Brendan Morris, Editor

The 23rd IEEE International Conference on Intelligent Transportation Systems (Virtual)

EDITOR'S NOTE

If you are organizing an intelligent transportation systems-related event in your part of the world and wish to communicate news about your event in *IEEE Intelligent Transportation Systems Magazine*, please contact Brendan Morris, the Intelligent Transportation Systems Society vice president, Conference Activities, University of Nevada, USA, via brendan.morris@unlv.edu.

The IEEE Intelligent Transportation Systems Conference (ITSC) is the annual flagship conference of the IEEE Intelligent Transportation Systems (ITS) Society. This article reports the main scientific and technical outcomes of the 23rd IEEE International Conference on Intelligent Transportation Systems (ITSC2020). The conference achieved its objective: the involvement of international participants in the Cooperative Intelligent Transportation Systems (C-ITS) domain from industry, academia, and authorities, to share their knowledge and experience with respect to recent developments in theory, analysis, simulation, and modeling. In addition to traditional topics such as advanced driver assistance

systems, automated driving, traffic modeling and simulation, data analytics, control algorithms and techniques, multimodal transport, and human factors, ITSC2020 covered some additional topics, such as infrastructure-supported C-ITS and communication technologies for vehicle-to-everything (V2X) applications, which were not adequately addressed at previous Society events.

Organization

The 23rd IEEE ITSC was meant to be held on 20–23 September 2020 in Rhodes, Greece. However, due to COVID-19, the conference had to be organized as an online event instead. ITSC2020 aimed to involve international participants from industry, academia, and authorities to share their knowledge and experience with respect to recent developments in theory, analysis, simulation, and modeling in the ITS domain, as well as recent field operational tests and deployments in this domain. This international conference covered relevant technical topics such as intelligent vehicles; smart mobility; autonomous and cooperative systems; products and services; C-ITS; modeling, control algorithms and techniques; information and communications technology; air, road, rail, waterways transportation network and systems; field

trials, tests and deployment; logistics and supply chain; sensor technologies; big data and naturalistic datasets; traffic control and management; deep learning and artificial intelligence; security, privacy and safety systems; and human factors and behavioral modeling.

A total of 939 initial paper submissions were received, including regular papers, special session papers, and workshop papers. After peer review, 570 papers were accepted. The paper acceptance rate was 60.8%. Despite the pandemic, 98% of the accepted papers were submitted in a final version (in total, 557 qualified final versions were received). The ITSC2020 virtual conference attracted around 700 attendees. Five plenary sessions, 19 workshops, 97 regular sessions, 15 special sessions, and two tutorials were organized. During the conference, 558 presentations were given. Although there were no normal networking opportunities due to the virtual nature of the event (such as the conference reception, gala dinner, and farewell party), ITSC2020 offered various online social events on topics such as yoga, art and architecture in Ancient Greece, and the performance of Greek music (see Figures 1–3). IEEE 2020 President Prof. Toshio Fukuda gave a speech at the closing ceremony of the conference.

Scientific and Technical Outcomes

Keynote Speeches

The ITSC2020 keynote speeches were given by four distinguished speakers, who addressed some current popular topics.

1) *Towards the Deployment of Connected and Cooperative Automated Mobility*, by Dr. Evangelos Bekiaris, director general, Hellenic Institute of Transport (HIT)—Centre for Research and Technology Hellas (CERTH)

