. Also, the system's ability to personalize service ownership represents a significant shift from traditional membership plans. Thus, the MaaS - Blockchain technology presents a novel solution to managing complex mobility ecosystems in a more efficient, reliable, and transparent manner.

SOURCE

TIM

Sources used in the signal's detection and description include, but are not limited to:
http://doi.org/10.1109/ICCCN.2019.8847027 ; http://doi.org/10.1145/3358695.3361844 ;
http://doi.org/10.1016/bs.adcom.2020.08.022 ; http://doi.org/10.1016/j.comcom.2020.10.007 ;
http://doi.org/10.1080/19427867.2021.2018556 ; http://doi.org/10.1016/j.jpdc.2

NUMBER | TITLE

1243 | Inclusive mobility

SUGGESTED MATURITY

n/a

SUMMARY DESCRIPTION

Inclusive mobility is an emerging technology in the field of mobility and transport, aiming to promote accessible and sustainable transportation for all individuals, including those with physical or visual impairments. It leverages advancements in technology such as the Internet of Things (IoT), Artificial Intelligence (AI), Blockchain and Big Data to optimize traffic flow, logistics, and route planning while reducing ecological footprints. This technology also addresses the need for travel information and orientation in unfamiliar environments, particularly crucial for visually impaired and mobility-impaired individuals. Inclusive mobility is a key component in the transition of cities into smart cities, where services such as Mobility-as-a-Service and autonomous vehicles become standard.The novelty of inclusive mobility lies in its focus on ensuring transportation accessibility for all, including persons with reduced mobility (PRM). Traditional transportation systems often overlook the needs of PRM, creating barriers to their mobility. In contrast, inclusive mobility uses technology to bridge these gaps. For example, it employs AI and data technologies to optimize routes and reduce traffic congestion, making travel more efficient for everyone, including PRM. It also considers the specific needs of PRM, such as providing reliable travel information and orientation aids for visually impaired individuals. Moreover, the technology also brings an ethical dimension to the design and evaluation processes, acknowledging experiences of individual users to enhance the system inclusivity. While inclusive mobility aligns with the broader trend towards smart cities, its emphasis on accessibility for all sets it apart from traditional mobility technologies.

SOURCE

TIM

Sources used in the signal's detection and description include, but are not limited to:
http://doi.org/10.18543/ced-56-2017pp79-104 ; http://doi.org/10.1016/j.tra.2020.08.003 ;
http://doi.org/10.1145/3373625.3417022 ; http://doi.org/10.1007/s11948-021-00284-y ;
http://doi.org/10.3390/s21062143 ; http://doi.org/10.1007/978-3-030-68824-0_67 ;

NUMBER | TITLE

1244 | Sustainable smart city

SUGGESTED MATURITY

n/a

SUMMARY DESCRIPTION

Sustainable smart cities are an application of Internet of Things (IoT) technologies aimed at addressing the challenges of urbanization and population growth. These cities integrate information communication technology (ICT) into city operations to intelligently support functions with minimal human interaction. They encompass various components such as smart economy, smart governance, smart living, smart people, smart environment, and smart mobility. Features include smart streets, parking, pedestrian management, transportation services, traffic management, navigation systems, and e-ticketing. The goal is to make cities more efficient, environmentally friendly, and improve the quality of life for citizens. Green IoT applications are essential in smart cities to reduce pollution, manage resources and energy consumption, and provide public safety.The novelty of sustainable smart cities lies in their integrated approach to urban management, leveraging IoT technologies, wireless communication, and big data. They differ from traditional cities by using an information map allowing edge computing servers to store service information, improving service response time and energy consumption. Another innovative aspect is the use of Cyber-physical systems to extract information from the physical world for processing in the cyber-world. Furthermore, the inclusion of green IoT technologies for sustainable development and eco-friendly environments distinguishes them from established technologies. However, their development and mainstream adoption face barriers related to technology, economics, and governance.

SOURCE

TIM

Sources used in the signal's detection and description include, but are not limited to:
http://doi.org/10.7873/date.2013.240 ; http://doi.org/10.1016/j.cities.2016.09.009 ;
http://doi.org/10.1016/j.scs.2018.01.053 ; http://doi.org/10.1007/s11036-021-01790-w ;
http://doi.org/10.1016/j.giq.2021.101626 ; http://doi.org/10.1109/ICSSIT53264.2022.

