PhD student: Aniello Mungiello

Cooperative, Connected and Automated Mobility: methodologies and applications

Tutor: Stefania Santini

Cycle: XXXVIII   Year: First

My background

- **Master Degree** in Autonomous Vehicle Engineering obtained from University of Naples – Federico II

- **Master Thesis:** Autonomous Driving Control System of a Race Car: Design and Experimental Validation (In collaboration with UniNa corse)

- **Research Group:** DAiSY Lab (Prof. Stefania Santini)

- **PhD start date:** January 2023

- **Scholarship type:** PNRR Centro Nazionale di Ricerca per la Mobilità Sostenibile (MOST) Spoke: CCAM e Smart Infra

Research Field 1/2

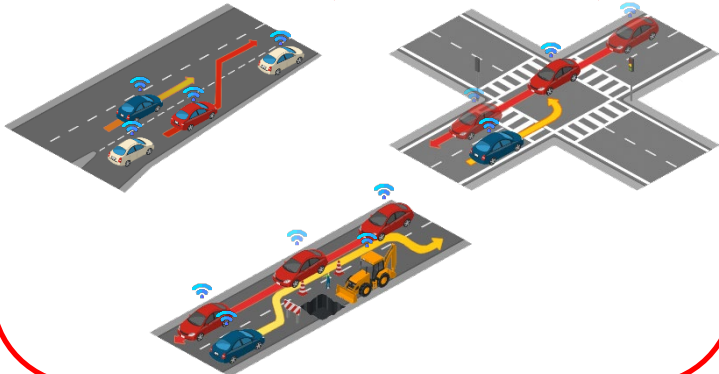Control Methods for Cooperative, Connected and Automated Mobility (CCAM).
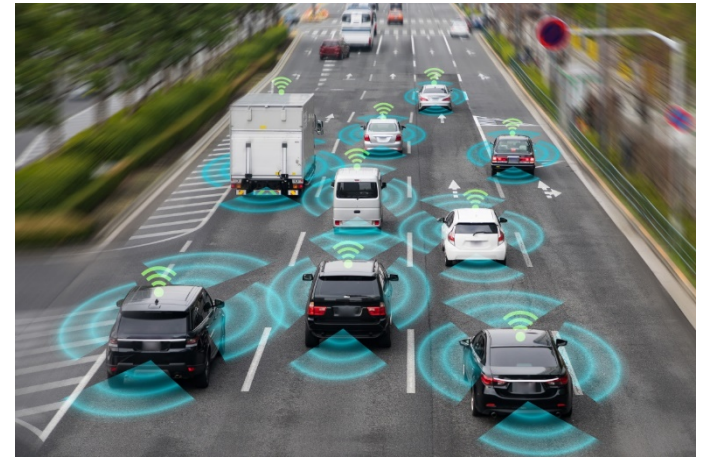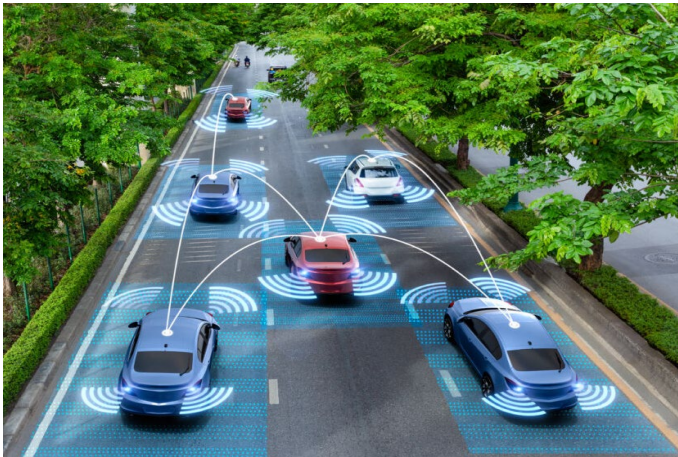
Research Field 2/2

Traffic Layer

Cooperative Driving Scenarios Via V2X (V2V,I2V ...)

Virtual Testing with Testbed Vehicle

My First Year:
Study & Training activities

The focus of my first-year activity is the acquisition of concepts related to my research topic. The state of the art around the topic I have previously presented and the different methodologies with which one can approach it.

