Title: **Structured Sum of Squares Polynomials in Optimization and Control**

In recent years, algebraic techniques in optimization such as sum of squares (SOS) programming have led to powerful semidefinite programming relaxations for a wide range of NP-hard problems in computational mathematics. We begin by giving an overview of these techniques, emphasizing mainly their implications for optimization and Lyapunov analysis of dynamical systems, and pointing out some challenges that remain in terms of scalability. We then introduce new algebraic relaxation schemes that are very similar to SOS relaxations in nature but instead of semidefinite programs result in linear or second order cone programs. These are what we call "DSOS and SDSOS programs." We show that these relaxations are orders of magnitude more scalable than SOS relaxations while enjoying many of the same asymptotic theoretical guarantees. (Joint work with Anirudha Majumdar.)

Time permitting, we will also present our recently-introduced area of "robust-to-dynamics optimization", which has to do with optimizing over invariant sets of dynamical systems. (Joint work with Oktay Gunluk.)

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