Abstract:
A single controller may be inadequate for systems that experience structural changes that arise, for example, from component failures. Such systems are often modeled by a family of plants with structural diversity. At any given time the appropriate plant model is uncertain. Hybrid Adaptive techniques have been proposed to accommodate such systems. Hybrid Adaptation selects a controller from a predefined set to achieve performance goals. In general, the set of controllers is finite although the family of plants may be continuous. The objectives of this thesis are to design a small set of controllers containing at least one controller that guarantees stability for each plant in the family and a switching strategy to select a stabilizing controller. Individual controllers are parameter adaptive and the set of controllers is a control covering.

Strict Equivalence is proposed as a framework to partition plant families. Changes in Strict Equivalence invariants form surfaces that bound simultaneous regulation with smooth control, thus motivating hybrid adaptation. Three issues are presented: (1) If individual controllers are parameter-adaptive, how do bounds in simultaneous regulation relate to strict equivalence boundaries? What is the parameter-adaptive control method? (2) Plants near the aforementioned surfaces are sensitive to parameter perturbation. The Strict Equivalence canonical form facilitates an unfolding to efficiently model the nearby families of plants. (3) Design of switch logic for this 'Multiple Model Adaptive Control' strategy.