For this reason, I attended to various seminars and courses, the most relevant of which are listed below:

➢ **EECI PhD School:** *"Learning-based predictive control" - Professor Melanie ZEILINGER, Professor Lorenzo FAGIANO, Doctor Lukas HEWING – ETH Zurich*

➢ **Course:** *The Linear Parameter Varying approach: theory and application – Professor Olivier SENAME*

➢ **Seminar:** *Using Delays for Control. <u>Useful overview about time-delay theory</u>*

I also attended to:

❑ **Conference:** *IEEE International Conference on Intelligent Transportation Systems* (ITSC 2023) – 24/28 September 2023

❑ **Event:** 2023 IEEE ITSS R8 Chapters Meeting in Berlin 30/11 – 1/12/2023

Research Activity: Problem Statement

- **Problem**
  - The brand new CCAM paradigm

- **Objective**
  - Developing distributed control laws for CAVs so to enhance traffic efficiency.
  - Designing Cooperative control strategies to promote sustainable mobility.
  - Performance assessment via virtual testing for different Operational Design Domain (ODD).
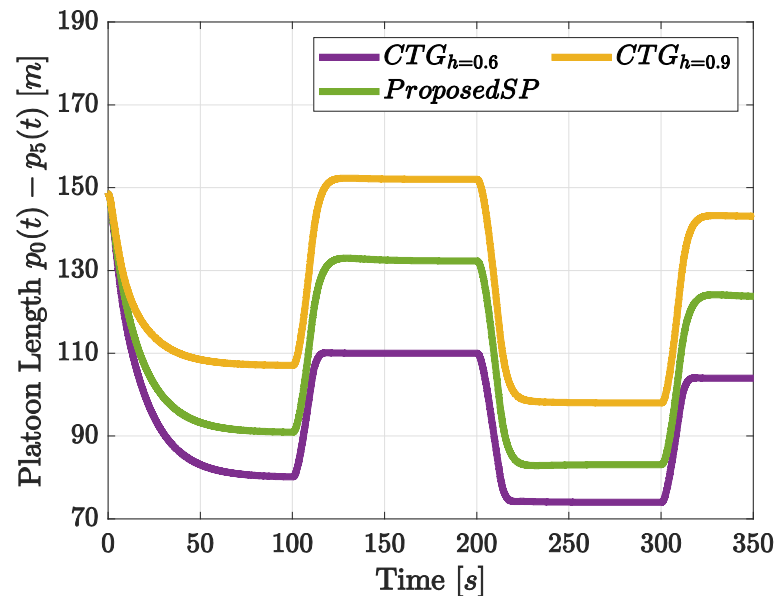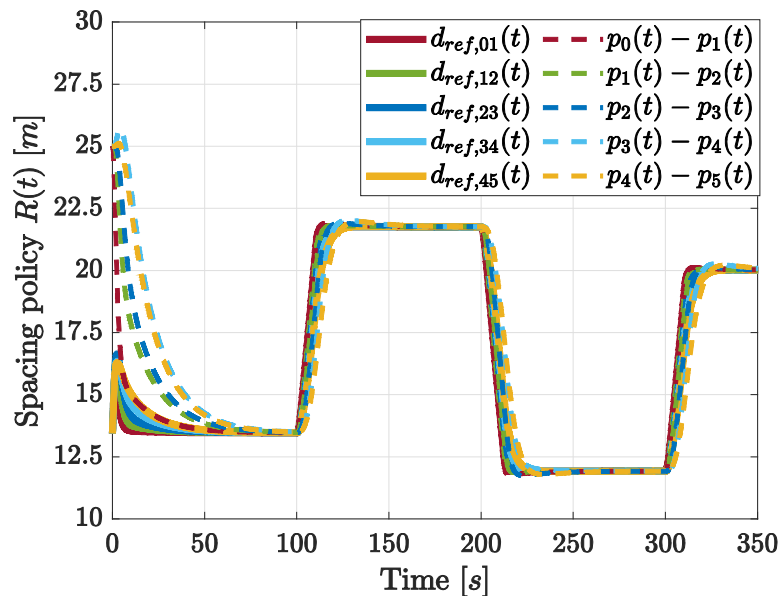
- **Methodology**
  - Multi-Agent Systems (MAS) and Networked Control System (NCS) paradigms.
  - Sustainable control solution.
 - Virtual testing via properly develop SiL and HiL simulation platform.

Research Activity 1/2

- **Contribution:** Solves the problem of formation platooning of autonomous non-linear vehicles connected using a variable spacing policy.

- **Methodology:** Distributed Formation Control.

- **Result:** Validation of the former control law and evaluation of KPI.

Research Activity 2/2

- **Contribution**: Design of a Predictor-Based distributed control to manage a platoon of vehicles under DoS Attacks.

- **Methodology**: Predictor Based CACC control strategy, capable of ensuring safety while CACC operates under DoS Attacks.

