

# Computing Concentrated Vortices Using Nonlinear Solitary Waves

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**Abstract:** A new method is described to efficiently simulate thin features, such as vortex filaments, in Eulerian computations on fixed, coarse grids. The method, Vorticity Confinement, involves treating the features as solitary waves that obey nonlinear, difference equations, which are different from Taylor expansion based discrete approximations to the governing, partial differential equations (pdes). These equations are rotationally invariant generalizations to multiple dimensions of 1-D discontinuity Confinement schemes. This allows additional physics to be simulated on the small scales of 1-3 grid cells which would ordinarily be lost due to numerical effects in pure pde-based finite difference approximations. In addition to small scales, the method is also efficient for large scales since it automatically reverts to conventional CFD for them.