ITSC 2022 Workshop Proposal
Co-Design and Coordination of Future Mobility Systems

Gioele Zardini, Nicolas Lanzetti, Andrea Censi, Emilio Frazzoli

Abstract

Increasing urbanization and exacerbation of sustainability goals threaten the operational efficiency of current transportation systems and confront cities with complex choices with huge impact on future generations. At the same time, the rise of private, profit-maximizing Mobility Service Providers leveraging public resources, such as ride-hailing companies, entangles current regulation schemes. This calls for tools to study such complex socio-technical problems. In this workshop, we discuss methods and tools to study the co-design of future mobility systems and the interactions between stakeholders of the mobility ecosystem, modeling regulatory aspects such as taxes and public transport prices, as well as operational matters for Mobility Service Providers such as pricing strategy, fleet sizing, and vehicle design.

Accessible from any background and seniority level, the workshop will provide basic tools to reason about these complex problems. Keynote talks from renowned experts will demonstrate how such tools can be implemented to solve real-world problems, and provide insights for future research avenues.

1 General Information

Type and duration: **Workshop, full day (6 hours + breaks)**

Date: TBD by conference organizers

Title: **Co-design and Coordination of Future Mobility Systems**

URL: https://idsc.ethz.ch/research-frazzoli/workshops/futuremobilitycodesign-itsc22 (in preparation)

2 Organizers

Gioele Zardini (primary point of contact): Ph.D. Candidate, Institute for Dynamic Systems and Control, ETH Zürich
Address: Sonneggstrasse 3, 8092 Zürich, Switzerland;
Phone: +41795737620
E-mail: gzardini@ethz.ch. Website: gioele.science

Nicolas Lanzetti: Ph.D. Candidate, Automatic Control Laboratory, ETH Zürich
Address: Physikstrasse 3, ETL K26, 8092 Zürich, Switzerland.
E-mail: lnicolas@ethz.ch. Website: people.ee.ethz.ch/ lnicolas

Andrea Censi: Senior Researcher, Institute for Dynamic Systems and Control, ETH Zürich.
Address: Sonneggstrasse 3, 8092 Zürich, Switzerland;
E-mail: acensi@ethz.ch. Website: censi.science

Emilio Frazzoli: Professor of Dynamic Systems and Control, ETH Zürich.
Address: Sonneggstrasse 3, 8092 Zürich, Switzerland;
E-mail: efrazzoli@ethz.ch. Website: idsc.ethz.ch/the-institute

Appendix B reports a sample of the workshops previously organized by the organizers.

3 Content

3.1 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 (μM), 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).
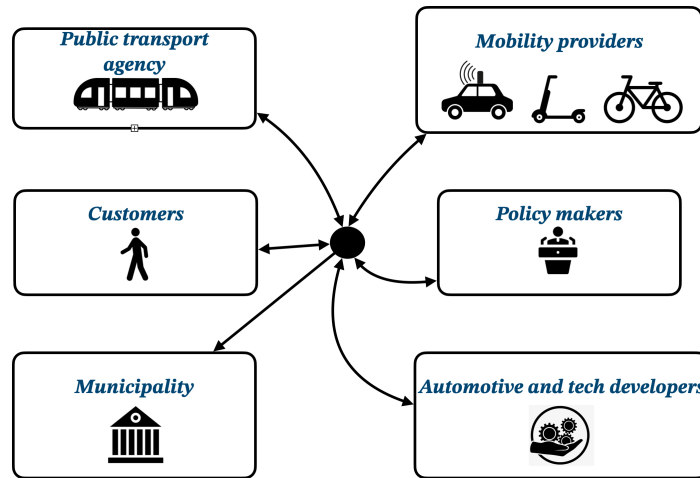

Figure 1: Multiple stakeholders interact in mobility systems in different ways, at different timescales, pursuing heterogeneous objectives.

