ACMS Applied Math Seminar

Maggie Regan

University of Notre Dame

Thursday, October 3, 2019

154 Hurley Hall

3:30 - 4:30 P.M.

Applications of Parameterized Polynomial Systems

Many problems in computer vision and engineering can be formulated using a parameterized system of polynomials which must be solved for given instances of the parameters. Due to the nature of these applications, solutions and behavior over the real numbers are those that provide meaningful information for the system. I use homotopy continuation within numerical algebraic geometry to solve these parameterized polynomial systems. First, I propose a new approach which uses locally adaptive methods and sparse matrix calculations to solve parameterized overdetermined systems in projective space. Examples will be provided in 2D image reconstruction to compare the new methods with traditional approaches in numerical algebraic geometry. Second, I discuss new homotopy continuation methods for solving two minimal trifocal calibrated relative pose problems defined by point and line correspondences, which appear together, e.g., in urban scenes or observing curves. Simulations and comparisons will be shown using real and synthetic data to demonstrate that challenging scenes can be reconstructed where standard methods fail. Third, I will present on a new definition of monodromy action over the real numbers which encodes tiered characteristics regarding real solutions. Examples will be given to show the benefits of this definition over a naive extension of the monodromy group (over the complex numbers). In addition, an application in kinematics will be discussed to highlight the computational method and impact on calibration.