Prior to ad hoc adoption of automated mobility at the city and country level across Europe, further research and predeployment activities are anticipated in tackling acceptance, technological, ethical, regulatory, operational, and business challenges that have to be fully addressed. Cities across Europe are progressively participating in initiatives, allowing them to explore their readiness. Connection and cooperativeness of all types of automated vehicles—involved in both passenger and freight mobility—with support of physical and digital infrastructure through a wide and evolving spectrum of technologies (e.g., the Internet of Things, ITS-G5, 4G LTE, 5G), ensuring interoperability and security while responding primarily at the dynamic context of traffic safety and its criticality constitutes the key technological challenge. Full automation (SAE Level-4 and Level-5) through remote operation of fleets and collaboration with traffic management centers and strategy managing systems is already validated in a series of European sites. Artificial intelligence and big data are deployed to provide personalized services to automated vehicles and road users. Dedicated human–machine interfaces for "drivers," passengers, and operators are being studied. Standardized homologation on a European level is key to wide deployment. Joint European efforts are disposed toward broad field predeployment with big fleets in different traffic contexts (urban, rural, motorways under mixed traffic conditions, or dedicated lanes), confronting different traffic scenarios and operating under different speed ranges and environmental conditions adhering to fleet-sharing demand response transport and first–last mile business models and automation as a service. Finally, drivers, operators, and road users need to be prepared and trained, and cities need to recognize those "soft" measures, initiatives, and policies that will best accommodate the smooth and cost-efficient integration of automated mobility in transport systems [1]–[2].

2) *Metrics, Methods and Assumptions: The State of the State of AV Safety Assurance*, by Dr. Jack Weast, senior principal engineer at Intel and vice president of Autonomous Vehicle Standards at Mobileye

This speech provided a front-seat perspective on the state of automated vehicle (AV) safety assurance. Much has happened since ITSC2019, but have we advanced state-of-the-art thinking on what the safety assurance of AVs is all

FIG 1 Alexandra Rossopoulou's yoga session was one of the online social events.
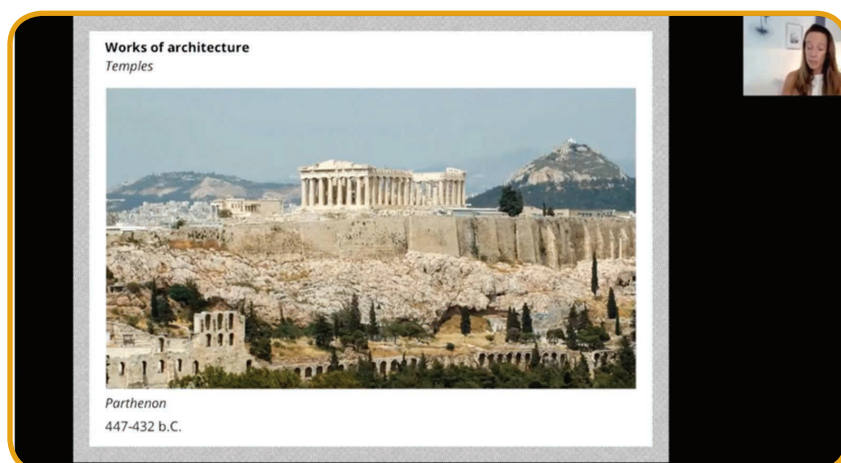

FIG 2 Apostolia Demertzi talking about the Parthenon at of the "Art and Architecture" online social session.

about? In some ways we have, with compelling new metrics and standards providing important clarity on the role of assumptions in the ability for an AV to navigate not only safely but usefully. Yet, in other areas, the industry remains far from aligned on the path forward, and here is where industry and researchers have an opportunity to come together to solve the final challenges of the automated vehicle safety assurance frontier [3]–[5].

3) *The Future of Urban Mobility and City Logistics after COVID-19*, by Dr. Georgia Ayfantopoulou, deputy director and research director, Hellenic Institute of Transport (HIT)—Centre for Research and Technology Hellas (CERTH)

COVID-19 created challenges and opportunities in urban transport and invoked transformations in urban context in relation to mobility and logistics. This speech provided an overview of the impacts of COVID-19 on European urban networks, highlighting best adaptation cases. It summarized what we learned from the lockdown and, on this basis, discussed priorities for research and innovation in order to efficiently meet the requirements of the future operation of the urban mobility and logistics systems and to avoid disruption of real operations [6]–[8].

