Research project for a PhD curriculum in ICT – Curriculum in Electronics and Telecommunications

Tutor:
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Proposed Title of the research:
Vehicle-to-everything (V2X) Communications for Green and Reliable Intelligent Transportation Systems – Comunicazioni veicolari per sistemi di trasporto intelligenti, verdi ed affidabili

Keywords – (5)
Vehicle-to-everything communications, cooperative perception, joint radar and communication

Research objectives: – (max 10 rows)
In the near future, the availability of safer and more efficient road transportation systems is envisioned thanks to the development of *collective perception services*. Such services, whose standardisation is currently being discussed by the European Telecommunications Standardisation Institute (ETSI), are expected to enable sensor-equipped vehicles and *roadside units* (RSU) to notify nearby vehicles of the objects detected by their sensors. Therefore, these services will significantly increase vehicle perception, improving road safety and making transportation smarter. Even if both vehicles and RSUs can contribute to collective perception, they have very different characteristics in terms of mobility, sensor field of view, communication coverage, processing capacity, and service integration cost. The proposed research activity aims at investigating the exploitation of joint radar and communication techniques in the millimiter wave band and distributed (and, in particular, federated) learning methods in cooperative sensing.

Proposed research activity – (max 10 rows)
The research activity will focus on a scenario in which vehicles employ *dual functional radar communication* (DFRC) systems equipped with antenna arrays and operating in the millimiter wave band. Such devices allow to generate a list of tracked objects in a certain field of view, communicate with other vehicles in order to avoid accidents and negotiate for cooperative

driving manoeuvres (e.g., lane change) and communicate with a smart road infrastructure (developed for assisting and guiding vehicles in complex traffic situations). The proposed research activities aim at investigating:

a) The use of spatial processing techniques in DFRC systems.
b) The exploitation of federated learning in vehicular networks.

Supporting research projects (and Department)

This project will be carried out at the Department of Engineering "Enzo Ferrari" and will be supported by research funds provided by Prof. Giorgio M. Vitetta and Prof. M. L. Merani.

Possible connections with research groups, companies, universities.

The research will involve the private company Silk Faw (Reggio Emilia), that is partially funding the