ALPEN-ADRIA UNIVERSITÄT KLAGENFURT

INVITATION TO THE LECTURE ON THE HABILITATION PROJECT

Stabilization and optimization of nonlinear systems: control design and stability properties

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Thursday, 3 October 2024 | 12:00–12:45

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ABSTRACT

The talk introduces a novel control design framework for addressing a variety of control problems for broad classes of nonlinear systems, such as stabilization, trajectory tracking, motion planning with obstacle avoidance, extremum seeking, and dynamic convex optimization. The proposed control design methods are based on ensuring that the system's solutions approximate the gradient-like flow of a specified potential function. Depending on how this approximation is achieved, two types of controls are developed: gradient-based and gradient-free. Gradient-based controls explicitly depend on the derivatives of a potential function and are effective when the analytical form of the potential is known, e.g., in motion planning problems with complete information about targets and obstacles. In this talk, such controllers are constructed for several classes of nonholonomic systems. While gradient-based controllers are well-established tools for stabilization and motion planning, many practical scenarios arise where the analytical expression of the potential function is either partially or entirely

unknown, making gradient computation infeasible. In these cases, gradient-free controls are designed to ensure gradient-like behavior without requiring explicit system descriptions or gradient computations. This is particularly useful in scenarios where target and obstacle locations are unknown, or in extremum seeking problems. Additionally, we will discuss the qualitative behavior of systems with the obtained controls, introducing novel asymptotic stability conditions and providing explicit estimates of convergence rates for essentially nonlinear dynamical systems.

We hope to see you there!