---

[1]We treated these topics in [12], which was appreciated in the community during last year's ITSC, and awarded the best paper award.

3.2 Objectives

We believe that the problem described in Section 3.1 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 workshop 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;

- find interaction opportunities between diverse research communities to unite forces and tackle the problems.

3.3 Detailed Schedule

The full-day program consists of invited talks, followed by questions and discussions (30 minutes talks and 10 minutes of questions and discussion). The workshop will also be open for submissions, which, upon selection, will receive a slot for an oral presentation or a poster presentation (to be decided depending on the number of submissions). The schedule is reported in Table 1.

Time	Speaker	Title
08:30-08:40	Gioele Zardini	*Welcome and introduction to the workshop*
08:40-09:20	Prof. Dario Paccagnan	*Two birds with one stone: optimal approximation for integral routing and congestion pricing*
09:20-10:00	Prof. Kara Kockelmann	*Using AVs to Replace Buses and Complement Urban Rail Systems*
		Coffee break
10:30-11:10	Prof. Marta Gonzalez	TBD
11:10-11:50	Prof. Marco Pavone	*When efficiency meets equity in mobility management*
		Lunch break
13:30-14:10	Prof. Klaus Bogenberger	TBD
14:10-14:50	Prof. Jinhua Zhao	*Transit-oriented AMoD policy and system design*
14:50-15:30	Prof. Emilio Frazzoli/Gioele Zardini	*Co-design and coordination of future mobility systems*
		Coffee break
16:00-17:00		Final discussion and poster session/selected presentations

Table 1: Schedule for the workshop.

In the following, we report a list of invited speakers, as well as their biographies.

Prof. Kara Kockelman - The University of Texas at Austin (confirmed)   Kara Kockelman is a registered professional engineer and holds a PhD, MS, and BS in civil engineering, a master's in city planning, and a minor in economics from the University of California at Berkeley. She has been a professor of transportation engineering at the University of Texas at Austin for 23 years, and is the recipient of an NSF CAREER Award, Google Research Award, MIT Technology Review Top 100 Innovators Award, Vulog's Top 20 of 2020 Influential Women in Mobility, and various ASCE, NARSC, TRF, and WTS awards. She recently served as

President of the North American Regional Science Association and sits on the Eno Center for Transportation's Advisory Board, as well as 3 TRB Committees. She has authored over 190 journal articles (and two books), and her primary research interests include planning for shared and autonomous vehicle systems, the statistical modeling of urban systems, energy and climate issues, the economic impacts of transport policy, and crash occurrence and consequences. Pre-prints of these articles (and book contents) can be found at caee.utexas.edu/prof/kockelman.

Prof. Dario Paccagnan - Imperial College London (confirmed) 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 between 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. Marco Pavone - Stanford University (confirmed) Prof. Marco Pavone is an Associate Professor of Aeronautics and Astronautics at Stanford University, where he is the Director of the Autonomous Systems Laboratory and Co-Director of the Center for Automotive Research at Stanford. He is currently on a partial leave of absence at NVIDIA serving as Director of Autonomous Vehicle Research. He received a Ph.D. degree in Aeronautics and Astronautics from the Massachusetts Institute of Technology in 2010. His main research interests are in the development of methodologies for the analysis, design, and control of autonomous systems, with an emphasis on self-driving cars, autonomous aerospace vehicles, and future mobility systems. He is a recipient of a number of awards, including a Presidential Early Career Award for Scientists and Engineers from President Barack Obama, an Office of Naval Research Young Investigator Award, a National Science Foundation Early Career (CAREER) Award, a NASA Early Career Faculty Award, and an Early-Career Spotlight Award from the Robotics Science and Systems Foundation. He was identified by the American Society for Engineering Education (ASEE) as one of America's 20 most highly promising investigators under the age of 40.

