
Beyond Traditional Sensing for Intelligent Transportation

Special Session Proposal

Duration

Half a Day

Organisers

Letizia Marchegiani

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Short Bio: Letizia Marchegiani is an Assistant Professor with Aalborg University (AAU), and was one of the organisers of this special session at ITSC 2018 and 2019. Before joining Aalborg University, she worked as a postdoctoral researcher at the Oxford Robotics Institute at the University of Oxford (2014-2018). Previously, she was associated with the INSPIRE (Investigating Speech Processing In Realistic Environments) Initial Training Network as a Marie Curie Postdoctoral Research Fellow (2012-2013) and collaborated, as a visiting researcher, with the Centre for Applied Hearing Research (2013), and the Cognitive Systems Group at the Technical University of Denmark (2009-2012). Letizia holds a BEng in Computer Engineering, an MSc in Computer Engineering with specialisation in Artificial Intelligence, and a PhD in Computing Science and Engineering from Sapienza, University of Rome. Her research interests lie in the areas of signal processing, machine learning, and their application to robotics, autonomous systems, cognitive modelling and intelligent healthcare. Most recently, her research activity has been focusing on auditory perception for smart vehicles. Letizia has served as an associate editor, reviewer, and session chair for ITSC, and is a Member of the IEEE, the IEEE Robotics and Automation Society (RAS), the IEEE Intelligent Transportation Systems Society (ITSS), the IEEE Signal Processing Society (SPS), and an Associate Member of the IEEE Autonomous Systems Initiative (ASI).

Dimitri Ognibene

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Short Bio: Dimitri Ognibene obtained his PhD in Robotics from the University of Genoa in 2009. Before joining the University of Essex, he has been a Marie Skłodowska-Curie CO-FUND Fellow at UPF, Barcelona, and a researcher at the Centre for Robotics Research, Kings College London, at the Personal Robotics Laboratory in Imperial College London, and at the Institute of Cognitive Science and Technologies of the Italian Research Council (ISTC CNR). He also collaborated with Wellcome Trust Centre for Neuroimaging (UCL). Dimitri has also been a visiting Researcher at Bounded Resource Reasoning Laboratory in UMass and at University of

Reykjavik (Iceland). His research interests entail the principles underlying adaptive social behaviour in complex conditions with particular attention to anticipative skills and exploration in unknown environments. His research covers both biological and artificial agents as well as physical (visual and multimodal) and virtual environments. Dimitri is Associate Editor of *Paladyn, Journal of Behavioral Robotics*, Guest Editor for *Human Friendly Robotics in Applied Science Journal*, MDPI, for *Computational Intelligence*, part of the journal(s) *Frontiers in Robotics and AI*, and the *Bionics and Biomimetics* section of *Frontiers in Bioengineering and Biotechnology*, as well as member of the Program Committee of several other conferences and symposia. Furthermore, he organised several special sessions, tutorials and demo sessions, such as: *Towards Human-Robot Collaboration: Enabling Technologies, Interfaces, Learning and Interaction* at the 9th Asia-Pacific Signal and Information Processing Association Annual Conference (APSIPA ASC 2017), the *Active Vision and Human Robot Collaboration* tutorial at the International Conference on Image Analysis and Processing (ICIAP 2017), and the demo and poster session at *Human Agent Interaction (HAI) 2016* in Singapore. Dimitri has served as an associate editor for ITSC.

Daniele De Martini - Contact Person

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Short Bio: Daniele De Martini works as a Postdoctoral Research Assistant at the Oxford Robotics Institute at the University of Oxford and a Junior Research Fellow of Kellogg College; his research focuses on allowing robots reaching superhuman sensing ability, with a special attention to radar technologies. Daniele holds a BSc in Mechanical Engineering from the Università degli Studi di Pavia, a MSc in Mechatronics Engineering from the Politecnico di Torino and a PhD in Electronics, Computer Science and Electrical Engineering from Università degli Studi di Pavia, with a focus on robotics. Daniele has served as an associate editor, reviewer, and session chair for ITSC.

