Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

A Framework for Linear Stability Analysis of Finite–Area Vortices BARTOSZ PROTAS, McMaster University, ALAN ELCRAT, Wichita State University — In this work we are interested in the linear stability of 2D solutions of the Euler equations which are steady in the appropriate frame of reference and feature compact regions with constant vorticity embedded in an otherwise potential flow. We argue that, since the evolution of such systems is governed by equations of the free–boundary type, the *shape calculus* is a natural framework for differentiation of such governing equations. We derive a general equation characterizing the evolution of area–preserving perturbations of the boundary. While for vortex regions with arbitrary shapes the perturbation equation needs to solved numerically (e.g., using spectral Fourier–Galerkin method), we show that for a circular boundary (i.e., the Rankine vortex) the problem can be solved analytically yielding the classical stability results due to Kelvin. We will also present stability calculation obtained numerically for more general vortex shapes and will discuss generalizations of this approach.

Bartosz Protas
McMaster University

Date submitted: 05 Aug 2010 Electronic form version 1.4