Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Inverse Problem of Vortex Reconstruction BARTOSZ PROTAS, McMaster University, IONUT DANAILA, Université de Rouen — This study addresses the following question: given incomplete measurements of the velocity field induced by a vortex, can one determine the structure of the vortex? Assuming that the flow is incompressible, inviscid and stationary in the frame of reference moving with the vortex, the "structure" of the vortex is uniquely characterized by the functional relation between the streamfunction and vorticity. To focus attention, 3D axisymmetric vortex rings are considered. We show how this inverse problem can be framed as an optimization problem which can then be efficiently solved using variational techniques. More precisely, we use measurements of the tangential velocity on some contour to reconstruct the function defining the streamfunction-vorticity relation in a continuous setting. Two test cases are presented, involving Hill's and Norbury vortices, in which very good reconstructions are obtained. A key result of this study is the application of our approach to obtain an optimal inviscid vortex model in an actual viscous flow problem based on DNS data which leads to a number of nonintuitive findings.

Bartosz Protas
McMaster University

Date submitted: 31 Jul 2014 Electronic form version 1.4