Xenofon Fafoutis

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Short Bio: Xenofon Fafoutis is an Assistant Professor with the Technical University of Denmark (DTU) and member of the Embedded Systems Engineering section of DTU Compute. From 2014 to 2018, he held various researcher positions at the University of Bristol, UK. He holds a PhD degree in Embedded Systems Engineering from the Technical University of Denmark (2014); an MSc degree in Computer Science from the University of Crete (2010); and a BSc in Informatics and Telecommunications from the University of Athens (2007). His research interests primarily lie in Networked Embedded Systems as an enabling technology for Digital Health, Smart Cities, Intelligent Transportation Systems, and the Industrial Internet of Things (IoT). Xenofon has served as the Program Co-Chair for *Adhoc-Now 2018* and *IEEE SenseApp 2018*, and as Publicity Chair for *IEEE SenseApp 2017*. Xenofon has served as a reviewer and an associate editor for ITSC.

Matthew Gadd - Contact Person

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Short Bio: Matthew Gadd is a Postdoctoral Research Assistant in the Mobile Robotics Group, within the Oxford Robotics Institute, and a Junior Research Fellow at Kellogg College, at the University of Oxford. His research is concerned with condition-invariant navigation and scene comprehension in formidable situations – firstly exploring “editing” perturbative effects of weather and clutter from imaging sensors and secondly advocating for a greater adoption of sensors inherently immune to weather such as radar. Gadd holds a BSc (Hons) in Mechatronics Engineering from the University of Cape Town and a DPhil (PhD) in Engineering Science from the University of Oxford. Gadd has served as a reviewer for a variety of international conferences (ITSC, ICRA, IROS, IV, ISER) and journals (IJRR, JFR, TRO, RA-L) and is also a topic editor for MDPI (Electronics).

Aim (up to 400 words)

Over the past few decades, sensors have not only become more advanced but also made impressive strides across an increasing number of sensing modalities. Despite the improved capabilities and breadth of available sensor systems, those used for intelligent transportation have remained relatively uniform across platforms; as a result, the algorithms and techniques being designed for these platforms do not take full advantage of the rich information that modern sensors can provide. Since all tasks – including perception, localisation, decision-making, and learning – are built on top of sensing, exploring alternative approaches to sensing is a compelling research area that can render all subsequent tasks more robust and accurate.

The objective of this special session is to explore unconventional sensing for intelligent transportation in three ways. Firstly, it will investigate sensor systems that are not typically applied to certain transportation tasks, such as radar for precise localisation, audio for failure detection, and RF sensing for road traffic estimation. Secondly, it will explore nontraditional sensor configurations and placements, such as ground-facing cameras using shadows to detect occluded moving objects. Lastly, it will look into the sensing of commonly overlooked information, such as the use of atmospheric sensors for gauging road surface traction or in-vehicle sensors for driving analysis. Via these three themes, this special session aims to stimulate discussion and research into nontraditional sensing in order to improve the reliability and accuracy of transportation systems.

Topics of Interest

An incomplete list of example topics that would suit the themes of this special session is provided below.

- Localisation and navigation using radars (e.g., scanning, Doppler, and ground-penetrating);
- Ego-noise and soundscape modelling and interpretation (e.g., sound-based failure detection, terrain/road surface status classification, urban sound source detection and localisation);
- Unconventional optical sensors for localisation and perception in challenging scenarios (e.g. event-based vision, multi-spectral imaging)

- In-vehicle sensing and wearable computing for failure detection, driver and passenger behaviour modelling;
- Novel sensor hardware and designs;
- Unconventional sensor placements or multi-sensor systems;
- Optimal sensor scheduling;
- Astronomical (skyward-facing), atmospheric or odour-based sensing;
- IoT technology for intelligent transportation and Internet of Vehicles (IoV);
- Passive Wireless/RF sensing.

Intended audience (up to 200 words)

The rapid growth in sensing technology and algorithms is leading the way towards intelligent transportation systems equipped with always smarter and more efficient perception and navigation frameworks. This special session wishes to attract the interest of those researchers in the intelligent transportation systems community who investigate the use of less traditional sensing, including novel sensors or sensor placement and configuration, as well as sensor systems that are not typically applied to certain transportation tasks. It is often difficult, when working with less conventional methods and tools, to find the right venue for dissemination and discussion. Relying on nontraditional sensing, indeed, means combining intelligent transportation with several other research areas, which span from signal processing and sensor design, to wireless communication. Strengthened by its inherent multidisciplinary nature and by the success of its three previous editions (more details are provided in the following section), this special session aims to be that venue. As confirmed by our statistics, both the Academic and Industrial worlds have consistently showed interest in the topics covered by this special session, yielding to the development of a new community involved in the analysis of nontraditional sensing for intelligent transportation, that is the audience targeted by this session.