NUMBER | TITLE

1245 | e scooter sharing

SUGGESTED MATURITY

n/a

SUMMARY DESCRIPTION

E-scooter sharing is a modern form of urban mobility where users can rent electric scooters through a smartphone application, typically for short, first/last mile trips. The technology is eco-friendly, widely accessible, and has been rapidly adopted in cities worldwide. E-scooter sharing services often use relocation strategies to maintain service quality by ensuring scooters are appropriately distributed within service areas. The technology also presents new challenges such as predicting demand in high spatial resolution and simulating e-scooter trips in agent-based models (ABMs). These challenges can be met through the development of new extensions or hybrid simulation models. The novelty of e-scooter sharing lies in its transformative impact on urban mobility and its potential for environmental sustainability. Compared to traditional shared mobility modes, e-scooter sharing offers flexibility, convenience, and reduced carbon emissions. It also presents unique challenges in terms of demand forecasting, relocation strategies, and the dual behavior of e-scooter riders as both pedestrians and vehicles. The use of technology like convolutional autoencoder and encoder–recurrent neural network–decoder (ERD) framework for predicting spatiotemporal events and modeling e-scooter usage is a novel approach. Additionally, the integration of e-scooter sharing into existing transport simulations for effective transport planning is a new area of research and application.

SOURCE

TIM

Sources used in the signal's detection and description include, but are not limited to:
http://doi.org/10.1080/01441647.2021.2015639 ; http://doi.org/10.1016/j.trpro.2022.02.057 ;
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http://doi.org/10.1108/978-1-83982-650-420201010 ; http://doi.org/10.

NUMBER | TITLE

1246 | Advanced air mobility

SUGGESTED MATURITY

n/a

SUMMARY DESCRIPTION

Advanced Air Mobility (AAM) is a developing technology that seeks to revolutionize the field of mobility by facilitating efficient, safe, and sustainable air transportation. It leverages hybrid-electric powertrains to power unmanned aerial vehicles (UAVs) for diverse applications, including emergency management, cargo delivery, and passenger mobility in urban and rural areas. AAM operates in specially designed urban airspace, employing machine learning and computational fluid dynamics to improve powertrain performance. Furthermore, it utilizes an Energy-Assisted Compression Ignition (EACI) approach, offering better ignition control with various jet fuels. In addition, AAM incorporates automation and artificial intelligence to increase scalability and accessibility of the services, while also meeting safety standards. The novelty of AAM lies in its ability to overcome the limitations of traditional air transportation and ground mobility. Unlike conventional UAV powertrains that use single fuel types, AAM allows for fuel flexibility, optimizing for sustainable aviation fuels with varying ignition qualities. Its use of machine learning-based optimization and AI for safety assurance marks a departure from conventional aviation practices. Moreover, AAM introduces the concept of urban air mobility, incorporating urban planning considerations into the design and management of airspace. This includes addressing zoning, air rights, and infrastructure needs, aspects often overlooked in traditional aviation. AAM also promises to democratize air travel, offering on-demand aviation services to the wider public, a significant shift from the exclusivity of traditional air travel.

SOURCE

TIM
Sources used in the signal’s detection and description include, but are not limited to:
http://doi.org/10.1109/TITS.2021.3082767 ; http://doi.org/10.1016/j.paerosci.2021.100726 ;
http://doi.org/10.2514/6.2022-1132 ; http://doi.org/10.1016/B978-0-08-102671-7.10764-X ;
http://doi.org/10.2514/6.2022-3036 ; http://doi.org/10.1109/ESARS-ITEC57127

NUMBER | TITLE

1247 | Dockless bike sharing

SUGGESTED MATURITY

n/a

SUMMARY DESCRIPTION

Dockless bike sharing is a novel mode of shared micro-mobility, offering an environment-friendly alternative for short commutes. Aided by GPS and smart lock technology, these bikes can be rented and parked anywhere, providing high flexibility to users. The technology, however, poses a significant challenge in terms of rebalancing the distribution of bikes, given the high similarity of user travel patterns. To mitigate this, advanced algorithms and deep learning frameworks are being employed to incentivize users and enhance service quality. Further, the integration of convolutional and recurrent neural networks has improved the accuracy of travel demand forecasts, thus facilitating efficient dispatch and relocation of bikes. The service can also serve as a feeder mode connecting to public transport, making it a crucial part of an integrated urban mobility system.The novelty of dockless bike sharing lies in its dockless nature, which is a significant shift from traditional docked bike sharing. This feature has revolutionized the bike-sharing market by eliminating the need for fixed docking stations and providing users with greater freedom and convenience. The use of big data and advanced algorithms to manage bike distribution and predict travel demand is another innovative aspect, enhancing the efficiency and user satisfaction of the service. Moreover, the integration of this technology with public transport systems exemplifies a new approach towards sustainable urban mobility. Nevertheless, its full potential depends on how effectively the challenges posed by this technology, such as bike imbalance and user behavior, are addressed.

SOURCE

TIM
Sources used in the signal’s detection and description include, but are not limited to:
http://doi.org/10.1080/15568318.2018.1429696 ; http://doi.org/10.1109/MDM.2019.00-59 ;
http://doi.org/10.1016/j.resconrec.2019.104513 ; http://doi.org/10.1016/j.trc.2022.103984 ;
http://doi.org/10.1016/j.scs.2022.104348 ; http://doi.org/10.1016/j.tranpol.