Prof. Jinhua Zhao - Massachusetts Institute of Technology (confirmed) Prof. Jinhua Zhao integrates behavioral and computational thinking to decarbonize the global mobility system. He shapes sustainable travel behavior and designs multimodal mobility system. He runs the JTL Urban Mobility Lab and Transit Lab at MIT and leads long-term research programs with transportation authorities and operators in London, Chicago, Washington D.C., Singapore and Hong Kong. Prof. Zhao sees transportation as a language to describe a person, characterize a city, and understand an institution, and enables cross-culture learning between cities in North America, Asia and Europe. He is the co-founder and chief scientist for TRAM, a mobility decarbonization venture. He founded and directs the MIT Mobility Initiative.

Prof. Emilio Frazzoli - ETH Zürich (confirmed) Emilio Frazzoli is a Professor of Dynamic Systems and Control at ETH Zurich. Until March 2021, he was Chief Scientist of Motional, the latest embodiment of nuTonomy, the startup he founded with Karl Iagnemma in 2013. He received the Laurea degree in aerospace engineering from the University of Rome, "Sapienza", in 1994, and the Ph.D. degree in Aeronautics and Astronautics from the Massachusetts Institute of Technology in 2001. Before joining ETH Zurich in 2016, he held faculty positions at the University of Illinois, Urbana Champaign, the University of California, Los Angeles, and at the Massachusetts Institute of Technology. His current research interests focus primarily on autonomous vehicles, mobile robotics, and transportation systems. He led the research groups that first

demonstrated an autonomous mobility service to the public, and performed the first analysis of the social and economic impact of such a service, based on real transportation data.

He was the recipient of a NSF CAREER award in 2002, the IEEE George S. Axelby award in 2015, the IEEE Kiyo Tomiyasu award in 2017, and has been named an IEEE Fellow in 2019.

Prof. Klaus Bogenberger - Technical University Munich (to be confirmed) Professor Bogenberger focuses on the theory of traffic flow in urban road networks and on motorways. In particular, new data sources such as vehicle data or drone data are used for mathematical modeling. Traffic simulations based on the resulting models are used to analyze the traffic effects of emerging technologies, such as autonomous vehicles or new control processes. His research is currently focused on the development of innovative traffic control methods that incorporate vehicle data and improve the traffic situation for pedestrians and cyclists. For years he has also been dealing with procedures for analyzing the quality of traffic information. Other research focuses are sharing systems and new forms of local public transport, such as on-demand mobility, robot taxi systems and urban cable cars.

Professor Bogenberger studied civil engineering at the Technical University of Munich from 1991 to 1996, after which he was a research assistant at the Traffic Engineering and Traffic Planning Department at TUM from 1996 to 2001 with Univ.-Prof. Dr./UCB Hartmut Keller. He received his doctorate in 2001 on "Adaptive Fuzzy Systems for Coordinated Traffic Responsive Ramp Metering". From 2001 to 2008 he worked for the BMW Group in Munich, first as a speaker for the BMW Group in the "Science and Transport" area, then in the "Company Quality" area. From 2008 to 2011 he was managing partner of TRANSVER GmbH, before being appointed full professor for Traffic Engineering at the Institute for Spatial Planning and Transportation at the University of the Bundeswehr in Munich in 2012.

Prof. Marta Gonzalez - University of California, Berkeley (to be confirmed) Marta C. Gonzalez is Associate Professor of City and Regional Planning at the University of California, Berkeley, and a Physics Research faculty in the Energy Technology Area (ETA) at the Lawrence Berkeley National Laboratory (Berkeley Lab).

With the support of several companies, cities and foundations, her research team develops computer models to analyze digital traces of information mediated by devices. They process this information to manage the demand in urban infrastructures in relation to energy and mobility. Her recent research uses billions of mobile phone records to understand the appearance of traffic jams and the integration of electric vehicles into the grid, smart meter data records to compare the policy of solar energy adoption and card transactions to identify habits in spending behavior.

