

Autonomous Shuttle Cooperative Perception and Control through Communications and Sensing

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As part of the Ride2Autonomy European Project (<https://ride2autonomy.eu/>), Aveiro was chosen as a city to test an autonomous shuttle. In October 2022, at Aveiro Tech Week, an autonomous shuttle was riding on Rua Direita in Aveiro. The shuttle was integrated in the Aveiro Tech City Living Lab infrastructure, which allowed, not only to integrate the information from the existing sensors on the shuttle with the sensors of a lamppost, both equipped with video cameras, but also all the information was transmitted through vehicle communication to infrastructure and 5G technologies. This information makes it possible to have, both in the infrastructure and in the shuttle, a map of all objects and people, their location and movement, which allows, through mechanisms of data fusion and artificial intelligence, to make a cooperative perception system for the best movement decisions of the autonomous vehicles ([Alm23]). A video of this system in operation is presented at <https://www.youtube.com/watch?v=8C1knpDDiWM> and in [Ama23]. With this autonomous vehicle in Aveiro, we were able to build an accident prevention system to improve safety on roads with less human influence. The research of virtual traffic lights in the infrastructure and its interaction with the autonomous vehicle through communication messages between the lamppost and the vehicle, allow to send “stop” and “go” orders to the

autonomous vehicle to demonstrate that it is possible to control the movement of the vehicle through a smart city. This mechanism has been extended with sensors and intelligent algorithms to detect the presence of people crossing the road: from the lamppost, a “stop” message is sent to the vehicle, the vehicle stops and people can cross the road. This mechanism has been demonstrated and tested in the road (<https://www.youtube.com/watch?v=3q-LbIHozhY>).

These works are being extended to the intelligent control of vehicles at intersections, roundabouts, and to build the autonomous mobility.

Reference

[Alm23] Pedro Almeida, Andreia Figueiredo, Pedro Rito, Miguel Luís, Susana Sargento, “On the Real Deployment of a Collective Perception Service”, 6th International Workshop on Intelligent Transportation and Autonomous Vehicles Technologies (ITAVT), 2023, Accepted. Link: <https://drive.google.com/file/d/1pB59gP3Tlg6bpvTPx9Pud6YfCNxyic3M/view?usp=sharing>
[Ama23] João Amaral, João Viegas, Bruno Lemos, Pedro Almeida, Rodrigo Rosmaninho, Gonçalo Perna, Pedro Rito, Susana Sargento, “Autonomous Shuttle Integrated in a Communication and Sensing City Infrastructure”, 1st IEEE International Conference on Mobility: Operations, Services, and Technologies (MOST '23), 2023, Accepted. Link: <https://drive.google.com/file/d/1pB59gP3Tlg6bpvTPx9Pud6YfCNxyic3M/view?usp=sharing>

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FIGURE 1, 2

Autonomous shuttle in the Rua Direita, Aveiro. Autonomous shuttle interacting with the smart lamppost equipped with communication and computing devices and sensors, as part of the Aveiro Tech City Living Lab.

