Aeroservoelastic Analysis of the Effects of Camber and Twist on Tactical Unmanned Aerial Vehicle Mission-Adaptive Wings

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Abstract

The most impotartant design reqirements in Unmanned Aerial Vehicles like in all air vehicles are weight reduction, fuel consumption reduction, maneuvrability and silence. In this project, a wing that is optimised for all these requirements will be designed. The aim of the project is to design, manufacture and test a wing that will sense the optimum aerodynamic force distribution required by the mission with its sensors and create the wing shape that will produce the required force distribution by actuators.

The smart wing will be designed to optimize the lift/drag ratio for a given flight condition. This will result in reduced fuel consumption rate, which will allow reaching longer distances with the same amount of fuel or stay airborne for a longer duration. Besides, the weight gain through less fuel requirement will allow more payload to be carried. Moreover, the control surfaces and high lift devices will be eliminated to the maximum possible extent, thus compared to a conventional wing, the smart wing will have a less number of mechanical devices. This will manifest itself in a lighter and less complicated structure.

To reach this objective, a control mechanism will be developed with sensors that will be distributed over the wing and actuators that will acquire the signals coming from the sensors. This mechanism will not only be self-sensing and actuating, but will be robust as well. The fundamental task of the actuators is to modify the geometry of the wing such that the aerodynamic load distribution of the wing is as desired.

Keywords: Unmanned Aerial Vehicles, smart structures, mission-adaptive wing, active vibration control, robust control, optimization, aeroelasticity, camber, twist