ITSC 2023 Special Session Proposal
Co-Design and Coordination of Future Mobility Systems

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1 Modality

Type and duration: **Full day**

Given the importance of the considered topics, we expect this session to attract at least 10 contributions, once formally accepted and advertised on the webpage (we have already received declarations of intents for 7 contributions). We would therefore like to propose the session as a **full day** one.

Date: TBD by conference organizers

Title: Co-design and Coordination of Future Mobility Systems

Note that this special session will complement the second edition of the homonym workshop, which will feature talks from experts on the subject. (To be proposed separately)

2 Scope

2.1 Motivation and relevance to the ITS community

In past decades, cities worldwide have observed a dramatic urbanization. Today, 55% of the world’s population resides in urban areas, and in the next 30 years the proportion is expected to reach 68% [1].

A direct consequence of the population density growth is the increase of urban travel, and of the externalities it produces [2]. In this rapidly expanding setting, cities have to take important decisions to adapt their transportation system to welcome larger travel demands. This is a very complex task for at least three reasons. First, cities need to accommodate the changing travel needs of the population, by predicting them [3], and by ensuring fairness and equity [4]. Second, designed policies not only have to account for the citizens’ satisfaction, but also for their impact on private Mobility Service Providers (MSPs) such as ride-hailing companies, micromobility ($\mu$M), and, in a near future, Autonomous Mobility-on-Demand (AMoD) systems [5]. Indeed, such services gained a considerable share of the transportation market in recent years; e.g., in NYC, ride-hailing companies have increased their daily trips by 1,000% from 2012 to 2019 [6]. While offering more choices to travellers, these systems operate benefiting from public resources (such as roads and public spaces), are profit-oriented, and often lead to potentially disruptive consequences for the efficiency of the transportation system and for society at large [7–9]. In this avenue, cities gain an important, onerous regulatory role. Third, policies have to be designed while meeting global
sustainability goals. It is not surprising that cities are estimated to be responsible for 78\% of the world’s energy consumption and for over 60\% of the global greenhouse emissions (30\% of which is produced by transportation, in US) [10]. Indeed, sustainability is central in policy-making worldwide: NYC plans to increase sustainable trips from 68\% to 80\% [6], and EU plans a 90\% reduction of emissions by 2050 [11].

Taken together, the aforementioned perspectives highlight the complexity of this socio-technical problem, and imperatively call for methods to inform and drive policy makers\(^1\). In this context, developed methods need to inform the co-design of individual mobility solutions and the associated mobility systems, accounting for a range of heterogeneous stakeholders with conflicting objectives (Fig. 1).

![Figure 1: Multiple stakeholders interact in mobility systems in different ways, at different timescales, pursuing heterogeneous objectives.](image)

### 2.2 Objectives

We believe that the problem described in Section 2.1 can be tackled by adopting a system-level perspective and by explicitly considering interactions between mobility stakeholders (both at the planning, and operational level, e.g., via game-theoretic tools) [12–18].

This session will gather experts from diverse engineering disciplines (including transportation, operations research, urban planning, and autonomy) to

- identify challenges and opportunities regarding the aforementioned problems;
- present promising tools to address such challenges;
- inform young researchers about such novel tools;

\(^1\)We treated these topics in [12], which was appreciated in the community during a previous ITSC, and awarded the best paper award.
• find interaction opportunities between diverse research communities to unite forces and
tackle the problems.

2.3 Topics of interest for the special session

General topics of interest listed in the conference focus points include: Advanced Road Transportation Management, Social Transportation, Parallel Transportation Systems, Traffic Theory for ITS, Human Factors in ITS, Intelligent Logistics, Connected and Automated Vehicles, Shared Mobility, Education in ITS, Public Policy, Regulatory, and Societal Issues in ITS, New Trends in ITS.

More specifically, this special session focuses on: Coordination and deployment of (Autonomous) Mobility-on-Demand services, game-theoretic tools for intelligent transportation systems, co-operative autonomy, co-design of mobility networks and services, policy making and incentive design for new mobility technologies.

3 Organizers

Gioele Zardini (primary point of contact): Ph.D. Candidate, Institute for Dynamic Systems and Control, ETH Zürich
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Bio: Gioele Zardini is a Ph.D. Candidate in Emilio Frazzoli’s group at the Institute for Dynamic Systems and Control, ETH Zurich. He received his BSc. and MSc. in Mechanical Engineering with focus in Robotics, Systems and Control from ETH Zurich in 2017 and 2019, respectively. He spent time in Singapore as a researcher at nuTonomy (then Aptiv, now Motional), at Stanford University (working with Marco Pavone) and at MIT (in 2020 working with David Spivak, and currently with Munther Dahleh). Driven by societal challenges, the goal of his research is to develop efficient computational tools and algorithmic approaches to formulate and solve complex, interconnected system design and autonomous decision making problems. His research interests include the co-design of complex systems, compositionality in engineering, applied category theory, planning and control, and game theory, with applications to intelligent transportation systems, autonomy, and complex networks and infrastructures. He is the recipient of a paper award at the 4th Applied Category Theory Conference, and of the Best Paper Award (1st Place) at the 24th IEEE International Conference on Intelligent Transportation Systems (ITSC).