Expected attendance

The special session “Beyond Traditional Sensing for Intelligent Transportation” has already been organised within ITSC 2018, ITSC 2019, and ITSC 2020. On all of these occasions, it attracted the interest of the robotics and intelligent transportation systems communities, with a considerable number of high-quality research paper submissions. The special session also managed to gather a large participation to the presentations and discussions over a number of high-quality research contributions from several top-level international institutions, as well as industry, from all over the world (e.g. Massachusetts Institute of Technology (MIT), Toyota Research Institute (TRI), Nissan Research Center, BMW, and University of Oxford). In its first edition, we were also honoured by the presence of a highly regarded keynote speaker, Prof. Timothy Barfoot, from the University of Toronto, funded by the special session organisers, who kicked off the session with an invited talk on his long-term experience in alternative sensing. Besides those positive statistics, there has been a continuity in the submissions and participation to the special session over its three editions, leading to the growth of a new community/audience, that will certainly contribute to the success of a fourth edition of the session. Thus, we anticipate that the proposed special session will attract 10-15 submissions. Besides the previous editions of this

special session, the organisers have experience in successfully planning similar events, as detailed in their biographies, attracting a significant number of submissions in all those instances.

In light of the successful dissemination activities carried out to advertise the special session “Beyond Traditional Sensing for Intelligent Transportation” for ITSC 2018, ITSC 2019, and ITSC 2020, which allowed us to obtain a considerable number of submissions, we are planning to replicate and enhance such activities to attract the consideration of all those members of the research community working in topics related to the ones of the special session. More specifically, we are planning to:

- Leverage established contacts of the organisers and the institutes they are affiliated with, to encourage submissions and further dissemination through chains of contacts. In the context of ITSC 2018, relying on the research networks of the Oxford Robotics Institute has been an extremely powerful means to stimulate the submissions and the interest in the session of a wide community in the area of autonomous vehicles. Similarly, in the context of ITSC 2019, thanks to the involvement of the organisers in other communities, the special session got endorsed by the IEEE Autonomous Systems Initiative (ASI) ¹ within the IEEE Signal Processing Society (SPS), that helped reach a different audience, and collect additional submissions. *Also for this edition, the special session will be able to count on the endorsement and support of ASI* (relative documentation is available upon request). Such endorsement further highlights the interest of multidisciplinary communities in the topics approached by the session (*cf.* previous section).
- Advertise the special session (and the main conference) at various stages through the major topic-related mailing lists, such as euRobotics, Auditory, Uai, Machine listening, Connectionist, MI-news, EuCog, Robotics worldwide, Robotics and AI, Comp-neuro, tcc-announce, sensorium, nordic-iot-hub.
- Produce dissemination material to distribute both digitally and printed through mailing lists, university websites and social media. An example of material produced for ITSC 2018 can be found on the website of the conference².
- Solicit submissions from researchers highly involved in the topics covered by the special session through direct contact.

Invited speakers/regular presentations

Considering the history of the special session and our extensive dissemination plan (*cf.* section above), we are confident that we would be able to obtain, a sufficient number of submissions in this edition as well.

We are not planning on inviting authors to submit papers on specific topics, but through hosting this special session at previous editions of ITSC and also drawing on the professional network available to the organisers and their institutions, we have already communicated with approximately 55 researchers in our community to let them know that we are soliciting submissions for this session at ITSC 2021.

We can also confirm the participation of the organisers in case the special session is approved. Specific documentation is available upon request.

¹<https://ieeearsi.signalprocessingsociety.org/>

²https://www.ieee-itsc2018.org/uploads/5/0/3/9/50391481/cfp_special_session_on_beyond_traditional_sensing_for_intelligent_transportation.pdf

Program

A tentative program of the special session would follow the classic structure of ITSC special sessions. Assuming, for sake of simplicity in the representation, a number of paper presentations spanning over one session, the program would be as follow:

Time	Activity
9:30-9:45	Talk 1
9:45-10:00	Talk 2
10:00-10:15	Talk 3
10:15-10:30	Talk 4
10:30-10:45	Talk 5
10:40-11:00	Talk 6
11:30-11:00	Coffee Break

Equipment

No additional equipment requirements.