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Balance equations for triple-joint vortex-sheet structures XI XIA, KAMRAN MOHSENI, University of Florida — A vortex sheet is the limiting case for a viscous shear layer as the thickness approaches zero. Recently, vortex-sheet based flow models have been demonstrated to provide significant reduction for numerical simulations of viscous and inviscid flows. In such modeling approaches, a prominent phenomenon is the formation of a new vortex sheet from existing vortex sheets, thereby creating a triple-joint vortex-sheet structure. In this study, the formation of the new vortex sheet is analytically determined by applying conservation laws of mass and momentum to flow surrounding the entire triple-joint vortex-sheet structure, together with the boundary conditions specific to any application. As a result, a general condition is obtained to determine the angle, strength, and velocity of the new vortex sheet. This model is validated by simulating airfoils in steady and unsteady background flows and comparing the flow structures and force calculations with experimental data. While the performance of this model is demonstrated in this study for the vortex shedding problem at the trailing edge, its future applications could be extended to flow separation on a smooth surface and triple contact point of multi-phase flows.

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