ESREM: Emergent, Sustainable and Resilient Mobility for Smart Regions and Cities

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Roman Henze*, David Inkermann†, Christoph Knieke‡, Lídia Montero§, Andreas Pfadler¶, Andreas Rausch‡
*Technische Universität Braunschweig, Institute of Automotive Engineering, Braunschweig, Germany
Email: r.henze@tu-braunschweig.de
†Technische Universität Braunschweig, Institute for Engineering Design, Braunschweig, Germany
Email: d.inkermann@tu-braunschweig.de
‡Technische Universität Clausthal, Department of Computer Science, Software Systems Engineering, Clausthal-Zellerfeld, Germany
Email: christoph.knieke@tu-clausthal.de, andreas.rausch@tu-clausthal.de
§Universitat Politècnica de Catalunya, Barcelona TECH, Barcelona, Spain
Email: lidia.montero@upc.edu
¶Universitat Politècnica de Catalunya, Signal Theory and Communications Department, Antenna Laboratory, Barcelona, Spain
Email: andreas.pfadler@tsc.upc.edu

***Abstract*—Emergent, Sustainable and Resilient Mobility are the keywords summarizing a mega-trend of our century. Extensive R&D investigations and innovation processes towards future mobility are driven faster than ever before. In combination with the predicted changes in customer demands, there is uprising a crucial paradigm change. The primary business sector of the OEMs is expanded, turning from car manufacturers to providers of sustainable mobility services. In terms of strategic alignment, the leading manufacturers are keeping traditional values, but at the same time they establish their own corporations or open to alliances with strong IT players, who benefit from their extensive know-how in artificial intelligence-based software, data processing and user-oriented services.**

Mobility in smart regions and cities of the future requires innovative concepts and research approaches to address these challenges. These innovative concepts and research approaches are the topic of the special track ESREM at ADAPTIVE 2018. Not only the integration of new sustainable and resilient mobility concepts in existing infrastructures is asked, but new customer orientated business models and services for rising profitability is needed.

Keywords–Intelligent Transportation Systems; Smart Transportation; Autonomous Vehicles; Smart Cities.

I. INTRODUCTION

Mobility is a global issue for the future. Increasing globalization, rising world population, demographic change and growing urbanization are causing traffic levels to rise and are leading to changing mobility needs throughout the world. These developments present technological, ecological, economic and societal challenges.

Sustainable vehicles of the future have to integrate into the urban environment in a compatible way and meet the needs of people and fulfill their individual mobility service requirements. Intelligent automated vehicle systems properly integrated with ICT applications offer new ways of meeting high levels of safety and comfort by applying new environment detection systems and vehicle-to-vehicle and vehicle-to-infrastructure communication. These vehicles also feature new low-emission drive systems with minimized weight and attractively low costs.

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For this special track we focus on the following topics related to mobility in smart regions and cities of the future:

- Open and emergent mobility services and solutions
- Self-organization of decentralized, autonomous vehicles and services
- Individual- and fleet-based predictive mobility optimization
- Internet of things solutions in urban mobility
- Identification of use scenarios for future mobility and related requirement determination
- Sustainable automated and emission free vehicle concepts
- Sustainable urban logistic
- Sustainable infrastructure for future mobility services
- Sustainable digital urban traffic management reconciling societal & individual goals and needs
- Intermodal mobility
- Advanced cooperative intermodal routing information and assistance services
- Resilient connected mobility

- Access-based services (Share Economy)

II. Submissions

The first paper is entitled "Automated and Connected Driving in Urban Scenarios" (Flormann et al.) [1]. The authors give an overview and evaluation of current Car2X communication standards. Flormann et al. discuss the advantages and disadvantages of the wireless technologies and assess the suitability for different use cases.

The second paper, "Highly accurate Map-based Path and Behavior Planning for automated urban Driving", (Reuber et al.) [2] proposes a new approach for a highly accurate map-based path and behavior planning for automated urban driving.