NUMBER | TITLE

1248 | Cellular connected UAV

SUGGESTED MATURITY

n/a

SUMMARY DESCRIPTION

Cellular connected Unmanned Aerial Vehicles (UAVs) or drones integrate into wireless networks as aerial base stations or mobile terminals, enhancing coverage, capacity, reliability, and energy efficiency. These UAVs can provide real-time video streaming, item delivery, and various other applications. They can also be used for mobile edge computing, where they offload computation tasks to ground base stations (GBSs) while in-flight. Their high mobility in 3D space and line-of-sight (LoS) channels present new challenges and opportunities in communication quality-of-service, aerial-terrestrial network interference, and energy efficiency. Furthermore, cellular-connected UAVs can also be used for interference-aware path planning, reducing wireless latency, and minimizing interference on the ground network.The novelty of cellular-connected UAVs lies in the integration of drones into cellular networks as aerial base stations or mobile terminals, a significant departure from traditional terrestrial communications. Their high mobility and LoS channels, which make more base stations visible to a UAV compared to ground users, introduce new challenges but also opportunities for maximizing macro-diversity gain. The technology also introduces the concept of UAVs offloading computation tasks to GBSs, a novel application of mobile edge computing. Additionally, the application of deep reinforcement learning algorithms for interference-aware path planning presents a unique approach to optimizing UAV trajectories for maximum energy efficiency and minimum latency and interference.

SOURCE

TIM
Sources used in the signal’s detection and description include, but are not limited to:
http://doi.org/10.1109/ICC.2018.8422706 ; http://doi.org/10.1109/SPAWC.2018.8445936 ; http://doi.org/10.1109/MWC.2018.1800023 ; http://doi.org/10.1109/TCOMM.2018.2880468 ; http://doi.org/10.1109/TWC.2019.2900035 ; http://doi.org/10.1109/COMST.2019.2902862

NUMBER | TITLE

1249 | Crowd shipping

SUGGESTED MATURITY

n/a

SUMMARY DESCRIPTION

Crowd shipping is a novel transportation approach that leverages the existing mobility of individuals, often called 'occasional drivers, ' to deliver goods. These drivers use their own vehicles and are compensated for their services, particularly if the delivery location aligns with their intended destination. This technique is becoming increasingly relevant in urban environments due to the rise of e-commerce and the need for efficient, cost-effective, and sustainable delivery systems. Crowd shipping can potentially reduce delivery costs, vehicle kilometers traveled, and associated emissions, offering a sustainable way of moving goods in urban areas. However, it also raises new challenges, such as the need for intelligent systems to match delivery demand with the availability and willingness of occasional drivers.Compared to traditional logistics and delivery models, crowd shipping introduces several novel aspects. Firstly, it utilizes the existing mobility of individuals for freight delivery, rather than relying solely on dedicated delivery vehicles. This not only has the potential to reduce costs but also environmental impact. Secondly, the flexibility of crowd shipping allows for the delivery process to adapt to the varying availability and willingness of occasional drivers, which can be influenced by factors such as the compensation offered. This introduces a new element of variability and uncertainty that traditional models do not account for. Finally, the integration of crowd shipping into urban transport systems requires innovative technological solutions, including advanced algorithms for efficient routing and matching of deliveries with drivers, and robust systems for managing and tracking these deliveries. These aspects make crowd shipping a complex but potentially highly effective and sustainable solution for urban freight delivery. However, further research is needed to address challenges and optimize its implementation.

SOURCE

TIM
Sources used in the signal’s detection and description include, but are not limited to:
http://doi.org/10.1016/j.trpro.2018.09.011 ; http://doi.org/10.1287/trsc.2016.0675 ; http://doi.org/10.1016/j.ejor.2016.03.049 ; http://doi.org/10.1109/MTITS.2017.8005629 ; http://doi.org/10.1007/978-3-319-67308-0_58 ; http://doi.org/10.1016/j.trpro.2018.

NUMBER | TITLE

1250 | Surrogate safety measures for aut vehicl

SUGGESTED MATURITY

n/a

SUMMARY DESCRIPTION

Surrogate Safety Measures (SSMs) for autonomous vehicles (AVs) are advanced technological systems aiming to enhance vehicle safety by predicting and preventing possible crash events. These systems use high-resolution data from connected vehicles to classify driving styles, ranging from aggressive to calm, and tailor driver assistance systems accordingly. By analyzing millions of Basic Safety Messages (BSMs) generated by connected vehicles, the technology can quantify instantaneous driving behavior and assess risks associated with different driving styles and road types. This technology also employs machine learning and simulation models to optimize traffic safety and mobility, reduce crash risks, and examine the behavioral impact of AVs on traffic flow. It can be applied to various traffic conditions, including work zones, mixed traffic flows, and varied weather conditions, to improve overall traffic safety and efficiency.The novelty of SSMs for AVs mainly lies in its use of big data, machine learning, and advanced simulation models to evaluate and optimize traffic safety in real-time. Compared to traditional safety measures that rely on historical crash data, SSMs provide a more proactive approach by predicting near crashes and adjusting driving behaviors accordingly. The technology also considers the diverse behaviors of human-driven vehicles and AVs in mixed traffic situations, a factor often overlooked in conventional safety measures. Additionally, it introduces new surrogate safety measures, such as the two-dimensional time-to-collision (2D-TTC) and vehicle jerk metrics, to identify safety-critical situations and aggressive drivers, respectively. This comprehensive, predictive, and adaptable approach to vehicle safety is a significant departure from established safety technologies.