Prior to joining Berkeley, Marta worked as an Associate Professor of Civil and Environmental Engineering at MIT, a member of the Operations Research Center and the Center for Advanced Urbanism. She is a member of the scientific council of technology companies such as Gran Data, PTV and the Pecan Street Project consortium.

3.4 Topics of interest

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, Regulartory, and Societal Issues in ITS, New Trends in ITS.

4 Plan to solicit participation

The organizers have proven experience in organizing workshops at conferences and international seminars (see Appendix). We have become skilled in soliciting participation beyond mailinglists. Usually our adver-

tising strategy includes:

- Direct marketing: inviting research groups directly to send their interested students. Together, the organizers and invited speakers have a direct coverage at ETH Zürich, Stanford University, Massachusetts Institute of Technology, Imperial College London, University of Texas at Austin, University of California, Berkeley, and Technical University Munich.
- Facebook, LinkedIn, and other social media advertising.

Estimate of the number of attendants   Similar workshops which we organized in the robotics community (see Appendix) are expected to attract 80-100 persons. Virtual editions of our workshops involved over 250 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 Macau and the country of residence.

Our strategy is to *maximize* the number of people that can benefit from the workshop, 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 workshop, recording, and possibly streaming it.

Additionally, we plan to disseminate the recordings after the workshop.

5   Plan to encourage interaction among participants

The interaction among participants is the key ingredient of the proposed workshop, which already includes very diverse communities. Workshop participants will be able to continuously interact in person or virtually, via GatherTown. We designed the sessions 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), being more similar to guided interactive lectures. In between talks we scheduled 10 extra minutes that shall serve to answer questions and stimulate the conversation among participants. 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 at any time.
- 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.
- The open submission talks shall foster interactions between young researchers presenting work, and more experienced ones.

6   Dissemination

We will compile a "learning packet" that can be used as a study guide and for the benefits of people who might not be able to attend in person or at the specific time.

The learning packet will contain:

- **Recordings of the talks** will be provided after the workshop.
- **Pointers to curated literature**.
- **A summary of highlighted open challenges and tools to solve them**.

All of the above will be available for download on the official website.

---

[2]https://www.gather.town

References

[1] D. o. E. a. S. A. United Nations, "68% of the world population projected to live in urban areas by 2050, says un," UN, Tech. Rep., 2021. [Online]. Available: https://www.un.org/development

[2] M. Czepkiewicz, J. Heinonen, and J. Ottelin, "Why do urbanites travel more than do others? A review of associations between urban form and long-distance leisure travel," *Environmental Research Letters*, vol. 13, no. 7, p. 073001, 2018.

[3] C. Calastri, S. Borghesi, and G. Fagiolo, "How do people choose their commuting mode? An evolutionary approach to travel choices," *Economia politica*, vol. 36, no. 3, pp. 887–912, 2019.

[4] S. Ranchordas, "Smart mobility, transport poverty, and the right to inclusive mobility," *Smart Urban Mobility-Law, Regulation and Policy (Springer, 2020), University of Groningen Faculty of Law Research Paper*, no. 13, 2020.

[5] G. Zardini, N. Lanzetti, M. Pavone, and E. Frazzoli, "Analysis and control of autonomous mobility-on-demand systems," *Annual Review of Control, Robotics, and Autonomous Systems*, 2021.

[6] T. city of New York, "Onenyc 2050 report," NYC, Tech. Rep., 2021. [Online]. Available: http://onenyc.cityofnewyork.us/strategies

[7] T. Berger, C. Chen, and C. B. Frey, "Drivers of disruption? Estimating the uber effect," *European Economic Review*, vol. 110, pp. 197–210, 2018.

[8] B. Rogers, "The social costs of Uber," *U. Chi. L. Rev. Dialogue*, vol. 82, p. 85, 2015.

[9] T. Yigitcanlar, M. Wilson, and M. Kamruzzaman, "Disruptive impacts of automated driving systems on the built environment and land use: An urban planner's perspective," *Journal of Open Innovation: Technology, Market, and Complexity*, vol. 5, no. 2, p. 24, 2019.

