DATI, AI E ROBOTICA @POLITO

RICERCA, TRASFERIMENTO TECNOLOGICO E SUPPORTO ALLE AZIENDE SUI TEMI FONDAMENTALI DEI BIG DATA, INTELLIGENZA ARTIFICIALE, ROBOTICA E RIVOLUZIONE DIGITALE

SERVICE ROBOTICS FOR PRECISION AGRICULTURE APPLICATIONS

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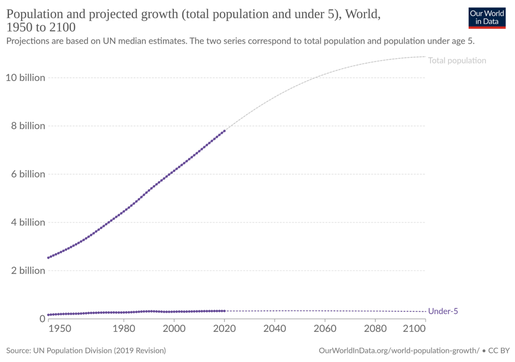
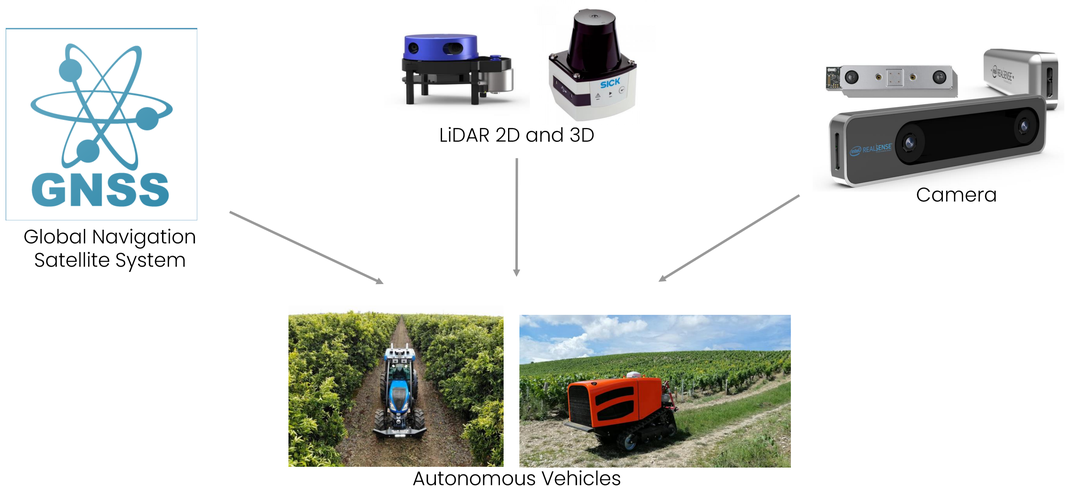
MOTIVATION AND BACKGROUND



- World population is expected to reach about 9 billions in 2050, as a consequence food demand will increase and arable areas will decrease.

- Increase efficiency and production, while reducing inputs and costs in agricultural processes.

- Autonomous machines in the agricultural context exploit LiDARs, Global Navigation Satellite System (GNSS), Inertial Measurement Units(IMUs), cameras, and sensors fusion algorithms.



ADDRESSED PROBLEM AND NOVELTIES

- Autonomous navigation in row-based crops (e.g. orchards and vineyards)
- Cooperation between Unmanned Aerial Vehicles (UAVs) and Unmanned Ground Vehicles (UGVs), computer vision, and novel deep learning based navigation algorithms.

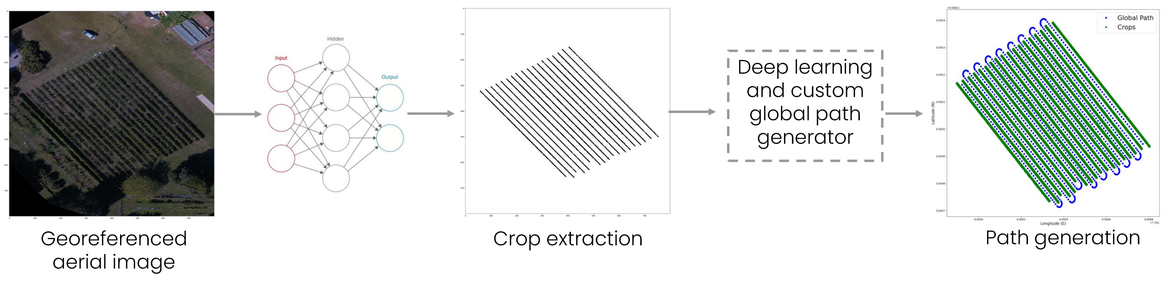
SUBMITTED AND PUBLISHED WORKS

- S. Cerrato, D. Aghi, V. Mazzia, F. Salvetti and M. Chiaberge, "An Adaptive Row Crops Path Generator with Deep Learning Synergy," *2021 6th Asia-Pacific Conference on Intelligent Robot Systems (ACIRS)*, 2021, pp. 6-12.
- Gu, Weibin, K. Valavanis, M. Rutherford and A. Rizzo. "UAV Model-based Flight Control with Artificial Neural Networks: A Survey." J. Intell. Robotic Syst. 100 (2020): 1469-1491.

ADOPTED METHODOLOGIES AND RESULTS

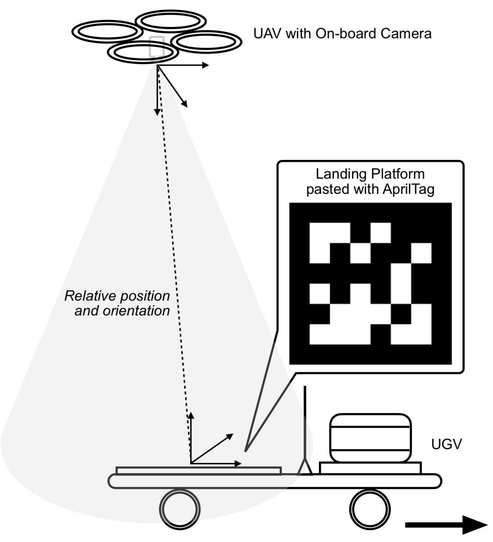
GLOBAL PATH GENERATION

- Georeferenced map generation of the designated crop and global path planning with novel approaches



UAV LANDING ON MOBILE PLATFORM

- Precise landing on the mobile platform of UGV is required for retrieval.
- Vision-based motion estimator and a robust tracking controller are used to achieve precise landing on the rover.
- The AprilTag is detected in real-time for localization thanks to robust tag detection with limited computation resources.
- Data-driven approach to estimate unknown aerodynamic forces induced by the ground effect for control synthesis.



LOCAL AUTONOMOUS NAVIGATION

- Extended Kalman Filter (EKF) to loosely fuse IMU and GNSS receiver data.
- Vision-based local navigation technique to overcome localization issues inside inter-row space, due to thick canopies.
- GNSS-based navigation to switch between two different rows, thanks to a clear view of the sky.

Segmentation based control algorithm