SOURCE

TIM
Sources used in the signal’s detection and description include, but are not limited to:
http://doi.org/10.1016/j.aap.2017.04.012 ; http://doi.org/10.1016/j.aap.2017.12.012 ;
http://doi.org/10.1016/j.trc.2020.102917 ; http://doi.org/10.1016/j.aap.2021.106157 ;
http://doi.org/10.1177/03611981211062891 ; http://doi.org/10.1177/03611981211049147

NUMBER | TITLE

1251 | Sustainable last mile delivery

SUGGESTED MATURITY

n/a

SUMMARY DESCRIPTION

Sustainable Last Mile Delivery (SLMD) pertains to the efficient, low-carbon transportation of goods from a transportation hub to the final delivery destination, often in urban environments. This technology encompasses a variety of innovative delivery methods, including the use of cargo-bikes, light electric vehicles, and Unmanned Aerial Vehicles (UAVs), and the establishment of micro hubs for localized distribution. Additionally, SLMD integrates solutions like the Internet of Things (IoT), autonomous vehicles, and blockchain technology for data tracking and security. Moreover, it involves consumer engagement strategies such as using social media to motivate sustainable choices and transparently displaying the environmental and social impacts of delivery options. It also considers the management of electric vehicles (EVs) charging and discharging schedules to optimize energy use and reduce costs.The novelty of SLMD lies in its multi-faceted and integrative approach to addressing the environmental and logistical challenges of last-mile delivery. Traditional delivery methods predominantly rely on fossil fuel-powered vehicles and do not consider consumer engagement in sustainability practices. In contrast, SLMD explores the use of low-emission vehicles and UAVs, and micro hubs to reduce carbon emissions and congestion. It employs data analytics and social media to involve consumers and increase awareness about sustainability. Furthermore, it contemplates the potential of EVs to support the energy grid and the use of blockchain technology for secure, traceable information sharing. Overall, SLMD represents a significant departure from traditional practices, leveraging technological advances and a more holistic approach to transform last-mile delivery into a more sustainable process.

SOURCE

TIM
Sources used in the signal’s detection and description include, but are not limited to:
http://doi.org/10.1108/IJLM-11-2019-0305 ; http://doi.org/10.1016/j.trc.2020.102878 ;
http://doi.org/10.1109/ACCESS.2020.3039010 ; http://doi.org/10.1016/j.scs.2021.102984 ;
http://doi.org/10.1016/j.trc.2021.103285 ; http://doi.org/10.24136/oc.2022.032 ;

NUMBER | TITLE

1252 | 6G V2X

SUGGESTED MATURITY

n/a

SUMMARY DESCRIPTION

6G Vehicle-to-Everything (6G V2X) technology is a groundbreaking application in the field of mobility, which enhances vehicular communication systems to support advanced applications like autonomous vehicles (AVs). Leveraging 6G V2X, vehicles can exchange real-time data with other vehicles and the network, revolutionizing Intelligent Transportation Systems. Key features include ultra-low latency, high-data rate, and high reliability. The technology employs techniques such as Vehicular Edge Computing (VEC), Federated Learning, and efficient Radio Resource Management to optimize resource allocation, data offloading, and reduce latency. It also uses artificial intelligence (AI) and machine learning (ML) tools for anomaly detection, cyber-attack mitigation, and dynamic resource allocation. Moreover, the integration of 6G V2X with other technologies like Unmanned Aerial Vehicles (UAVs) and Reconfigurable Intelligent Surfaces (RIS) can provide 3D and adaptive service coverage, and enhance vehicular communication networks, respectively.Compared to established technologies, 6G V2X introduces several novelties. It brings unprecedented advancements in vehicular communication with ultra-low latency and high-data rates. It uses novel techniques like VEC and Federated Learning for computation offloading, delay reduction, and resource management. The use of AI and ML tools in 6G V2X for anomaly detection and dynamic resource allocation is a significant advancement over existing technologies. The integration of 6G V2X with UAVs and RIS is also a novel approach, providing 3D and adaptive service coverage and enhancing vehicular communication networks. Furthermore, 6G V2X also addresses challenges like traffic congestion, massive connections, and energy shortening in small devices in V2X communications. The application of these new techniques and integrations sets 6G V2X apart from traditional vehicular communication technologies.

