Analyzing and Synthesizing Safety for Dynamical Systems

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Abstract:

Safety is one of the most important and fundamental properties for intelligent autonomous systems. Take robotics systems for example, safety requires collision avoidance in the environment, and velocity of the robot to be bounded. Control Barrier Functions (CBF) have been proposed as analogous to Control Lyapunov Functions (CLF) but for certifying safety in dynamical systems. Existing works have explored using CBF into min-norm control or model predictive control frameworks for safe controller design. However, most of the methods are *fixing* the CBF for a convex formulation, this however, sacrificing feasibility and safety for many cases. In this talk, we will discuss about how to efficiently co-design a CBF and a safe feedback controller by solving a semi-definite program. The proposed method can precisely handle the cases of high-relative degree, input saturation, and model uncertainty. We will motive the design with linear systems and then show generalizations to nonlinear systems. Finally, we will discuss how to design safe and stable control by using CBF and CLF.