Title: Nonlinear Control of UAV’s Using Dynamic Inversion

Synopsis: Constructing a controller for unmanned aerial vehicles using nonlinear dynamic inversion for advanced applications.

Abstract: Unmanned aerial vehicles (UAVs) offer solutions to many high-value and high-risk missions. They have been used for both military and civilian applications. Main advantages of UAVs are that they are cheaper and pose no risk to human loss. In order to fully utilize the potential of these vehicles, their autonomy must be increased. However, the use of these vehicles is limited. One reason for this is that the controllers for these vehicles are designed using classical control system design techniques. Such controllers are based on linearized flight dynamics model and are designed to work for particular flight conditions. If the flight dynamics changes due to changes in flight speed and/or altitude, the controllers most likely will not function. This will result in the loss of the vehicle and expensive onboard sensors, equipment, and information stored. As the role of UAVs increases, UAVs are expected to fly over wide range of flight envelope characterized by frequent changes in dynamic pressure (change in speed and altitude). Controllers based on nonlinear flight dynamic models can work for the entire flight envelope. The purpose of this research ongoing at Cal Poly Pomona is to develop and validate via flight tests the nonlinear controllers for UAVs. A Twin-Engine UAV airplane is being used for this research. The nonlinear flight dynamics model for the airplane has been developed and validated using flight data. The airplane is equipped with a Piccolo II autopilot and was flown for flight data collection. The validated model is being used for the development of nonlinear controllers for the airplane. The controllers will be tested in the simulation including software-in-the-loop and hardware-in-the-loop simulations. Once found satisfactory in these simulations, the controllers will be tested in flight.