Lees-Kubota Lecture Hall

Aeronautics Seminar Series

Monday, May 16th :: 1:00 pm

Guggenheim 101

"Adaptive Airfoil Dynamic Stall Control"

Michael Kerho

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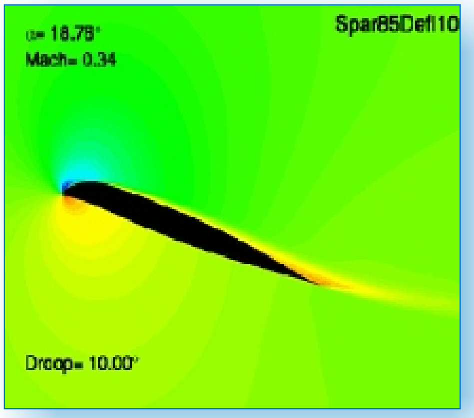

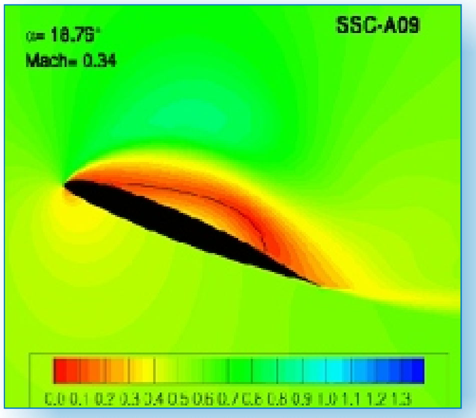

The research to be presented investigates an adaptive airfoil design to alleviate, or greatly reduce the negative effects of dynamic stall on rotorcraft blades. The adaptive airfoil design uses compliant structures technology to design an aerodynamically smooth, variable droop leading-edge for airfoil dynamic stall control. Compliant structures technology coupled with variable camber leading-edge dynamic stall control has the potential to significantly improve the performance of modern rotorcraft. The research presented will focus on the numerical predictions of the aerodynamic performance of the adaptive leading-edge. Both steady and unsteady time accurate numerical predictions for a 2-D pitching and deforming airfoil have been performed using a modified version of the NavierStokes solver OVERFLOW. The OVERFLOW code was modified to allow for a dynamically deforming grid system. In addition to the dynamic pitch and deformation capability, the OVERFLOW code was modified to allow for a variable Mach number throughout the pitch cycle. The varying Mach number is used to more closely mimic the rotational behavior of the rotorcraft blade in forward flight. Numerical simulations were obtained with increasing complexity: from a simple fixed Mach number with a sinusoidal pitch cycle through a prescribed CAMRAD II pitch distribution with fully variable Mach and a dynamically deforming airfoil. Results obtained to date indicate that the variable droop/camber compliant leading-edge system can achieve a higher Clmax than a baseline section, or eliminate the dynamic stall vortex at a Cl equivalent to the baseline section Clmax while maintaining the baseline section's high Mach number advancing blade characteristics.