Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Vortex Force Map Method for Unsteady Incompressible Viscous Flows[1] JUAN LI, XIAOWEI ZHAO, The university of Warwick — Recently, Li & Wu (2017, 2018) proposed a vortex force map method for a flat plate and extended it to general airfoils at high Reynolds numbers by adopting Howe's (1995) force formula for the derivation of the vortex force vectors. Here, the vortex force map method is refined to have the capability of dealing with more general cases for a larger range of Reynolds numbers. Updated vortex-pressure force maps, which ensure vortices far away from the body have negligible effect on body-force, are built based on the vortex-pressure force factors derived from viscous governing equations. These maps help us identify the force contribution role of each given vortex more precisely than the ones presented previously. The impulsively started flows around a cylinder and a NACA0012 airfoil are used to demonstrate the applications of this vortex force map method. CFD is used to provide the velocity and vorticity data, as well as for validations by comparing the forces directly given by it with those from the proposed vortex force map method. In order to explore the possibility of applying this method to extracting forces from PIV data, the accuracy of this approach on small domains and under coarse sampling is demonstrated.

[1]the Marie Sklodowska-Curie grant agreement No.765579

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Date submitted: 31 Jul 2019 Electronic form version 1.4