SOURCE

TIM
Sources used in the signal's detection and description include, but are not limited to:
http://doi.org/10.1109/JIOT.2023.3294279 ; http://doi.org/10.1109/JIOT.2021.3070744 ;
http://doi.org/10.1109/MCOMSTD.001.2000017 ; http://doi.org/10.1016/j.vehcom.2021.100396 ;
http://doi.org/10.1109/JPROC.2022.3173031 ; http://doi.org/10.1109/TNSE.2022.3

NUMBER | TITLE

1253 | Sustainable mobility as a service

SUGGESTED MATURITY

n/a

SUMMARY DESCRIPTION

Sustainable Mobility as a Service (SMaaS) is a concept that combines various transportation services into a single accessible platform. It is intended to reshape urban mobility by offering a sustainable alternative to private car use. SMaaS integrates different modes of transport, including bike-sharing, public transit, and autonomous vehicles, into one service that can be accessed digitally. Its potential applications include reducing traffic congestion, air pollution, and promoting more efficient use of urban spaces. It also has the potential to contribute to the sustainability goals of reducing carbon emissions and enhancing urban living. SMaaS leverages advanced technologies, such as decision support systems, to design, manage, and monitor transport services. Moreover, it employs innovative modeling techniques to understand and predict passenger behavior, which is crucial for designing effective transportation systems.The novelty of SMaaS lies in its integration of various transportation services into a single platform, providing a seamless and efficient mobility experience for users. Unlike traditional transport systems that operate in silos, SMaaS is user-centric and focuses on meeting the mobility needs of passengers. Additionally, SMaaS uses advanced technologies and modeling techniques to understand and predict passenger behavior, which is a significant departure from conventional transport planning methods. Furthermore, SMaaS is designed with sustainability at its core, aiming to reduce the environmental impact of urban transportation. This is a shift from traditional transport systems that are primarily designed for efficiency and convenience, often at the expense of the environment.

SOURCE

TIM
Sources used in the signal's detection and description include, but are not limited to:
http://doi.org/10.1021/nn507168x ; http://doi.org/10.1016/j.tra.2018.01.019 ;
http://doi.org/10.1016/j.procir.2017.11.129 ; http://doi.org/10.1016/j.trpro.2022.02.075 ;
http://doi.org/10.3390/info13070346 ; http://doi.org/10.3390/info13080355 ; http://doi

NUMBER | TITLE
1256 | 15 minutes city
SUGGESTED MATURITY
n/a
SUMMARY DESCRIPTION
The 15-minute city is a concept in urban planning and mobility that aims to create neighborhoods or urban areas where essential amenities and services are within a 15-minute walk or bike ride from homes. This concept aims to reduce the reliance on long commutes and private vehicles, potentially mitigating traffic congestion, reducing carbon emissions, and improving the livability of cities. It emphasizes the importance of polycentric city structures, increasing local accessibility and walkability. Applications of this model could include urban planning and development, transport policy, environmental sustainability strategies, and responses to public health crises like COVID-19. The 15-minute city can also be a critical tool in developing strategies for urban resilience, as it can contribute to social distancing measures and reduce pressure on public transportation systems.The novelty of the 15-minute city lies in its holistic approach to urban planning, which contrasts with the traditional focus on infrastructure and the "predict and provide" paradigm. While the concept of local, walkable neighborhoods is not new, the application of this model in the context of modern urban environments, digital technology, and sustainable mobility represents a significant shift. The 15-minute city paradigm also utilizes data and mapping technology to assess urban areas' potential and weaknesses, providing a data-driven basis for urban planning and development. Furthermore, this concept is a response to evolving societal and environmental challenges, including public health crises, climate change, and the need for sustainable urban development.
SOURCE
TIM Sources used in the signal’s detection and description include, but are not limited to: http://doi.org/10.1371/journal.pone.0250080 ; http://doi.org/10.1016/j.dibe.2021.100065 ; http://doi.org/10.1016/j.trpro.2021.12.044 ; http://doi.org/10.1016/j.trpro.2021.12.045 ; http://doi.org/10.1016/j.trpro.2021.12.043 ; http://doi.org/10.1016/j.trpro

