Aerodynamics and Aeroelasticity Methodologies for Future Concepts in Vertical Lift

Marilyn J. Smith
Professor and Director, Vertical Lift Research Center of Excellence
Georgia Institute of Technology
Atlanta, GA USA

Vertical lift concepts for future applications across the military and civilian sectors transcend traditional helicopter designs. Military specifications call for new configurations with increased forward flight speeds, increased maneuverability, and significant reductions in drag, as well as operation in challenging environments. Concurrently, civilian thrusts in the vertical take-off and landing regime call for many of the same design improvements, with concepts ranging from small delivery drones to urban air mobility. Future operations may be as a single vehicle, teamed with another vehicle, or as a swarm, and these may be piloted or unpiloted.

In order to meet the plethora of new design goals, engineers must be able to apply high-fidelity methodologies earlier in the design cycle. This presentation will discuss current high-fidelity aerodynamic methodologies under development to meet these advanced design goals, including adjoint optimizations, dual-solver hybridization, and first-principles-based reduced-order modeling. Some of these designs will require revolutionary technologies integrated into the vehicles, such as virtual surfaces from flow control. Development of aerodynamic methodologies to more accurately predict these integrated technologies are needed for design, but also to understand the underlying physics. Finally, the ability of these aerodynamic tools to improve interdisciplinary predictions that are inherent to vertical lift, such as aeroelasticity and aeroacoustics will be discussed.

150 Words

Vertical lift concepts for future applications across the military and civilian sectors transcend traditional helicopter designs. Military specifications call for new configurations with increased forward flight speeds, increased maneuverability, and significant reductions in drag, as well as operation in challenging environments. Civilian designs call for many of the same improvements, with concepts ranging from small delivery drones to urban air mobility. To meet the plethora of new design goals, engineers must be able to apply high-fidelity methodologies earlier in the design cycle. This presentation will discuss aerodynamic methodologies to meet these advanced design goals, including adjoint optimizations, dual-solver hybridization, and first-principles-based reduced-order modeling. Development of aerodynamic methodologies to more accurately predict these integrated technologies are needed for design, but also to understand the underlying physics. The ability of these aerodynamic tools to improve interdisciplinary predictions that are inherent to vertical lift, such as aeroelasticity and aeroacoustics will be discussed.