INSPIRING NEXT GENERATIONS

Multi-Fidelity Modeling for Vehicle Design

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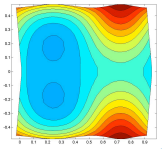
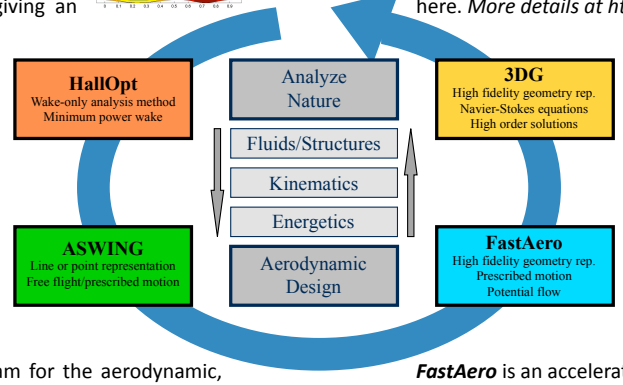
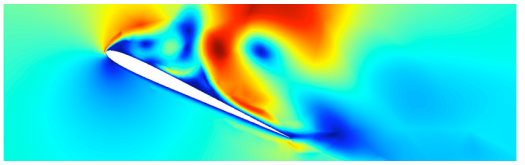
A set of computational tools enables the aerodynamic and structural analysis of flying vehicles at different levels of physical fidelity. These range from a wake-only potential flow to the Navier-Stokes equations.

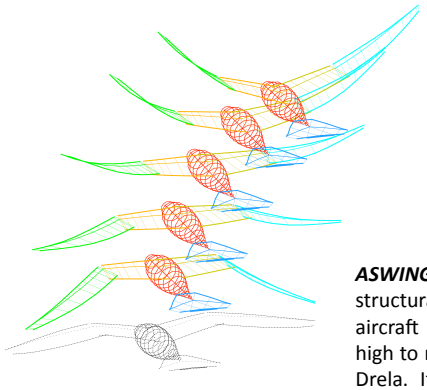
HallOpt is a wake-only potential flow analysis tool, based on a generalization of Betz' criterion for unsteady periodic flow proposed by the Hall Brothers. The idea is to determine the optimal distribution of vorticity (or circulation) in a wake shed by a flapping wing. The method provides the best possible vorticity distribution (as shown in the picture) for a given set of aerodynamic forces, thus giving an upper bound on the efficiency of the flight. *More details at http://www.mit.edu/~djwillis/FlappingFlight/HallOpt.html*



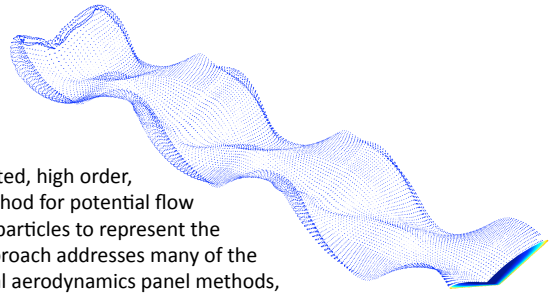


3DG is a high order Navier-Stokes solver which is based on the Discontinuous Galerkin method, originally written by P.O. Persson and J. Peraire. It has been developed to be a primarily compact code which can effectively address the high accuracy desired in many different situations (Fluid Structure Interactions, Acoustics, etc.). Mach number contours around a pitching HT13 airfoil are shown here. *More details at http://threedg.mit.edu*





ASWING is a program for the aerodynamic, structural, and control-response analysis of aircraft with flexible wings and fuselages of high to moderate aspect ratio, created by M. Drela. It combines an unsteady lifting-line line aerodynamic model, a non-linear beam structural model, and flight dynamics and controls. Here it is being used to simulate a flexible flapping bird. *More details at http://web.mit.edu/drela/Public/web/aswing/*



FastAero is an accelerated, high order, Boundary-Element Method for potential flow Combined with vortex-particles to represent the flow vorticity. This approach addresses many of the drawbacks of traditional aerodynamics panel methods, and provides a fast analysis tool. An example of wake shape is shown here. *More details at http://www.mit.edu/~djwillis/FlappingFlight/FastAero.html*

For more information visit the various links
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