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High order viscous vortex methods with deforming elliptical Gaussians LOUIS ROSSI, University of Delaware, RODRIGO PLATTE, Arizona State University — Vortex methods are numerical schemes for approximating solutions to the Navier-Stokes equations using a linear combination of moving basis functions to approximate the vorticity field of a fluid. Typically, the basis function velocity is determined through a Biot-Savart integral applied at the basis function centroid. Since vortex methods are naturally adaptive, they are advantageous in flows dominated by localized regions of vorticity such as jets, wakes and boundary layers. A semi-discrete convergence formulation leads to a new viscous vortex method based on deforming elliptical Gaussian basis functions that achieves fourth order spatial convergence. One odd thing about the new method is that basis functions do not move with the physical flow velocity at the basis function centroid as is usually specified in vortex methods. Rather, high order accuracy is obtained when one adds a consistently small flow field curvature correction. We will present two distinct approaches to the evaluation of the Biot-Savart integral for elliptical Gaussian basis functions. Non-trivial flow field calculations will demonstrate the efficacy of the method for both convection-diffusion problems and Navier-Stokes flows in 2D.

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