- **Result**: Simulations performed on simulink reported that such logic in the presence of long delays avoids vehicle collisions compared to simple predictor-free control logic.
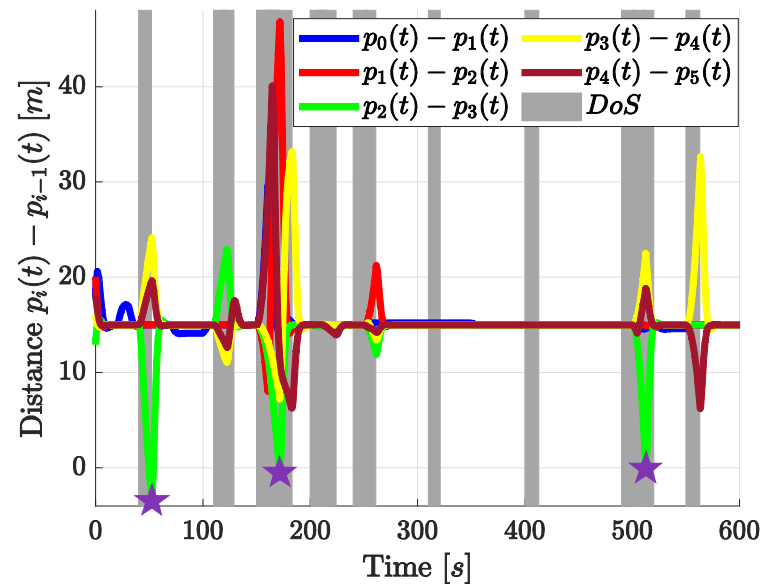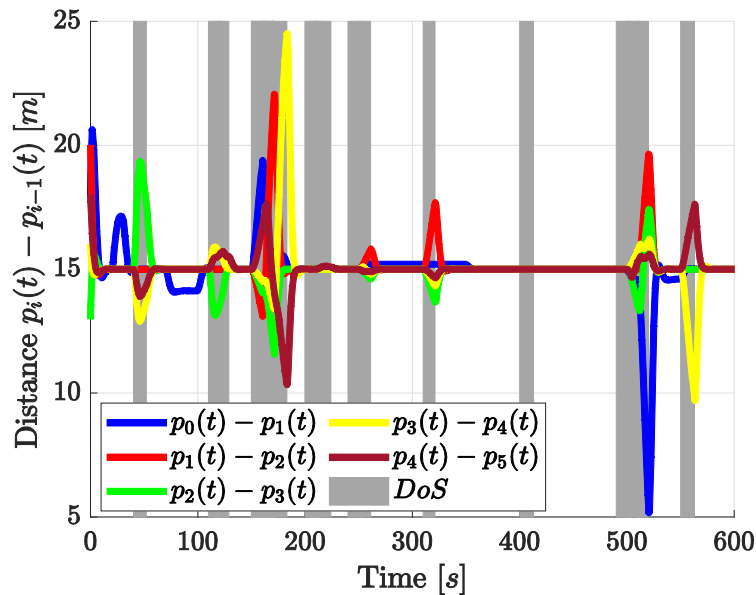
Study and Training Activities – Credits earned

	Courses	Seminars	Research	Tutorship	Total
Bimonth 1	0	3	7	0	10
Bimonth 2	6	0.8	3.2	0	10
Bimonth 3	0	0.6	9.4	0	10
Bimonth 4	12	0	3	0	15
Bimonth 5	1.6	1	7.4	0	10
Bimonth 6	0	0	10	0	10
Total	**19.6**	**5.4**	**40**	**0**	**65**
Expected	**20 - 40**	**5 - 10**	**10 - 35**	**0 – 4.8**	

Products

[C1]	B.Caizzo, D. G. Lui, **A. Mungiello**, A. Petrillo, S. Santini "On the resilience of Autonomous Connected Vehicles Platoon Under DoS Attacks: a predictorbased sampled data control", IEEE Intelligent Transportation Systems Conference (ITSC) Bilbao 26-30/09/2023, To appear.

Next Year

- Distributed control by leveraging Vehicle to Everything paradigm so to enhance driving experience and traffic congestion.

- Study on robust control laws w.r.t communication impairments, as well as sensor fault.

- Study about the impact and the benefits of CCAM control strategy for different traffic flow condition and different driving scenario, along with the definition of novel KPI.

- Keeping on working on the development of the high fidelity virtual testing platform, which will be exploited for the evaluation of the achievement of CCAM objectives.