[10] U. Nations, "Cities and pollution," UN, Tech. Rep., 2021. [Online]. Available: https://www.un.org/en/climatechange

[11] E. C. for Mobility and Trasport, "Sustaiable and smart mobility strategy," EU, Tech. Rep., 2021. [Online]. Available: https://ec.europa.eu/transport/sites/transport/files/2021-mobility-strategy-and-action-plan.pdf

[12] G. Zardini, N. Lanzetti, L. Guerrini, E. Frazzoli, and F. Dörfler, "Game theory to study interactions between mobility stakeholders," in *2021 IEEE International Intelligent Transportation Systems Conference (ITSC)*, 2021, pp. 2054–2061, best Paper Award (1st place).

[13] G. Zardini, N. Lanzetti, M. Salazar, A. Censi, E. Frazzoli, and M. Pavone, "On the co-design of AV-enabled mobility systems," in *2020 IEEE 23rd International Conference on Intelligent Transportation Systems (ITSC)*, 2020, pp. 1–8.

[14] F. Dandl, R. Engelhardt, M. Hyland, G. Tilg, K. Bogenberger, and H. S. Mahmassani, "Regulating mobility-on-demand services: Tri-level model and bayesian optimization solution approach," *Transportation Research Part C: Emerging Technologies*, vol. 125, p. 103075, 2021.

[15] F. Dandl, K. Bogenberger, and H. S. Mahmassani, "Autonomous mobility-on-demand real-time gaming framework," in *2019 6th International Conference on Models and Technologies for Intelligent Transportation Systems (MT-ITS)*, 2019, pp. 1–10.

[16] B. Mo, Z. Cao, H. Zhang, Y. Shen, and J. Zhao, "Competition between shared autonomous vehicles and public transit: A case study in singapore," *Transportation Research Part C: Emerging Technologies*, vol. 127, p. 103058, 2021. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S0968090X21000863

[17] D. J. Fagnant and K. Kockelman, "Preparing a nation for autonomous vehicles: opportunities, barriers and policy recommendations," *Transportation Research Part A: Policy and Practice*, vol. 77, pp. 167–181, 2015. [Online]. Available: https://www.sciencedirect.com/science/article/pii/S0965856415000804

[18] D. Paccagnan, R. Chandan, B. L. Ferguson, and J. R. Marden, "Optimal taxes in atomic congestion games," 2021.

A Biographies of the organizers

Gioele Zardini   Gioele is a Ph.D. candidate at the Institute for Dynamic Systems and Control at ETH Zurich, under the supervision of Prof. Emilio Frazzoli. He received the B.Sc. and the M.Sc. degrees in mechanical engineering, with focus in Robotics, Systems, and Control from ETH Zurich in 2017 and 2019, respectively. He worked at nuTonomy (then Aptiv AM, now Motional) and was a visiting researcher at Stanford University and Massachusetts Institute of Technology. His current research interests include the co-design of complex systems (all the weay from future mobility to embodied intelligence), compositionality in engineering, planning and control, and game theory. He is the recipient of the Best Paper Award (1st Place) at the 2021 IEEE International Conference on Intelligent Transportation Systems.

Nicolas Lanzetti   Nicolas is a Ph.D. candidate at the Automatic Control Laboratory at ETH Zurich, under the supervision of Prof. Florian Dörfler. He received the B.Sc. and the M.Sc. degrees in mechanical engineering, with focus in Robotics, Systems, and Control from ETH Zurich in 2016 and 2019, respectively. He was a visiting researcher at Massachusetts Institute of Technology and Stanford University. His current research interests include optimal transport and gradient flows in the Wasserstein space, with applications in robust optimization and game theory. He is the recipient of the Willi Studer Prize, the ETH Medal and the SVOR/ASRO award for his Master's thesis, and the Best Paper Award (1st Place) at the 2021 IEEE International Conference on Intelligent Transportation Systems.

