Modern aircraft, military and commercial, rely extensively on hydraulic systems. However, there is great interest in the avionics community to replace hydraulic systems with electric systems. There are physical challenges to replacing hydraulic actuators with electromechanical actuators (EMAs), especially for flight control surface actuation. These include dynamic heat generation and power management.

Simulation is seen as a powerful tool in making the transition to all-electric aircraft by predicting the dynamic heat generated and the power flow in the EMA. Chapter 2 of this dissertation describes the nonlinear, lumped-element, integrated modeling of a permanent magnet (PM) motor used in an EMA. This model is capable of representing transient dynamics of an EMA mechanically, electrically, and thermally.

Inductance is a primary parameter that links the electrical and mechanical domains and, therefore, is of critical importance to the modeling of the whole EMA. In the dynamic mode of operation of an EMA, the inductances are quite nonlinear. Chapter 3 details the careful analysis of the inductances from finite element software and the mathematical modeling of these inductances for use in the overall EMA model.

Equally important to the modeling effort is the ability to precisely predict the performance of the electric power generator, from which the EMA draws its power. To do this, an electric generator with an exciter and main generator are dynamically simulated using nonlinear inductances. Chapter 4 details this effort extending the work of Chapter 3 to accommodate the greater complexities of generators.

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The public is welcome to attend.