ALPEN-ADRIA UNIVERSITÄT KLAGENFURT

Invitation to the Colloquium

Ass.-Prof. Dr. Viktoriia Grushkovska

University of Klagenfurt

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

HS 2 | Tuesday, 29 April 2025 | 4:45 p.m.

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.

Barbara Kaltenbacher and the Department of Mathematics look forward to seeing you at the talk!