4) *Hierarchical Large-Scale Control for Heterogeneously Congested Urban Networks*, by Prof. Nikolas Geroliminis, École Polytechnique Fédérale de Lausanne (EPFL)

Human mobility in congested city centers is a complex dynamical system with high density of population; many transport modes compete for limited available space and many operators try to efficiently manage different parts of this system. New emerging modes of transportation such as ride-hailing and on-demand services and new technologies such as autonomous vehicles create additional opportunities but also more complexity. The new era of sharing information and the "big data world" has raised our expectations to make mobility more predictable and controllable through better utilization of existing resources and capacity. The primary motivation of this talk was to study the spatiotemporal relation of congested links in large networks, develop new advancements in the macroscopic fundamental diagram, observe congestion propagation from a macroscopic perspective, identify the effect of multimodal interactions in network capacity, and, finally, design network-level control strategies to improve multimodal mobility. Investigating the clustering problem over time helps us to reveal hidden information during the process of congestion formation and dissolution. In this framework, we will be able to chase where congestion originates and how traffic management systems affect its formation and the time it finishes. Different control strategies are developed based on principles of optimization control theory [9]–[12].

Workshops, Sessions, and Tutorials
The topics of the ITSC2020 workshops were:

■ Deep Reinforcement Learning for Traffic Signal Control
■ Smart Public Transportation Systems
■ Transportation 5.0: Big Data, Super Computing and AI for ITS
■ Network Impacts of Emerging Mobility Trends
■ Advanced Cybersecurity Approaches for Connected, Automated, and Electric Vehicles
■ Use of AIMSUN Next for ITS Applications
■ Collaborative Transportation
■ Collaborative and Federated Deep Learning for Autonomous Driving
■ Traffic Management for Future Mobility—CAVs in a Mixed Traffic Environment
■ Smart Initiatives to Improve Last-Mile and 50 Feet Logistics to Improve Freight Fluidity
■ Testing and Evaluating Connected and Automated Vehicles Using Simulation
■ Probabilistic Prediction and Comprehensible Motion Planning for Automated Vehicles
■ Basic Applications of the SUMO Microscopic Traffic Simulator
■ Automated Vehicle Safety: Verification, Validation, and Transparency
■ Towards Fully-Automated World-Wide Mapping for HAD
■ Cooperative and Automated Driving

FIG 3 Ayali Aman performing Greek music.

- Self-Awareness Advances in Heterogeneous Autonomous Systems
- Automated and Connected Transportation Systems: Modeling, Control, and Deployment
- Application of Multi-Sensor Fusion Technology for Autonomous Driving.

The topics of the special sessions were:

- Decision Making in Autonomous Driving
- Smart Railway—High-Speed
- Modeling, Simulation, and Control for Mass Transit
- Solving the Automated Vehicle Safety Assurance Challenge
- Intelligent Public Transport
- Advanced Network Modeling and Computing Solutions for Electric Mobility Systems
- Beyond Traditional Sensing for Intelligent Transportation
- Control, Communication, and Emerging Technologies in Smart Rail Systems
- Data Driven Optimization and Predictive Modeling for Smart Cities
- Navigation and Localization for Intelligent Transportation Systems
- Next-Generation Traffic Management for Connected, Cooperative, Automated Mobility
- V2X-Based Intelligent Decision Making and Control.

Regular sessions covered a wide range of topics in the ITS domain:

- Advanced Vehicle Safety Systems
- Sensing, Vision, Perception, Monitoring, Detectors, and Actuators
- Automated Vehicle Operation, Motion Planning, Navigation
- Multi-Automated Vehicles Models, Techniques and Simulations
- Driver Assistance Systems
- Cooperative Techniques and Systems
- Communications and Protocols in ITS
- Data Mining and Data Analysis
- Data Management, Geographic Information Systems, and Data Processing Techniques
- Theory, Simulation, and Modeling
- Traffic Control and Management

- Human Factors in Intelligent Transportation Systems
- Travel Behavior Under Intelligent Transportation Systems
- Travel Information, Travel Guidance, and Travel Demand Management
- Commercial Fleet Management
- Public Transportation Management
- Incident Management and Management of Exceptional Events
- ITS Field Tests and Implementation
- ITS Policy, Design, Architecture, Standards, and Security
- Modeling, Simulation, and Control of Pedestrians and Cyclists
- Multi-Modal Intelligent Transportation Systems
- Intelligent Logistics.