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Bio: Dario Paccagnan is an Assistant Professor at the Department of Computing, Imperial College London since the Fall 2020. Before that, he was a postdoctoral fellow with the Center for Control, Dynamical Systems and Computation, University of California, Santa Barbara. He obtained his PhD from the Automatic Control Laboratory, ETH Zurich, Switzerland, in 2018. He received a B.Sc. and M.Sc. in Aerospace Engineering from the University of Padova, Italy, in 2011 and 2014, and a M.Sc. in Mathematical Modelling and Computation from the Technical University of Denmark in 2014;
all with Honors. Dario's interests are at the interface of game theory and control theory, with a focus on the design of behavior-influencing mechanisms for socio-technical systems. Dario was a finalist for the 2019 EECI best PhD thesis award and was recognized with the SNSF Early Postdoc Mobility Fellowship, the SNSF Doc Mobility Fellowship, and the ETH medal for his doctoral work.

Prof. Maximilian Schiffer, Operations and Technology Department, Technical University of Munich
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Bio: Maximilian Schiffer is a tenured Professor of Business Analytics & Intelligent Systems in the School of Management and a Core Member of the Munich Data Science Institute at the Technical University of Munich. Moreover, Maximilian is an Associate Member of the GERAD. Before joining TU Munich, he was a visiting postdoctoral scholar at Stanford University and a postdoctoral scholar at RWTH Aachen University. He received a Ph.D. degree in Operations Research from RWTH Aachen University in 2017. As a scholar, Maximilian’s expertise lies in the fields of Operations Research, Prescriptive Analytics, Machine Learning, and Data Science applied to a variety of application fields, e.g., transportation problems, supply chains, production networks, and big data. His research currently focuses on electric vehicles, smart city logistics, autonomous systems, interpretable machine learning, as well as innovative applications in supply chain and production management. He is the recipient of several awards, among others the INFORMS TSL Dissertation Prize and the GOR Doctoral Dissertation Prize. His work has been recognized with a best paper awards from the IEEE Conference on Intelligent Transportation Systems and the INFORMS TSL SIG on Facility Logistics, and an Anna Valicek Medal from the AGIFORS. He is currently serving on the Editorial Boards of Transportation Science, OR Spectrum, Transportation Research Part C & Part E, and Business & Information Systems Engineering.
4 Intended audience and expected attendance for the special session

**Intended audience** The interaction among participants is the key ingredient of the proposed session, which already includes very diverse communities. Session participants will be able to continuously interact in person or virtually. We designed the session to be highly interactive and not targeted to participants with a specific background (we expect a diverse mix of junior and senior researchers, from heterogeneous backgrounds). In the case of a virtual edition, participants will be able to join thematic virtual rooms. Interactions will be facilitated through:

- The possibility to ask questions by physical attendees.
- In case of a virtual/hybrid edition, questions will be collected by a moderator over zoom-chat and will be answered at the end of the talk.
- Question spaces at the end of each talk.

**Plan to solicit participation** The organizers have proven experience in organizing workshops at conferences and international seminars. We have become skilled in soliciting participation beyond mailing lists. Usually our advertising strategy includes:

- Direct marketing: inviting research groups directly to send their interested students.
- Facebook, LinkedIn, Twitter, and other social media advertising.

**Expected attendance** Similar events which we organized (both in the robotics and intelligent transportation systems community) are expected to attract 80-100 persons. Virtual editions of our events involved over 150 participants, and were carried out online on Zoom, with interactions happening on GatherTown\(^2\). However, as this edition will be physical (maybe even hybrid), it is hard to estimate the number of participants, as there might be travel restrictions due to the current pandemic and some of our colleagues around the world could experience difficulties in joining in person. Online participation is not the absolute solution, because it suffers from the time zone difference between Europe and the country of residence.

Our strategy is to *maximize* the number of people that can benefit from the session, even though they might not be able to attend in person, or online at the specific time in which it takes place. Because of this, we plan to have an hybrid session, recording, and possibly streaming it.

5 Materials and equipment needed for the special session

For the session we have minimal requirements, including a projector, audio system (microphone and speakers), and some chairs.

6 Contact details of the proposers (email, postal address, etc)

These are provided at the beginning of the document.

\(^2\)https://www.gather.town
References