NUMBER | TITLE
1257 | N octanol
SUGGESTED MATURITY
n/a
SUMMARY DESCRIPTION
n-Octanol is a renewable biofuel and a promising alternative to diesel fuel due to its high cetane number, high energy content, and low hygroscopic nature. It can be obtained from ligno-cellulosic biomass raw materials, making it a sustainable energy source. In the mobility sector, n-Octanol is primarily used in compression ignition (CI) engines. Its physical and chemical properties can be manipulated for optimal combustion by blending it with other biofuels, such as di-n-butylether (DnBE) or biodiesel. This blending can lead to shorter ignition delays, higher peak pressures, and longer combustion durations, thus improving engine performance. Additionally, blending with n-Octanol can help reduce carbon monoxide (CO) emissions and achieve soot-free combustion while increasing nitrogen oxides (NOx) emissions.The novelty of n-Octanol technology lies in its ability to harness renewable energy for CI engines while optimizing combustion and emission control. Unlike traditional fuels, n-Octanol has a higher oxygen content that aids in efficient combustion and reduces soot emissions. Manipulating the blending ratio of n-Octanol with other biofuels like DnBE or biodiesel can optimize CI engine performance, a feature not readily available with conventional fuels. While the application of n-Octanol in CI engines leads to an increase in NOx emissions, this can be balanced by blending it with other fuels. Also, the introduction of n-Octanol results in higher viscosity and latent heat of evaporation, which can influence the combustion and emission performances of CI engines. Overall, n-Octanol represents a sustainable and efficient alternative to traditional fuels in the field of mobility.
SOURCE
TIM Sources used in the signal’s detection and description include, but are not limited to: http://doi.org/10.1016/j.fuel.2018.07.126 ; http://doi.org/10.1016/j.energy.2019.115946 ; http://doi.org/10.1080/15435075.2020.1722132 ; http://doi.org/10.3390/pr9020310 ; http://doi.org/10.1016/j.fuel.2021.121453 ; http://doi.org/10.1016/j.fuel.2021.1221

NUMBER | TITLE

1266 | Advanced Air Mobility for Healthcare

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Several types of drones (operated either by a pilot in the aircraft or on the ground (teleoperated) or autonomously) are appearing to be used for medical use cases. Examples range from blood sample delivery from rural communities to further away hospitals to new types of "helicopters" for emergency patient transports. Vehicle tech ranges from rather standard leisure drones to advanced aircrafts with full certifications yet to be approved. Benefits include faster and better coverage without the need for more physical infrastructure to a faster, cheaper, quieter, and generally more sustainable service for emergency response due to e.g., electric propulsion.

SOURCE

External experts
https://www.weforum.org/publications/medicine-from-the-sky-india-taking-primary-healthcare-to-all/

NUMBER | TITLE

1535 | Dynamic routing and demand-responsive public transportation

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Traditionally, public transportation in many urban centers in Europe still runs on fixed timetables and routes. Internationally, there are increasing signs that major cities and public administrations are testing dynamically routed and demand-responsive public transportation systems (e.g., Detroit, Dubai) in order to enhance efficiency and cost-effectiveness in public transportation. The necessary technologies are already on the market or at least close to the market, but in Europe there is often a lack of important prerequisites (e.g., large-scale trials, insufficient stakeholder cooperation (e.g., for ride-pooling services), insufficient data connectivity,...)

SOURCE

External experts
https://www.linkedin.com/pulse/dynamic-routing-demand-responsive-transit-smart-city

NUMBER | TITLE

1538 | Leveraging and upscaling the potential of Web3 projects for the future of mobility

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

The European Union (EU) recognized the potential of Web3 projects for the future of mobility early on, as shown by initiatives such as Gaia-X. However, the EU should step up and accelerate its efforts to test promising applications (e.g., via incentivizing). Put differently, there is once again a risk that time-to-market will be shorter in competing economies

SOURCE

External experts
https://www.sibb.de/blockchain-transformation-in-mobility-and-logistics-be1a7ab06cd2fe27

NUMBER | TITLE
1549 | Edge AI for CCAM
SUGGESTED MATURITY
Novel (TRL 1-3)
SUMMARY DESCRIPTION
"Edge AI can bring many benefits, in limiting the communication from vehicle to the cloud. Especially for computations that have to be done fast, on-board edge AI can be super powerful. Yet, this type of AI is to be balanced with other solutions, to determine what is the best division of tasks over the vehicle and cloud. This also holds for ""smart infrastructure"". Furthermore, Edge AI can help to limit the energy consumption of computations, while it can boost cyber security (better containment and less sharing of data) and privacy. The benefits and approaches to make Edge AI work for CCAM and broader for mobility are underexplored."
SOURCE
External experts (no link was provided by the expert)

NUMBER | TITLE
1550 | Battery Management for AVs
SUGGESTED MATURITY
Novel (TRL 1-3)
SUMMARY DESCRIPTION
Battery Management can make an huge leap forward when right-of-way scenarios are extended to determine the optimal energy use for a scenario, rather than for a single vehicle, in automated driving. Optimisation parameters are to be explored, and ways to balance right of way, energy use and safety (predictability of scenarios).
SOURCE
External experts (no link was provided by the expert)

NUMBER | TITLE
1551 | Software-defined vehicle
SUGGESTED MATURITY
Emerging (TRL 4-6)
SUMMARY DESCRIPTION
Traditionally hardware-oriented automotive industry is undergoing a digital transformation towards software-defined cars, offering advanced infotainment, over-the-air updates and personalized modifications. SDVs are characterized by rapidly growing number of lines of code and share of software in the total value of the vehicle. Transition to SDVs poses a challenge to the EU automotive sector, which faces strong pressure from its global competitors.
SOURCE
External experts https://www.bcg.com/publications/2023/rewriting-rules-of-software-defined-vehicles

NUMBER | TITLE

1552 | Cobalt reduction in EV batteries

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Reduction of cobalt content is among the main challenges of the current battery research. This rare earth material is an indispensable component of the majority of the lithium-ion batteries currently available on the market. At the same time, its use raises ethical and environmental concerns. New materials and battery chemistries are under investigation that could reduce the amount of cobalt in batteries or possibly eliminate it completely.

