ALPEN-ADRIA UNIVERSITÄT KLAGENFURT

INVITATION TO THE COLLOQUIUM

Controlling Nonholonomic Systems: From Steering to Motion Planning in Complex Environments

Viktoriia Grushkovska | University of Klagenfurt

Chaired by Barbara Kaltenbacher | Department of Mathematics

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HS 2

ABSTRACT

The study of nonholonomic systems represents a fundamental area of research in mathematical control theory, with numerous real-world applications ranging from wheeled vehicles and rolling spheres to underactuated spacecrafts and quantum systems. Despite a long history, these systems continue to attract significant mathematical interest due to their rich geometric structure and challenging theoretical properties. A well-known result by R. Brockett demonstrates that even if a nonholonomic system is controllable, meaning it can reach any configuration from any initial state, it may not be stabilizable via smooth, time-invariant feedback. This highlights a crucial insight in nonlinear control theory: controllability does not imply stabilizability, motivating the development of more advanced control strategies. In this talk, we will explore both classical and modern control problems for nonholonomic systems, including steering, stabilization, trajectory tracking, and obstacle avoidance. We will review traditional techniques based on Lie bracket theory for motion planning under nonholonomic

constraints and introduce a novel approach that provides a unified solution to these challenges and beyond. Besides, we will discuss future perspectives in the design of control algorithms for nonholonomic systems operating in complex, dynamic environments, where additional challenges arise due to moving targets and obstacles, external disturbances, and limited knowledge of the mathematical models of both the system and the environment.

We hope to see you there!