Andrea Censi   Andrea is the deputy director of the Dynamic Systems and Control chair at ETH Zurich, director of the Duckietown Foundation, and founder of Zupermind. He obtained a M.Eng. degree in Control and Robotics from the University of Rome, "Sapienza", and a Ph.D. from California Institute of Technology. He has been a research scientist at the Massachusetts Institute of Technology, and the Director of Research at Aptiv Autonomous Mobility (now Motional).

He has been the recipient of NSF and AFRL awards.

Emilio Frazzoli   Emilio is a Professor of Dynamic Systems and Control at ETH Zurich. Until March 2021, he was Chief Scientist of Motional, the latest embodiment of nuTonomy, the startup he founded with Karl Iagnemma in 2013. He received the Laurea degree in aerospace engineering from the University of Rome, "Sapienza", in 1994, and the Ph.D. degree in Aeronautics and Astronautics from the Massachusetts Institute of Technology in 2001. Before joining ETH Zurich in 2016, he held faculty positions at the University of Illinois, Urbana Champaign, the University of California, Los Angeles, and at the Massachusetts Institute of Technology. His current research interests focus primarily on autonomous vehicles, mobile robotics, and transportation systems. He led the research groups that first demonstrated an autonomous mobility service to the public, and performed the first analysis of the social and economic impact of such a service, based on real transportation data.

He was the recipient of a NSF CAREER award in 2002, the IEEE George S. Axelby award in 2015, the IEEE Kiyo Tomiyasu award in 2017, and has been named an IEEE Fellow in 2019.

B Previously organized conferences at workshops

A large portion of the organizers organized the first and second workshop on Compositional Robotics: Mathematics and Tools at **ICRA 2021, ICRA 2022**).
Website: https://idsc.ethz.ch/research-frazzoli/workshops/compositional-robotics.html.

We are also organizing the Autonomy Talks (over 80 seminars in the field of autonomy).

Dr Censi's previously co-organized workshops/competitions:

- Workshop on Evaluating the Broader Impacts of Self-Driving Cars, **IROS 2021**.
  Website: https://montrealrobotics.ca/broader-impacts-self-driving/speakers/
- Tutorial on Game-theoretical Motion Planning, **ICRA 2021**.
  Website: idsc.ethz.ch/research-frazzoli/workshops/game-theoretical-planning-icra21
- Workshop Towards Reproducibility and Objective Performance Evaluation in Robotics and AI, **ICRA 2021**.
  Website: robot.t.u-tokyo.ac.jp/TC_PEBRAS_ICRA2021/index
- Several editions of the AI Driving Olympics (AI-DO), at **NeurIPS 2018**, **ICRA 2019**, **NeurIPS 2019**, **NeurIPS 2020**. An **ICRA 2020** workshop was accepted but was cancelled due to to the COVID-19 epidemics.
  Website: duckietown.org/research/ai-driving-olympics
- Workshop on Benchmarking Progress in Autonomous Driving, **IROS 2020**.
  Website: http://montrealrobotics.ca/driving-benchmarks/
- Workshop on Minimality and Design Automation, **RSS 2016** (together with Prof. Shell and Prof. O'Kane).
  Website: http://minimality.mit.edu/RSS2016/rss2016.html
- Workshop on Minimality and Design Automation, **RSS 2017** (together with Prof. O'Kane).
  Website: http://minimality.mit.edu/
- Workshop on sensorimotor learning, **ICRA 2015**.
  Website: http://sensorimotor-learning.mit.edu/
- Workshop on Task-driven Perceptual Representations: Sensing, Planning and Control under Resource Constraints, **ICRA 2016**.
  Website: http://task-driven-representations.mit.edu
- Workshop on Innovative Sensing for Robotics, **ICRA 2015**. Website: http://innovative-sensing.mit.edu