

# A Particle Method and Adaptive Treecode for Vortex Sheet Motion in 3-D Flow

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**Abstract:** A particle method for computing vortex sheet motion in three-dimensional flow will be described. The particles representing the sheet are advected by a regularized Biot-Savart integral. New particles are inserted to maintain resolution as the sheet rolls up. The particle velocities are evaluated using an adaptive version of the Barnes-Hut treecode that reduces the operation count from  $O(N^2)$  to  $O(N \log N)$ , where  $N$  is the number of particles representing the sheet. The present treecode algorithm uses multidimensional Taylor approximation in Cartesian coordinates to evaluate the particle-cluster interactions. The necessary Taylor coefficients of the regularized Biot-Savart kernel are computed using a recurrence relation. The adaptive features include nonuniform clusters, variable-order approximation, and a run-time choice between Taylor approximation and direct summation. Simulation results will be presented for the formation of azimuthal waves on a vortex ring and the merger of two vortex rings. (This is joint work with Keith Lindsay, NCAR.)