Two training seminars were organized:

- AIMSUN Training Seminar on "How to use AIMSUN Next for ITS applications"—It focuses on the use of the AIMSUN Next traffic simulator and on evaluating the application of different traffic

> Artificial intelligence and big data are deployed to provide personalized services to automated vehicles and road users.

management strategies and policies, to provide an insight into the applications and evaluation of ITS.
- SUMO Training Seminar on "Basic applications of the SUMO microscopic traffic simulator"—This is a basic tutorial for beginners and people who want to get an introduction to the workflow of Simulation of Urban MObility (SUMO), and microscopic traffic simulation in general.

The overall impression of the workshops, sessions, and tutorials is that they were good in content and quality. Workshops, especially the ones with a high number of industry participants, received very positive feedback from attendees (see Figures 4 and 5). Special sessions and regular sessions were very well organized. The tutorials were considered very informative and useful for the participants.
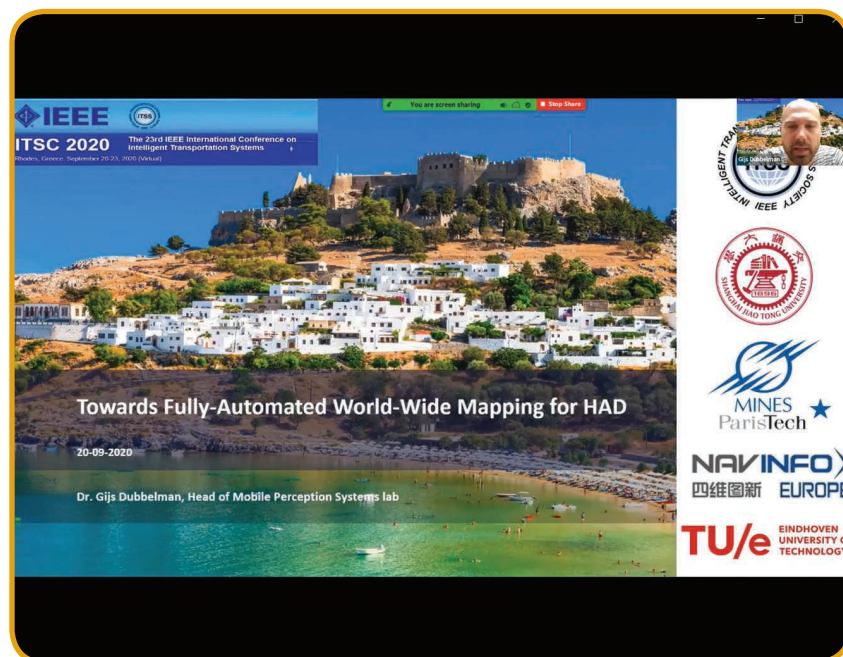

FIG 4 A screenshot of the workshop "Towards Full-Automated World-Wide Mapping for HAD."

In addition to traditional topics covered in the previous ITS Society main conferences, ITSC2020 adequately addressed infrastructure-supported C-ITS and communication technologies for V2X (vehicles to everything) applications, which received a great deal of attention and interest from both industrial and academic participants. Deployment of cooperative systems has been less rapid than of autonomous systems, partly due to the higher level of complexity. In addition, these systems are less well known to the general public. But certainly they are a prelude (and an indispensable component) of an even more advanced technology, which has been rapidly developed in recent years, and is receiving widespread attention, from the general public as well, that of automated driving. Careful selection of eventual technologies and business models will substantially influence the further development toward connected, cooperative, and automated transport, and determine its success [13]–[20].

FIG 5 A screenshot of the workshop "Industry Panel Cooperative and Automated Driving."

FIG 6 The beautiful island of Rhodes, which we hope to visit in person some day.

