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CCoM Seminar

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Invariant Differential Positivity

Abstract:

Monotone systems are of great interest for their numerous applications and close connections to many physical and biological systems. In linear spaces, a local characterisation of monotonicity is provided by differential positivity with respect to a constant cone field, which combines positivity theory with a local analysis of nonlinear dynamics. Since many dynamical systems are naturally defined on nonlinear spaces, it is important to develop the concept on such spaces. The question of how to define monotonicity on a nonlinear manifold is complicated by the absence of a general and well-defined notion of order in such settings. Fortunately, for Lie groups and important examples of homogeneous spaces that are ubiquitous in many problems of engineering and applied mathematics, symmetry provides a way forward. Specifically, the existence of a notion of geometric invariance on such spaces allows for the generation of invariant cone fields, which in turn induce conal orders. We propose differential positivity with respect to invariant cone fields as a natural and powerful generalisation of monotonicity to nonlinear spaces. We illustrate the key concepts with examples from consensus theory on Lie groups and operator theory on the set of positive definite matrices.

Host: Melvin Leok

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