Aerodynamic Performance Benefits of Utilising Camber Morphing Wings for Unmanned Air Vehicles

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Abstract

This work considers the effects of camber morphing, both in magnitude and chord position, on the performance of a generic unmanned air vehicle (UAV). Specifically, the enhancement of range, endurance, and stall speed is sought by means of maximising their aerodynamic performance parameters, C_L/C_D, $C_L^{3/2}/C_D$, and C_{Lmax} respectively. An analysis of the effects of camber morphing is carried out using the vortex panel code, XFOIL, utilising aerofoils from the NACA 4-digit family. The results are then adjusted to account for 3D flow factors such as induced drag, offering a more realistic appraisal of their effectiveness. Flight testing is then performed on four wings of fixed aerofoil sections, optimised for each performance characteristic, to validate the trends observed in the XFOIL data onboard a 1.64m span aircraft.

Biography

Alberto Garcia Naranjo is an Engineer at Blue Bear Systems Research (BBSR). Alberto joined the company in 2007 as a KTP Associate from the University of Sheffield investigating rapid prototyping techniques for micro air vehicle airframes. He is currently completing his MPhil dissertation at the University of Sheffield in camber morphing technology.

Dr. Ian Cowling is a Senior Scientist at Blue Bear Systems Research. Ian joined BBSR in 2007 after completing his PhD at Cranfield University where he researched optimal guidance and control for a quadrotor UAV.

John Green is a Principal Engineer at BBSR specialising in modelling and aerodynamics. He has 20 years experience in the defence industry and holds a degree in Aeronautical Engineering from the University of Bristol.

Prof. Ning Qin is a Professor of Aerodynamics and Head of the Thermofluids Group at the University of Sheffield. His current research interest includes aerodynamic design optimisation, flow control, and meshing techniques for unsteady aerodynamics.