Conclusion

ITSC2020 provided participants with a unique opportunity to extend knowledge, generate new ideas, and establish or strengthen valuable contacts. As it was the first time that ITSC was held online and because of the differences between a physical event and a virtual event, a huge effort had to be made to guarantee quality. ITSC2020 successfully achieved its objective, that is, to involve international participants from industry, academia, and authorities to share their knowledge and experience with respect to recent developments in theory, analysis, simulation, and modeling in the C-ITS domain. ITSC2020 also made a substantial effort to achieve higher involvement from industry and create a social networking environment. In addition to traditional ITS topics covered in the previous ITS Society main conferences, ITSC2020 especially addressed ICT infrastructure for C-ITS deployment and communication technologies for V2X applications.

Due to COVID-19, ITSC2020 participants could not meet in Rhodes, Greece. Hopefully, we will meet again in person at future ITS activities, and maybe we will once have a chance to visit this beautiful Greek island (see Figure 6).

Meng Lu
Peek Traffic B.V. (Dynniq Group)
meng.lu@dynniq.com

Evangelos Mitsakis
Centre for Research and Technology
Hellas/Hellenic Institute of Transport
emit@certh.gr

References

[1] I. Katsouri, L. Athanasiadis, E. Bekiaris, and M. Tsolaki, "Differences between professional and non-professional drivers with cognitive disorders," *Hellenic J. Nucl. Med.*, vol. 22, pp. 17–31, Jan. 2019.

[2] F. Diederichs et al., "Adaptive transitions for automation in cars, trucks, busses and motorcycles," *IET Intell. Transp. Syst.*, vol. 14, no. 8, pp. 889–899, 2020. doi: 10.1049/iet-its.2018.5342.

[3] J. Wishart et al., "Driving safety performance assessment metrics for ads-equipped vehicles," *SAE Int. J. Adv. Curr. Pract. Mobil.*, vol. 2, no. 5, pp. 2881–2899, 2020. doi: 10.4271/2020-01-1206.

[4] J. Wishart, S. Como, U. Forgione, and J. Weast, "Literature review of verification and validation activities of automated driving systems," *SAE Int. J. Connect. Automat. Veh.*, vol. 3, no. 4, pp. 267–323, 2020. doi: 10.4271/12-03-04-0020.

[5] P. Koopman, B. Osyk, and J. Weast, "Autonomous vehicles meet the physical world: RSS, variability, uncertainty, and proving safety," in *Proc. Int. Conf. Comput. Saf. Reliab. Security*, 2019, pp. 245–253.

[6] A. Nikiforiadis, G. Aifadopoulou, J. M. S. Grau, and N. Boufidis, "Determining the optimal locations for bike-sharing stations: Methodological approach and application in the city of Thessaloniki, Greece," *Transp. Res. Procedia*, vol. 52, pp. 557–564, 2021. doi: 10.1016/j.trpro.2021.01.066.

[7] A. Skoufas, S. Basbas, J. M. S. Grau, and G. Aifadopoulou, "Analysis of in-vehicle warning system for rail-road level crossings: case study in the city of Thessaloniki, Greece," *Periodica Polytechnica Transp. Eng.*, vol. 49, no. 1, pp. 42–59, 2021. doi: 10.3311/PPtr.14892.

[8] G. Aifadopoulou, I. Mallidis, D. Vlachos, J. M. Salanova Grau, and E. Iakovou, "Development of a 'fair' marketplace for on-demand capacity matching," *Transp. Res. Rec.*, vol. 2674, no. 3, pp. 46–56, 2020. doi: 10.1177/0361198120909107.

[9] I. I. Sirmatel and N. Geroliminis, "Stabilization of city-scale road traffic networks via macroscopic fundamental diagram-based model predictive perimeter control," *Control Eng. Pract.*, vol. 109, p. 104,750, Apr. 2021. doi: 10.1016/j.conengprac.2021.104750.

[10] C. V. Beojone and N. Geroliminis, "On the inefficiency of ride-sourcing services towards urban congestion," *Transp. Res. C, Emerg. Technol.*, vol. 124, p. 102,890, Mar. 2021. doi: 10.1016/j.trc.2020.102890.

