COMPUTER AND CONTROL ENGINEERING

MUR DM 117/Stellantis - Use of collective and collaborative perception for automated driving at L4+ level

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Context of the research activity	The objective of the research will focus on enhancing existing sensing technology in vehicles to extend the perception of the surrounding environment. The goal is the development of a collaborative perception approach that leverages multiple sources in order to have a clearer representation of the environment in which autonomous vehicle will travel. Progetto finanziato nell'ambito del PNRR - MUR DM 117/2023 - CUP E14D23002020004
	This activity will be conducted in collaboration with Stellantis. Environment perception constitutes a foundational block for Automated Driving Systems (ADS). Despite significant advances in sensor technology in recent years, the perception capability of these local sensors is ultimately bounded in range and field of view (FOV) due to their physical constraints. In addition, occluding objects in urban traffic environments such as buildings, trees, and other road users impose challenges in perception. There are also robustness related concerns (sensor degradation in adverse weather conditions, sensor interference, hardware malfunction and failure). Enhancing such features is imperative to breach the barrier of complex environments such as urban scenarios. Occluding obstacles, sudden appearance and disappearance of detected objects/people are just a few of the challenges traditional tracking algorithms may face in an urban context that hinders their performance. Furthermore, approaches that deal with data association and merging are still physically limited by the point-of-view of the ego vehicle. A new approach is therefore needed in order to allow all traffic participants and infrastructure to share information on objects (Vulnerable Road Users (VRUs), obstacles, other vehicles) detected by their object-tracking sensors. Ultimately, the collaborative environment perception will affect the Operational Design Domain (ODD), i.e., a description of the specific operating conditions

Objectives	in which the ADS is designed to properly operate. The research work plan, developed in collaboration with Stellantis, will be articulated as follows: First year: • Definition of a collaborative perception approach to merge different perspectives coming from different sensors and nearby vehicles to enhance the reliability of the environment perception of automated vehicles in complex scenarios. • Application of the collaborative perception approach firstly for some specific scenarios, analyzing in particular important issues as full sensors coverage, precision of measured attributes, real-time operation, time-synchronization, etc. Second year: • Creation of a simulation framework that incorporates the entire collective perception pipeline enabling to comprehensively study sensor-based perception, Intelligent Road-Side Unit (IRSU) and connected ADS platforms. It will also expected to provide detailed insight in end-to-end delays and aging of information within the environmental model of automated vehicles. • Extension of the perception approach from conventional detection (complex roadside sensor tech, vehicle is a passive object) to collaborative detection (where the vehicle is an active part of the process). Third Year: • Application to ADS of Level 4 and above, increasing progressively the ODD, specifically: - ODD extension of Ego Vehicle equipped with ADS of level L4 in complex urban scenarios (occlusions, appearing/disappearing, intersections, etc.) - Cooperative driving mobility in “reserved” areas (limited traffic zones) - “Robo-taxis” operated in an Autonomous Mobility on Demand service

Skills and competencies for the development of the activity	Required: Programming skills in C/C++/Python. Desirable: - Knowledge of Data management and ML/AI techniques. - Familiarity with concepts of simulation and mobile/vehicular communication.