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Calculating forces on thin flat plates with incomplete vorticity-field data ERIC LIMACHER, CHRIS MORTON, DAVID WOOD, University of Calgary — Optical experimental techniques such as particle image velocimetry (PIV) permit detailed quantification of velocities in the wakes of bluff bodies. Patterns in the wake development are significant to force generation, but it is not trivial to quantitatively relate changes in the wake to changes in measured forces. Key difficulties in this regard include: (i) accurate quantification of velocities close to the body, and (ii) the effect of missing velocity or vorticity data in regions where optical access is obscured. In the present work, we consider force formulations based on the vorticity field, wherein mathematical manipulation eliminates the need for accurate near-body velocity information. Attention is restricted to nominally two dimensional problems, namely (i) a linearly accelerating flat plate, investigated using PIV in a water tunnel, and (ii) a pitching plate in a freestream flow, as investigated numerically by Wang & Eldredge (2013). The effect of missing vorticity data on the pressure side of the plate has a significant impact on the calculation of force for the pitching plate test case. Fortunately, if the vorticity on the pressure side remains confined to a thin boundary layer, simple corrections can be applied to recover a force estimate.

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