

On The Motion Planning & Control of Nonlinear Robotic Systems

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What If Robotics and System Theory Met By Mistake?

Intuition:

As long as robotics and system theory develops independently we shall never reach cutting-edge solutions.

Objectives:

- 1 Join the two fields of robotics and control theory.
- 2 Let both of them borrow tools from its counterpart.
- 3 Improve domain-specific solutions.

Methods:

- 1 Identify a possible common point.
- 2 Develop both robotics and system solutions around the identified link.
- 3 Approach a specific-domain problem borrowing tool from both fields.

Robotic View

Development of a fully autonomous aerial vehicle for indoor flight.

Common Joint Link

Gaussian process regression, a new paradigm to unsupervised learning.

System View

Development of nonlinear control techniques, focusing on the field of output regulation.

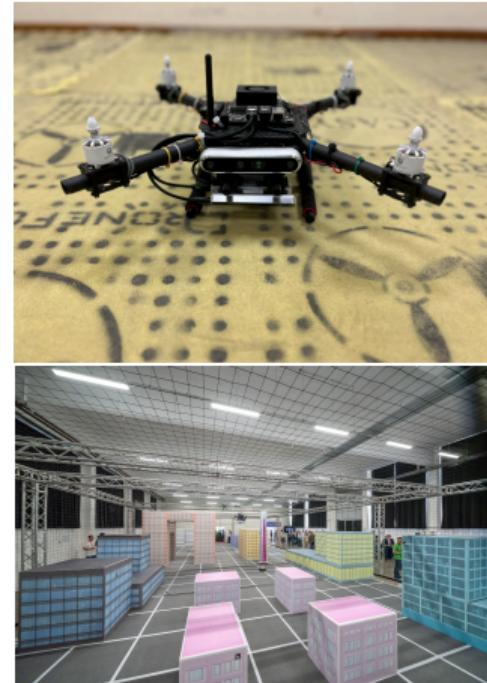
The Leonardo Drone Contest

Main Goal

Implement, deploy, and test autonomous navigation algorithms for drones in applications of GPS-denied indoor flight.

Developed Solutions:

- 1 Environment mapping and localisation.
- 2 Environment exploration and patrolling.
- 3 Trajectory planning and optimisation.
- 4 Trajectory replanning for obstacle avoidance.
- 5 Precise landing on spots.
- 6 Buildings inspection.
- 7 Object tracking.
- 8 Text detection and recognition.



Common Link: Gaussian Process Inference

Gaussian Process Inference

Autonomous Environment Exploration

Autonomous Environment Exploration

Autonomous Areas Patrolling

Autonomous Areas Patrolling

Data-Driven Control Barrier Functions

Data-Driven Control Barrier Functions

Adaptive Nonlinear Output regulation

Adaptive Nonlinear Output regulation
