Abstract for GR-TR Conference on Statistical Mechanics and Dynamical Systems

Talk Invited Invited Talk

Information Geometry and Quantum Dynamical Systems: Conceptual Problems and Potential Applications

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Information Geometry is a Riemannian geometry of manifolds of distributions. For classical distributions, the Fisher metric is effectively unique and the geometric set up offers useful tools for parameter estimation problems, neural networks and other classical applications. For Quantum Mechanics, and the corresponding manifolds of quantum states, i.e. spaces of density operators, there is a host of non equivalent Riemannian metrics with information content. Tools for the quantum estimation problem have been developed, the concept of quantum dual connections has been analyzed, but the potential of the geometric structure is still not fully explored. Here we present some results related to problems which concern quantum dynamical systems and can be formulated and studied with techniques of quantum information manifolds. We first make a short introduction to the main concepts of Information Geometry. Then we introduce an approach to the geometric structure using the phase-space formulation of Quantum Mechanics and discuss the possibilities it offers for the semi-classical analysis. Next we present some results on symmetries of information manifolds and their relation to evolution problems. General quantum processes and specifically decoherence are formulated in the information geometric language. Finally we present some ideas about the development of techniques related to control theory and other potential applications.