Numerical Analysis and Scientific Computing Seminar

The Interplay of Curvature and Control in Dynamical Systems

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Abstract: This talk will focus on recent advances in geometry and control with a specific emphasis on how curvature (a measure of flatness in Riemannian geometry) is intimately tied to rate functions with applications in areas of inverse problems in autonomy, systems biology, to seemingly disparate areas in economics. In the first part of this talk, we will motivate our discussion with a broader thematic result due to Lott, Villani, and Sturm whereby one form of curvature, namely Ricci curvature, is intimately connected to Boltzmann entropy. In turn, we reexamine the open problem of developing Ricci curvature over discrete metric spaces and how such advances that leverage coarse geometry can be employed to exploit (network) functionality. For example, by placing a probability structure on a graph as opposed to dealing directly with the discrete space, the graph can be treated as a Riemannian manifold for which there exists a richness of tools and advantages that will be discussed. Other (combinatorial) discretizations will be introduced and their use in the context of control towards biological systems. From this and through the lens of Riemannian geometry, we will then pivot towards inverse problems in imaging for the second half of the talk. Here, we will show that stability of classical 3D shape inversion from a 2D scene is intimately tied to a form of curvature. Time permitting, we will close with a few problems in economics. Such disparate applications are presented with the intent to highlight the richness of interplay between Riemannian geometry and control and as such, this talk is designed to be accessible to a general audience with an interest in any of the above domains with a general interest in dynamical systems. ¡br¿¡br¿Romeil Sandhu is currently an Assistant Professor at Stony Brook University with appointments in Biomedical Informatics and Applied Mathematics & Statistics Departments. He is the recipient of the AFOSR YIP Award for work on 2D3D feedback control and machine learning for autonomous systems and NSF CAREER Award for work on geometric optimization of time-varying networks. Romeil first received his B.S. and M.S, and Ph.D. degrees from the Georgia Institute of Technology. His research interest focuses on the broad area of applied geometry, topology, & control towards the understanding of faltering autonomous agents in an unknown environment where ambiguity often arises.

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