Departamento de Matemática

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Dynamics of Linear Control Systems on $SE(3)$: Classification and Controllability

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Abstract

Geometric control theory is a branch of applied mathematics that draws on differential geometry, topology, and Lie theory to analyze and design complex control systems. This talk will introduce the fundamental concepts of the field, with particular emphasis on linear control systems defined on Lie groups. We will first discuss recent developments in the area, focusing on how symmetries, algebraic structures, and geometric reduction provide powerful tools for understanding nonlinear dynamics. Rather than treating non-Euclidean state spaces as a complication to be avoided, we will show how formulating control systems directly on Lie groups and homogeneous spaces reveals their underlying geometric and topological structure. To illustrate these ideas, the talk will conclude with a concrete study of the Special Euclidean group $SE(3)$, the natural mathematical setting for rigid-body motions in three-dimensional space. By examining the linear control systems induced on its lower-dimensional homogeneous spaces, we will demonstrate how abstract Lie-theoretic structures translate into the geometry of spatial motion.

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