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Fast Potential Flow Computations for Low-order Aerodynamic Modeling[1] DIEDERIK BECKERS, JEFF D. ELDREDGE, University of California, Los Angeles — Potential flow plays an important role in many applications, including flow estimation in aerodynamics. For the models in these applications to work efficiently, it is best to avoid Biot-Savart interactions between the potential flow elements, particularly for 3D models. This work addresses grid-based computations for potential flows in 2D and 3D and their implementation in a low-order vortex model for fast modeling of separated aerodynamic flows and gust interactions. The model uses the immersed boundary projection method to solve for the vector potential field subject to the constraints introduced by the presence of a body, any edge conditions, and Kelvins circulation theorem, with each constraint adding a Lagrange multiplier to the overall saddle point system. Sharp edges are treated by decomposing the body forcing Lagrange multiplier into a singular and non-singular part. To enforce the Kutta condition, the non-singular part can then be tuned to remove the singularity introduced by the sharp edge. The equations are discretized on a staggered Cartesian grid and solved using the lattice Greens function. The accuracy of these computations is demonstrated for a flat plate shedding singular vortex elements in 2D and the extension to 3D flows will be discussed.

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