DAUSY

Research theme title:

Stability and security of interconnected platoons of vehicles.

Contacts:

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Curriculum of DAUSY:

C3 AS for Monitoring and Security

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Supervisor:

Prof. Elena De Santis (Dipartimento di Ingegneria e Scienze dell'Informazione e Matematica (univaq.it))

Description:

The research will focus on stability analysis and control of vehicular traffic in the presence of autonomous, interconnected, and electrically powered vehicles. Recent results of the research group at University of L'Aquila have focused on the problem of "String Stability" in platoons of interconnected vehicles that make use of traffic information provided by some global variables, such as mean and variance of speed and intervehicular distance. Adaptive "human-based" control was also developed through the use of Model Predictive Control, which takes into account human behavior in response to different environmental situations.

The objective of the proposed research is to analyze the possibility of using, at the decentralized controller level, global traffic information possibly obtainable as an output of a macroscopic model. The complex case of mixed autonomous and assisted driving traffic

will be investigated, where autonomous vehicles can play the role of a traffic regulation tool, with benefits for the reduction of emissions, congestion and safety. Another element that will be considered is the power supply, which introduces the need to appropriately manage the battery charging process in the control system.

Dedicated courses for doctoral students offered at universities contributing to the national doctoral program are provided. Participation in conferences, workshops and seminarsi is encouraged.

The doctoral student will acquire technical and scientific skills that can be used in multiple application contexts. The theoretical topics covered, integrated with the more strictly engineering knowledge envisaged in the project, will provide the Ph.Dstudent with a high level of expertise.

Recent references of the research group:

[1] M. Mirabilio, A. Iovine, E. De Santis, M.D. Di Benedetto, G. Pola, "On the utilization of Macroscopic Information for String Stability of Vehicular Platoon", *2020 59th IEEE Conference on Decision and Control (CDC)*, 2020, pp. 2811-2816.
[2] M. Mirabilio, A. Iovine, E. De Santis, M.D. Di Benedetto, G. Pola, "String Stability of a Vehicular Platoon with the use of Macroscopic Information", *IEEE Transactions on Intelligent Transportation Systems*, vol. 22, no. 9, pp. 5861-5873, Sept. 2021.
[3] M. Mirabilio, A. Iovine, E. De Santis, M.D. Di Benedetto, G. Pola, "Mesoscopic Controller for String Stability of Platoons with Disturbances", *IEEE Transactions on Control of Network Systems*, vol. 9, no. 4, pp. 1754 – 1766, 2022.
[4] M. Mirabilio, A. Iovine, E. De Santis, M.D. Di Benedetto, G. Pola, "Scalable Mesh Stability of Nonlinear Interconnected Systems", *IEEE Control Systems Letters*, vol. 6, pp. 968-973, 2022.
[5] M. Mirabilio, A. Iovine, E. De Santis, M.D. Di Benedetto, G. Pola, "A Microscopic Human-Inspired Adaptive Cruise Control for Eco-Driving", *2020 European Control Conference (ECC)*, 2020, pp. 1808-1813.
[6] M. Mirabilio, A. Iovine, E. De Santis, M.D. Di Benedetto, G. Pola, "A Mesoscopic Human-Inspired Adaptive Cruise Control for Eco-Driving", *IEEE Transactions on Intelligent Transportation Systems*, 24 May 2023, DOI: 10.1109/TITS.2023.3275706.

Specific Information:

Applicants must hold a master's degree, preferably in Engineering, with a solid background in mathematics and relevant areas of interest (i.e. nonlinear control, optimal control). Solid coding skills are encouraged. Proficiency in both spoken and written English is required.

The candidate should be highly motivated and interested in undertaking innovative and challenging research activities involving both theoretical analysis and experimental validation.

Type of scholarship:

Project funded by PNRR DM118

Study and research period outside the Hosting Institution:

Envisaged study and research period abroad:

- Period length: 6 -12 months;
- Hosting institutions:
    - University of California Berkeley
      Department of Civil and Environmental Engineering
    - Centrale Supélec
      Laboratoire L2S