SOURCE

External experts
https://news.mit.edu/2024/cobalt-free-batteries-could-power-future-cars-0118

NUMBER | TITLE

1553 | Digital automatic coupling

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Railroad coupling refers to connecting the locomotive and consecutive wagons to form a train. Europe is one of the few remaining world regions where it is still done manually, causing huge inefficiencies. DAC is seen as a game changer for rail industry, representing a direct upgrade to an automated system, able to quickly couple and uncouple wagons. Next to mechanical connection DAC also provides digital connectivity - a key enabler of smart trains.

SOURCE

External experts
https://rail-research.europa.eu/wp-content/uploads/2021/04/DAC-Factsheet_EN.pdf

NUMBER | TITLE

1554 | Virtual coupling

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Reduction of distance between consecutive trains is one of the ways of extending the available rail capacity without costly and time-consuming development of new infrastructure. VC applies the concept of relative braking distance, similar to behaviour of cars on a highway – by merging trains into digitally connected convoys their speed and braking can be coordinated, thereby allowing for shorter headways between virtually coupled trains.

SOURCE

External experts
https://www.railtech.com/innovation/2022/08/02/how-virtual-coupling-can-bring-the-needed-rail-capacity-for-the-future/

NUMBER | TITLE

1555 | U-space

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

The ever increasing number of drones in the skies requires their coordination and safe accommodation into the existing airspace. U-space can be defined as an airspace dedicated specifically for drones, comprising a set of services and procedures for their safe, efficient, and secure large-scale operations. The features include e-registration and tracking, flight planning and authorization, automatic collision avoidance, up to full integration with manned aviation.

SOURCE

External experts
https://www.sesarju.eu/U-space

NUMBER | TITLE

1556 | Hydrogen-powered airplane

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Hydrogen is being intensely revisited by aviation industry, with some of the major players looking at development of a hydrogen-powered commercial airplane by the end of the next decade. Hydrogen offers an attractive alternative to other options that either raise sustainability concerns (SAF), or are limited by low energy density (electric planes). Hydrogen storage on board and hydrogen-based propulsion are currently main unresolved challenges.

SOURCE

External experts
https://www.scientificamerican.com/article/hydrogen-powered-airplanes-face-5-big-challenges/

NUMBER | TITLE

1557 | Wind-assisted propulsion

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Apart from the alternative maritime fuels for the future, other shipping decarbonisation measures are under investigation. WASP aims to harness the most ancient shipping ‘fuel’ – wind. The options range from cylindrical rotors, modern versions of traditional sails, to suction wings and kites. WASP performance highly depends on its design, wind conditions and ship type – in favourable conditions it could theoretically act as the only source of propulsion

SOURCE

External experts
https://www.emsa.europa.eu/publications/reports/item/5078-potential-of-wind-assisted-propulsion-for-shipping.html

NUMBER | TITLE

1558 | Alternative fuel for shipping

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Maritime industry is under heavy pressure to reduce its emissions, and alternative fuels will play a central part in this transition. However, the future fuel mix is under heavy debate. There are several potential fuels on the table, each coming with advantages and shortcomings of its own. The most promising seem to be hydrogen, ammonia, methanol, and biofuels.

SOURCE

External experts
https://www.dnv.com/expert-story/maritime-impact/alternative-fuels/#:~:text=Among%20the%20proposed%20alternative%20fuels,offer%20potential%20for%20ship%20applications.

NUMBER | TITLE

1559 | Digital technologies for transport

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Several emerging digital technologies with potential uses in transport, e.g. AI (air traffic management, algorithms for AVs situational awareness), digital twins (predictive maintenance, quick prototyping in automotive and aerospace), additive manufacturing (prototyping, spare parts production, manufacturing of complex-shaped elements from a single piece of material), blockchain (cargo tracking and smart contracts in logistics), edge computing (critical for CCAM and V2X communication), extended reality (maintenance, safety training), Internet of Things (automation of manufacturing processes, tracking of goods in logistics).

SOURCE

External experts
(no link was provided by the expert)

NUMBER | TITLE

1576 | The collapse of High Speed Rail

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Synthetic aviation fuels that will without any doubt be there in relative low cost in a few decennia on the one hand and electric cars at the other hand will make HSR completely redundant. HSR has huge environmental cost (habitat dames, noise, particulate) and needs heavy subsidies to make relative rich people travel much further than they otherwise will do without any real benefits for society.

