Ph.D. in Information Technology
Thesis Defense

July 24th, 2024
at 15:00 p.m.
Room Alpha

Luca MOZZARELLI – XXXVI Cycle

NAVIGATION ALGORITHMS FOR AUTONOMOUS ROBOTS IN PEDESTRIAN AREAS
Supervisor: Prof. Matteo Corno

Abstract:

With the increasing interest in autonomous vehicles, a growing number of applications require the use of robotic platforms in urban areas.
Examples range from surveillance drones, guide and wayfinding robots, autonomous street sweepers, and parcel delivery robots. The latter in particular have attracted a lot of attention, with several vehicles being developed and experimented with. The promise is for these small, electrically powered, and autonomous vehicles to reduce the congestion and environmental impact of deliveries, all while decreasing costs for the operators.
Indeed, autonomous delivery robots could navigate on sidewalks and in pedestrian areas, replacing large and inefficient delivery vans. The task of autonomously navigating in pedestrian areas, however, is still a demanding problem, and an open one. The challenges of such a task are many, deriving from the unstructured nature of an environment built solely for humans and ranging from the requirement to handle locations with varying layouts (tight sidewalks, vast squares, unpaved park paths...), to the lack of strict norms governing navigation, to the need to interact at close quarters with pedestrians.

This dissertation presents algorithmic solutions for different components of an autonomous driving stack specifically designed to handle the challenges of pedestrian areas.
First, a perception and mapping algorithm is developed to detect and map dangerous locations automatically. The resulting map can be employed as a global planning map or to supplement online perception algorithms in challenging situations. As a second task, the localization problem is treated in depth. A detailed analysis of state-of-the-art map-based localization algorithms is performed, while also developing a robust localization architecture. Finally, a socially aware local planner is developed, enabling robotic vehicles to efficiently and safely interact with pedestrians in collision avoidance maneuvers.

As a final contribution of this work, a robotic guide for Blind or Visually Impaired people is conceived, developed, and validated, gathering feedback from potential users. All algorithms are validated experimentally on a two-wheeled actively stabilized robot.

PhD Committee

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