Title: Performance Based Multidisciplinary Design Optimization of Energy Efficient and Novel Aircraft Configurations

Abstract

Presently, in line with the permanent need to increase speed and capacity, the aircraft industry faces the demanding challenge to reduce the environmental impact of air transportation, often leading to strict and conflicting requirements. To incorporate these challenges in preliminary aircraft design, it is necessary to explore Multidisciplinary Design Optimization (MDO). For this purpose, a performance based MDO framework was developed with the capability of analyzing novel configurations and morphing wing solutions. This tool integrates the main aircraft design disciplines specially formulated to incorporate the performance constraints. A morphing wingtip concept and a joined-wing configuration were optimized with the goal of maximizing range and minimizing fuel consumption. Another current trend in novel aircraft design is to increase the wing aspect-ratio to reduce the aerodynamic induced drag and minimize fuel burned. However, high deformations are associated with high aspect-ratio wings due to the higher wing flexibility. Hence, an additional effort was included in the current thesis to study the nonlinear aeroelasticity of high aspect ratio wings. The influence of geometric and stiffness parameters was investigated on the aeroelastic performance in terms of flutter and divergence speeds.

Keywords: Preliminary Aircraft Design, Multidisciplinary Design Optimization, Aircraft Performance, Optimization Architecture, Morphing Aircraft, Joined-Wing Aircraft, High Aspect-Ratio Wings, Nonlinear Aeroelasticity, Aeroelastic Scaling, Energy Efficiency.