SOURCE

External experts
https://www.differ.nl/research/plasma-solar-fuels-devices https://www.youtube.com/watch?v=xMs1yDOf81I

NUMBER | TITLE

1577 | Ethical Goal Functions (Ethics and AI for automated decision making)

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Although ethics is often seen as either a philosophical discussion, a problem that cannot be solved since people will not agree or as a functional safety issue or a DL approach (enough exemplary behaviour will teach the system to be ethical), we firmly know a new approach is needed. We need a human before the loop approach with clear boundaries of the symbolic and symbolic elements, and proper development of Ethical Goal Functions, representing societal values, allowing explications in court and providing enough freedom to industry to keep their own characteristics of their automation. The EGF need to be developed on a European level with 4 stakeholder fields, being citizens (proper moral elicitation methods), researchers/academics to work with citizens and regulators, regulators that do not understand AI and ethics need to know at what level they need to regulate (AI Act is not sufficient, not even after JCT21 is done next year) and industry needs to optimise on predefined criteria and the defined EGF and we need to evaluate this in a project with a socio-techological feedback loop, allowing to learn and change over time. This is what we call Augmented Utilitarianism, allowing to go beyond different specific ethical theories.

SOURCE

External experts
https://dspace.library.uu.nl/bitstream/handle/1874/409275/paper_12.pdf?sequence=1

NUMBER | TITLE

1582 | Smart Composite Containers for Sustainable Mobility and Optimized Supply Chain Operations"

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

In my job I had the opportunity to connect with AELER, a young start up in Switzerland. Aeler has developed what I consider state-of-the-art smart shipping containers made from composite materials, offering excellent durability, increased payload capacity, built-in insulation, advanced security locking mechanisms, and IoT connectivity. The native insulation eliminates the need for additional materials such as polyurethane, while the higher payload capacity reduces the overall number of containers required, leading to lower operational costs and emissions. This innovative solution enhances supply chain efficiency by enabling real-time monitoring of cargo conditions and movements, ultimately reducing CO2 emissions by eliminating the need for energy-intensive refrigerated containers (reefers). AELER's technology is both environmentally sustainable and scalable, positioning it as a key player in the future of sustainable mobility and supply chain transparency.

SOURCE

External experts
https://www.aeler.com/

NUMBER | TITLE

1583 | AI-based Planning technology for goods distribution.

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

In my job I had the opportunity to know this Technology (software) for goods transportation planning that optimizes order allocations across trucks/loads and reduce CO2 emission. Cargoful is the young start up working on it and their technology provides faster & more accurate solutions compared to traditional planning software by automatically fine-tuning optimization parameters blending smoothly Artificial Intelligence with Operational Research.
The algorithm adapts to each specific use case, considering a comprehensive range of factors including daily operational data (e.g., orders, quantities, cut-offs, waiting times, etc.), transportation variables (e.g., location accessibility, working hours, driving time, etc.), and master data (e.g., supplier contracts, internal operational practices). This holistic approach ensures highly tailored and efficient daily planning solutions.
The technology is implemented on top of existing TMS/ERPs.

SOURCE

External experts
https://cargoful.tech/

NUMBER | TITLE

1588 | Urban.Mass - sustainable personalised mobility for global cities

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

Urban.MASS is set to transform mass transit and set new standards of affordability, accessibility and sustainability. It solves the problem that global cities are facing with growing populations that urgently need innovative, environmentally sustainable, affordable mass transit solutions to remain connected and attractive places. Operating above ground level it can avoid the current congested road network making journeys safe and speedy. Several design elements make it rapid to deploy and significantly less expensive to build and operate compared to existing tram and light rail systems.

SOURCE

External experts
https://www.urbanmass.co.uk/

NUMBER | TITLE

1589 | 40seater hybrid-hydrogen eVTOL with 4.5ton cargo capacity

SUGGESTED MATURITY

Emerging (TRL 4-6)

SUMMARY DESCRIPTION

LYTE Aviation is pioneering a 40-seater hybrid-hydrogen eVTOL in the AAM industry and disrupting point-to-point passenger mass (SkyBus) and cargo (4.5 tons) (SkyTruck) transit, without requiring a runway! And that for the price of 39$/seat, at 300km/h speed and a 1.000km range!

SOURCE

External experts
https://lyteaviation.com/

NUMBER | TITLE

1596 | Autonomous e-scooters could ride themselves back to charging points

SUGGESTED MATURITY

Close to market (TRL 7-9)

SUMMARY DESCRIPTION

Rental e-scooters have become a common sight in cities around the world with users able to hire them via a smartphone app and leave them wherever their journey ends. But this tends to mean the hire companies have to go to great efforts to round them up to recharge and redistribute them to places where people usually want to start a ride. Robin Strässer and David Meister at the University of Stuttgart in Germany and their colleagues are working on an autonomous scooter that could remove the need for this. They have already demonstrated a self-balancing version that can be operated remotely, and have now shown that adding ultrasonic sensors allows it to automatically stop when faced with an obstacle.

SOURCE

CCFOR
New Scientist
https://www.newscientist.com/article/2424170-autonomous-e-scooters-could-ride-themselves-back-to-charging-points/?

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