Special Session Proposal

- Title: Traffic Control and Connected Autonomous Vehicles: benefits for efficiency, safety and beyond
- Modality: 3 Technical sessions of duration 100 minutes
- Scope, including the following sections:
  - Motivation and general scope

Mobility is facing a transformation in terms of connectivity, allowing vehicles to communicate with each other, with the smart road infrastructure, and with other road users. Such knowledge, gained via the adoption of advanced sensing/communication technologies, has the potential to fundamentally shift the mobility paradigm towards mobility as a service, contributing to more efficient, safe, and comfortable ground transportation systems.

Indeed, on the one hand, such continuous awareness about mobility conditions lets the smart infrastructure regulate the traffic flow at macroscopic level by limiting the flows entering a road section (ramp metering), by regulating the flows already present in the mainstream (mainstream control) or by routing traffic flows on alternative paths of a network (route guidance).

On the other hand, the information provided by the smart infrastructure combined with the one received by other communicating entities along the road (i.e. autonomous vehicles, human-driven vehicles, pedestrians) can support, at microscopic level, autonomous vehicles in taking the proper control decision in different traffic scenarios to guarantee a safe, smooth, comfortable and sustainable driving experience, e.g. by avoiding strong accelerations / decelerations or by avoiding hazardous maneuvers.

Besides road vehicles, this new emerging mobility concept is nowadays gaining momentum in the railway research field, where cooperation among autonomous trains and radio Block Centers (RBC) plays a key role in increasing rail line capacity while reducing traffic congestion.

Thus, coordination and cooperation allows traffic and mobility control at an entirely new level. This new mobility paradigm, also known as Cooperative, Connected and Automated Mobility (CCAM) enables and provides an ITS service that offers better quality and an enhanced service level, compared to the same ITS service provided by only one of the ITS sub-systems (personal, vehicle, roadside and central, infrastructures), hence improving traffic management, reducing congestion, and contributing to sustainable and eco-mobility. Indeed, all the traffic information, available on-board of vehicles, can be exploited for improving the planning, the decision and the control of the autonomous connected vehicles (including autonomous trains) moving in this smart environment. This brings to a new traffic
management system which, by acting on CAVs, aims to achieve numerous goals, such as the optimum use of energy, reliable journeys, as well as the reduction of accidents, costs, environmental pollution and traffic congestion. Finally, since the great amount of information shared could be compromised by cyber-attacks, resilient control algorithms are also required to achieve the aforementioned control goals.

In this perspective, this Special Session aims at exploring how to design new control solutions for traffic and vehicle control systems able to face CCAM challenges in a resilient and sustainable way, also in the transition phase where a good co-existence of conventional and connected vehicles is needed in mixed traffic environments.

  o Relevance to the ITS community

All the topics covered in this Special Session are very relevant for the ITS community. Control of CAVS, with all the impacts in terms of performance improvement, safety and sustainability guarantees, represents a very hot topic for the ITS community, which is more and more interested in developing efficient control algorithms for smart mobility systems. It is important to underline that this research area can be very relevant for the ITS community not only for the development of new methodologies, but also for the technological challenges involving control systems, communication, sensing and information technologies, as well as cyber-security topics and sustainability-related issues. This Special Session aims to gather researchers of different areas and with different backgrounds but with the same research interest related to the development of control algorithms for Connected Autonomous Vehicles, with specific focus on traffic efficiency, road safety and energy management. It is expected that the presentations of the Special Session will represent an opportunity for different research groups to discuss, share new ideas and show experimental results, testbeds and pilot studies. This will increase the awareness and the knowledge of the ITS community on the main challenges related with traffic control and management of Autonomous Connected Vehicles.

  o Topics

The Special Session will include the following topics:

- Development of safe and secure Cooperative-ITS (C-ITS) services for traffic management;
- Autonomous Connected Vehicles;
- Results from experimental systems, testbeds, and pilot studies;
- Networked information processing, decision making, and intelligent control;
- Energy-oriented C-ITS;
- Modeling approaches for mixed traffic;
- Analysis of the impact of C-ITS in mixed traffic flow;
- Benefits of C-ITS for road safety and traffic efficiency.

  o Organizers (names, affiliations, emails, and short bio):

Stefania Santini, University of Napoli Federico II, stefania.santini@unina.it
Short Bio: She is an Associated Professor in the Department of Electrical Engineering, and Information Technologies (DIETI) at the University of Naples Federico II, Napoli, Italy, where she leads the Distributed Automation Systems Lab (DAiSYLab: https://daisylab.dieti.unina.it/). She is involved in many projects with industry, including small- and medium-sized enterprises, also operating in the transportation field. Her research interests include nonlinear control of nonlinear and cyber-physical systems, and networked control with applications to energy, automotive engineering, transportation technologies. She is currently Associated Editor of IEEE Trans. on Intelligent Transportation Systems. She is the Vice-chair of the IEEE ITSS - Italian Chapter and member of the IEEE TC on Smart Cities (TC-SC).

Alberto Petrillo, University of Napoli Federico II, alberto.petrillo@unina.it

Short Bio: He is currently a research fellow at University of Naples Federico II. His research activity concerns both theoretical and applicative topic in the field of Automatic Control Systems and combines the methodological aspects with in the field experimentation. Specifically, the research activity mainly focuses on the design of Networked Control System for cyber-physical systems in the presence of communication impairments (such as packet losses and time-delays) and security vulnerabilities with application to vehicular networks in the automotive and railway sectors, to intelligent Transportation Systems.

Silvia Siri, University of Genova, silvia.siri@unige.it

Short Bio: She is an Associate Professor of Automatic Control at the University of Genova. Her research interests include control of freeway traffic systems, planning of logistics systems and intermodal terminals, optimal management of electric mobility systems. She is co-author of more than 100 papers in international journals, chapters and conference proceedings. She is Senior Editor of the IEEE T-ITS, Associate Editor of IEEE T-ASE, Editor-in-Chief of the IEEE ITSS Newsletter and Associate Editor of LCSS. During 2019-2021 she was Member of the BOG of the ITSS, now she is Chair of the ITSS Italy Chapter, Chair of the CSS TC on “Smart Cities”, and Co-Chair of the ITSS TC on “Planning and Control of Transportation and Logistic Networks”.

Cecilia Pasquale, University of Genova, cecilia.pasquale@edu.unige.it

Short Bio: She received the bachelor degree in Civil Engineering in 2009 from the Polytechnic University of Torino, Italy, the Master degree in Transports and Logistics Engineering and the Ph.D. degree in Monitoring of Systems and Environmental Risk Management from the University of Genova, Italy, in 2012 and 2016, respectively. Currently she is a postdoctoral research fellow at the University of Genova. Her research interests include modelling, optimization, and control methods applied to the field of transportation systems. Presently she serves as Associate Editor for the IEEE Open Journal of Intelligent Transportation Systems, IEEE Transactions on Intelligent Vehicles and for Control Engineering Practice.

● Intended audience and expected attendance of the special session:
Due to the interdisciplinarity of the topic herein addressed, involving information science, communication technology, intelligent systems, automatic control and transportation sciences, the Special Session could be relevant for all the researchers involved into the design of Cooperative Intelligent Transportation Systems for traffic control and autonomous connected vehicles.

- **Materials and equipment needed for the special session:**

  *Neither materials nor equipment are required for the special session.*

- **Contact details of the proposers (email, postal address, etc):**

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