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Force Element Theory for Finite Wings at Low Reynolds numbers CHIN-CHOU CHU, JIAN-JHIH LEE, CHENG-TA HSIEH, CHIEN-CHENG CHANG, National Taiwan University — This paper is aimed to examine various contributions to the forces on an impulsively started finite plate from the perspective of a force-element representation. The wing plate has an aspect ratio (AR) between 1 and 3, and is placed at low and high angles of attack (α =5°, 10°, 15°, 30°, 45°, and 60°), while the Reynolds number Re is varied between 100 or 300. The force theory enables us to quantify the contributions to the forces exerted on the plate in terms of all the fluid elements with nonzero vorticity, such as in the tip vortices (TiVs), leading- and trailing-edge vortices (LEV and TEV) as well on the plate surface. The present vorticity force analysis (VFA) was made parallel to the pressure force analysis (PFA) by examining the sectional force contributions along the wing span, but can further extend to include the outer regions (of TiVs). The interplay between the LEV and the TiVs by assessing the relative importance of the transverse as well as the longitudinal vorticity components at various time stages leads to insightful physical explanations of the force mechanisms.

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