The stability of capillary waves on fluid sheets

Mark Blyth, University of East Anglia

The linear stability of finite amplitude capillary waves on inviscid sheets of fluid is discussed. A method similar to that recently used by Tiron & Choi (2012) to determine the stability of Crapper waves on fluid of infinite depth is developed by extending the conformal mapping technique of Dyachenko et al. (1996) to a form capable of capturing general periodic waves on both the upper and the lower surface of the sheet, including the symmetric and antisymmetric waves studied by Kinnersley (1976). Our primary and surprising result is that both symmetric and antisymmetric Kinnersley waves are unstable to small superharmonic disturbances. The waves are also unstable to subharmonic perturbations. Growth rates are computed for a range of steady waves in the Kinnersley family, and also waves found along the bifurcation branches identified by Blyth & Vanden-Broeck (2004). The instability results are corroborated by time integration of the fully nonlinear unsteady equations. Evidence is presented for superharmonic instability of nonlinear waves via a collision of eigenvalues on the imaginary axis which appear to have the same Krein signature.