
PROGRAMA DE VERÃO 2023 - 709

ESCOLA DE MATEMÁTICA APLICADA FGV EMap

DISCIPLINA: Optimization-based control of robotic systems

PROFESSOR: Gennaro Notomista

CARGA HORÁRIA: 12h

PRÉ-REQUISITO:

PERÍODO: 16/01 a 27/01 (Segundas, quartas e sextas-feiras)

HORÁRIO: 10h as 12h

PLANO DE ENSINO

1. Ementa

Description

This course will introduce students to modern optimization-based methods for robot control. Robot models will be described first. Then, unconstrained and constrained optimization problems will be introduced. The special case of convex optimization will be presented and used to formulate stabilizing and safety-ensuring controllers for robotic systems. Finally, two lectures will be dedicated to the optimization-based control of manipulators and mobile robots, respectively. By the end of the course, students should be able to formulate and solve robot control problems arising in their research projects by means of optimization-based control techniques.

Prerequisites Some knowledge of feedback control theory is preferable, however all required background material on control systems, linear algebra, and optimization will be recalled during lectures when needed. Interest in robotics is the only real prerequisite.

2. Procedimentos de avaliação

Não será aplicado avaliação durante o curso.

3. Bibliografia Obrigatória

- [1] Richard M. Murray, Zexiang Li, and S. Shankar Sastry. *A Mathematical Introduction to Robotic Manipulation*. CRC Press, 1994.
- [2] Stephen Boyd and Lieven Vandenberghe. *Convex optimization*. Cambridge university press, 2004.
- [3] Zvi Artstein. Stabilization with relaxed controls. *Nonlinear Analysis: Theory, Methods & Applications*, 7(11):1163–1173, 1983.
- [4] Eduardo D Sontag. A ‘universal’ construction of Artstein’s theorem on nonlinear stabilization. *Systems & control letters*, 13(2):117–123, 1989.
- [5] Aaron D Ames, Samuel Coogan, Magnus Egerstedt, Gennaro Notomista, Koushil Sreenath, and Paulo Tabuada. Control barrier functions: Theory and applications. In *2019 18th European control conference (ECC)*, pages 3420–3431. IEEE, 2019.

4. Mini Currículo

I am an Assistant Professor, and the Varma Family Professor in robotics, in the Department of Electrical and Computer Engineering at the University of Waterloo.

In my research, I am broadly interested in robot design and control for long-duration autonomy with applications to sustainable environmental monitoring for climate change mitigation and adaptation. More details [here](#).

My multi-scale quasiperiodic academic path bounced multiple times between Italy and Germany, and between Europe and the Americas. I studied Mechanical and Automotive Engineering in Napoli and Ingolstadt, respectively, I completed a PhD in Robotics at the Georgia Institute of Technology, and I spent one year as a post-doctoral researcher at the CNRS in Rennes, France. Here is the complete trajectory.