The third paper "Towards cross-domain Release Engineering - Potentials and Challenges for Automotive Industry" (Inkermann et al.) [3] introduces a basis understanding of cross-domain Release Engineering (RE) in the domains of software and mechanical engineering. Furthermore, it aims at pointing out potentials and challenges of cross-domain RE for the automotive industry.

"Improving Thermal Management of Electric Vehicles by High-Precision Prediction of Thermal Disturbance Variables" is the title of the paper presented by Peter Engel [4]. Efficient thermal management is one of the core issues in the conflict area between comfort and range of electric vehicles. At the same time precise thermal management strategies require not only the controller design (e.g., MPC or PI controller) but furthermore robust methods to estimate the external disturbance variables like outside temperature, radiation etc. Beyond the existing climate control approaches for conventional driven cars the paper presents the special requirements of EV control modes and introduces a new approach to a stepwise structured disturbance estimator. The prognosis system uses machine learning algorithms which are trained and evaluated by recorded real field data in conjunction with local weather map information. As a result it is shown that velocity, temperature and radiation can be predicted with high accuracy vs. the time based road profile.

The paper "Long-Term Environment Prediction for Model Predictive Control in Vehicles" (Storm et al.) [5] deals on the prediction of Driver behavior in real traffic environs as a key for adaptive functions, here discussed with view on the example of exhaust control influenced by engine load and speed. After setting a broad overview about predictive control systems, methods for driving style identification and driver state monitoring an own approach is described, that is based on specific pattern recognition. The analyzed data results from repeating real driving measurements on a given road course. The authors compare different methods of prediction algorithms showing that location based pattern recognition is generally capable to deliver an adequate prediction of the long term prediction.

The paper "Vehicle Antenna Footprint Optimization for Efficient MIMO V2X Communications" (Pfadler et al.) [6] focuses on the modeling of MIMO communication systems which are modeled regarding the correlation between channel capacity and interelement spacing. A typical urban scenario (example from Barcelona city), a vehicle material model and model of omnidirectional elements for the base station are integrated in the software simulation. The authors compare the impacts of the interelement spacing as well in V2I as in V2X-MIMO communications. Two main conclusions result from the numerical simulation: the increment of distance generally improves capacity and MIMO systems with higher order require larger interelement distances at the same time.

"Towards Alignment of Processes, Tools, and Products in Automotive Software Systems Development" is the title of the paper presented by Joachim Schramm [7]. The complexity of Automotive Software Systems leads to a substantial need for efficient tools supporting the development process chain. The existing platforms require high expenditure and infrastructure investments in the most cases. In contrast the current paper presents "TOPWATER" as an alternative approach, using a unified metamodel to specify the linkage of processes, standards and tools. After presenting the background and describing the TOPWATER approach from conceptual and technical perspective the practical feasibility is shown based on a pretest, evaluating that the generated files are adequate to support a TÜV-compliant certification process.

The final paper in this session, "Barcelona Virtual Mobility Lab: The multimodal transport simulation testbed for emerging mobility concepts evaluation" (Montero et. al.) [8] describes a Virtual Mobility Lab that enables the evaluation of new mobility concepts by using a multimodal macroscopic simulation model. The use case is to predict real traffic scenarios in the urban environment of Barcelona city. The special emphasis is lying on the network hierarchy taking multimodal network exchange and the change between different private and public transport modes into account. The private transport part represents the urban network geometry by importing geographical maps from HERE (see `https://www.here.com`) and at the same time the available transport systems in the modeled section. In extension the multimodal public transport part generates Origin to Destination matrices which describe the paths and linking of train, underground, bus and tramways.

III. Conclusion

The ESREM special track includes a broad range of topics related to mobility in smart regions and cities of the future. It contains both academic research papers as well as studies from industry introducing interesting ideas for future work in this thriving research domain.

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