Mathematics, Statistics, and Computer Science **@ UIC**

Analysis and Applied Mathematics Seminar

Studying dynamics using computational polynomial optimization

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Abstract: Many complex systems are governed by nonlinear ODEs or PDEs that cannot be solved exactly. Various properties of such solutions can be inferred by constructing auxiliary functions satisfying suitable inequalities. The most familiar example is the construction of Lyapunov functions to infer stability of particular states, but similar approaches can produce many other types of mathematical statements, including for systems with chaotic or otherwise complicated behavior. Such statements include estimates of time-averaged quantities and extreme transient behavior, approximation of nonlinear stability properties, and design of controls. In many cases, the search for the auxiliary function that implies the strongest mathematical statement can be posed as a convex optimization problem. Such problems can be studied analytically or computationally, but in most cases computation is needed to find solutions that are close to optimal. Of particular use are computational methods of polynomial optimization, where the optimization constraints include polynomial inequalities. This talk will provide an overview of different ways in which auxiliary functions can be used to study nonlinear ODEs and PDEs, as well as how polynomial optimization can be used to implement these methods computationally. Methods will be illustrated using applications to various complex systems.

Monday, February 24 at 4:00 PM in 636 SEO