Texas Tech University - Department of Mathematics and Statistics

Seminar in Applied Mathematics

Linear stability for solutions of the vortex filament flow hierarchy

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ABSTRACT. The vortex filament equation or VFE, an idealized model for the motion of thin vortex lines in an incompressible fluid, is part of a hierarchy of commuting, completely integrable geometric evolution equations for space curves. This hierarchy is linked to the integrable nonlinear Schrodinger equation (NLS) by the Hasimoto transformation, and this connection enables us to construct a wealth of finite-gap solutions to the VFE and its higher-order companion flows.

We study the linear stability of closed loop VFE solutions, and show that these are generically linearly unstable in the presence of a double periodic point in the Floquet spectrum; in particular, weve shown that (p,q) torus knots are generically linearly unstable as VFE solutions for p¡q, and we find examples of neutrally stable knots for p¿q, both of which give counterexamples to claims made in earlier studies by Ricca et al. We also address the generalizations of these results to higher-order flows in the hierarchy. This is joint work with Annalisa Calini and Stephane Lafortune.