Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

A reduced model for vortex shedding from a body using matched asymptotics[1] SHREYAS MANDRE, XINJUN GUO, PONNULAKSHMI V. K., Brown University — Flow around a solid body at high Reynolds number is often computed efficiently using inviscid vortex methods, if the distribution of vorticity shed from the surface of the body can be predicted accurately. The only method currently available for predicting the shed vorticity is by the application of the Kutta condition, which applies to slender wings at the leading and trailing edges. Therefore, benefit from the high Reynolds number approximation is limited to situations where the Kutta condition is applicable. We present a method based on matched asymptotic analysis to compute the strength and distribution of vorticity shed from rigid bodies of smooth but otherwise arbitrary shape executing arbitrary motion in a uniform far-field flow. The method decomposes he flow domain in an inviscid outer region and a thin viscous boundary layer near the solid body. The flow is approximated by inviscid vorticity dynamics in the outer region and Prandtl's boundary layer theory in the boundary layer. The treatment of the boundary layer dynamics may be considered analogous to the Kutta condition, which yields an approximation to the shed vorticity. An approximately 100-fold increase in computational speed may be achieved using this method compared to direct numerical simulations.

[1]AFOSR Award # FA9550-12-1-0099

Shreyas Mandre
Brown University

Date submitted: 01 Aug 2014 Electronic form version 1.4