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XXXVIIth cycle

Thesis Title: Design and Autonomous Driving Strategies for Agricultural Rovers.

Summary

The Agricultural Sector needs to efficiently increase productivity levels, in the near future, both in terms of quantity and quality. The reasons, behind this necessity, are numerous and they cover different aspects concerning environmental, social, economic, and geo-political aspects. One of the solutions, to all these issues, can be represented by agricultural rovers. Agricultural rovers are smart and automated vehicles, able to execute different tasks which cover all the main features of the production cycle, such as soil preparation, harvesting or monitoring operation.

At the basis of the agricultural rovers there is their autonomous driving strategy which makes possible to them to accomplish their mission. The autonomous driving algorithm is structured into three main parts: path planning, path following and obstacle avoidance. The first one aims to identify the ideal trajectory that the vehicle must follow to accomplish its mission. The next step consists of the strategy, used by the rover, to follow the predetermined path. Finally, the obstacle avoidance algorithm consists of a local redefinition of the trajectory in order to avoid unpredictable obstacles.

The autonomous driving strategy represents the starting point of this thesis. First, a virtual kinematic model to develop autonomous driving strategies for agricultural rovers operating in orchards/ vineyards was built. Then, two autonomous driving algorithms with two different path following strategies and a novel obstacle avoidance algorithm, called "Follow the space method", were developed. A scaled prototype was created in order to evaluate the entire motion strategy, the sensor fusion structure, and powertrain architecture of the rover. Finally, the design of a full-scale prototype based on the experimental activity results is presented and validated through a virtual dynamic test.