1063-35-220 **Thomas Y. Hou*** (hou@acm.caltech.edu), Applied and Comput. Math, 217-50, Caltech, Pasadena, CA 91125. *On dynamic stability and non-blow-up of a class of solutions of 3D incompressible Euler and surface QG equations.*

Whether the 3D incompressible Navier-Stokes equations can develop a finite time singularity from smooth initial data is one of the most challenging problems for both computation and analysis. We review some recent theoretical and computational studies of the 3D Euler equations which show that there is a subtle dynamic depletion of nonlinear vortex stretching due to local geometric regularity of vortex filaments. Our study reveals a surprising nonlinear stabilizing effect that the convection term plays in regularizing the solution. Finally, we present a new class of solutions for the 3D Euler and surface QG equation, which exhibit very interesting dynamic growth property. By exploiting the special structure of the solution and the dynamic balance between the vortex stretching term and the local geometric property of the solution, we prove nonlinear stability and the global regularity of this class of solutions. (Received August 16, 2010)