[11] M. Paipuri, E. Barmpounakis, N. Geroliminis, and L. Leclercq, "Linear regression analysis of regional mean speed of Athens city network using drone data: A multi-modal approach," in *Proc. Transp. Res. Board 100th Annu. Meeting*, Washington D.C. (virtual), 2021.

[12] H. Fu, Y. Wang, X. Tang, N. Zheng, and N. Geroliminis, "Empirical analysis of large-scale multimodal traffic with multi-sensor data," *Transp. Res. C, Emerg. Technol.*, vol. 118, p. 102,725, Sept. 2020. doi: 10.1016/j.trc.2020.102725.

[13] E. Mintsis, E. Vlahogianni, and E. Mitsakis, "Dynamic eco-driving near signalized intersections: A systematic review and future research directions," *J. Transp. Eng. A, Syst.*, vol. 146, no. 4, 2019. doi: 10.1061/JTEPBS.0000318.

[14] E. Mitsakis and I. S. Anapali, "Recent developments on security and privacy of V2V & V2I communications: A literature review," *Periodica Polytechnica Transp. Eng.*, vol. 48, no. 4, 2020. doi: 10.3311/PPtr .14955.

[15] E. Mintsis, E. I. Vlahogianni, E. Mitsakis, and S. Ozkul, "Enhanced speed advice for connected vehicles in the proximity of signalized intersections," *Euro. Transp. Res. Rev.*, vol. 13, no. 2, 2020. doi: 10.1186/s12544-020-00458-y.

[16] M. Lu, Ed. *Cooperative Intelligent Transport Systems: Towards High-Level Automated Driving*. London: Institution of Engineering and Technology, 2019.

[17] M. Lu, R. Blokpoel, and M. Joueiai, "Enhancement of safety and comfort of cyclists at intersections," *IET Intell. Transp. Syst.*, vol. 12, no. 6, pp. 527–532, 2018. doi: 10.1049/iet-its.2017.0250.

[18] M. Lu, J. Ferragut, M. Kutila, and T. Chen. "Next generation of wireless networks for V2X applications," in *Proc. 23rd IEEE Int. Conf. Intell. Transp. Syst. (ITSC)*, Rhodes (virtual), Sept. 2020.

[19] M. Lu, and F. Bouali, "Advanced 5G validation trials across multiple vertical industries: Use cases of Intelligent Transport Systems (ITS) industry," in *Proc. 27th World Congr. Intell. Transp. Syst.*, Los Angeles, to be published.

[20] M. Lu, R. Blokpoel, M. Fünfrocken, and J. Castells, "Open architecture for internet-based C-ITS Services," in *Proc. 21th IEEE Int. Conf. Intell. Transp. Syst. (ITSC)*, Hawaii, Nov. 2018. doi: 10.1109/ITSC.2018.8569941.

ITS Society Conferences

With COVID-19 vaccines being administered around the globe, it looks like we may be turning the corner on the pandemic and getting back to "normal." But what is the new normal going to look like for conferences? The last year has forced us to reevaluate our conferences due to safety but has given us an opportunity to assess new technologies for virtual meetings. We've all become experts at video conferencing and figuring out how to mute ourselves on Zoom/WebEx/Meet/Teams and so forth. Furthermore, our virtual meetings are opening up opportunities for participation from people and places that in general have not had the resources to attend in-person meetings. The 2020 IEEE Intelligent Vehicles (IV) Symposium had 16% of its presentation views, 19% of paper downloads, and 51% of the USB Proceedings downloaded after the synchronous portion of the meeting. In fact, all of the IEEE ITS Society conferences went virtual in 2020 and enjoyed great success. It seems like on-demand access to conference material is a natural way to increase engagement and fill any gaps.

The 2021 conference lineup is taking shape, with organizers navigating the new normal. Our flagship conferences are planning welcoming the community in person with IV2021 in Nagoya in July and ITSC2021 in Indianapolis in September. The IEEE/ASME International Conference on