Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Variational Methods For Sloshing Problems With Surface Tension. CHEE HAN TAN, MAX CARLSON, CHRISTEL HOHENEGGER, BRAXTON OSTING, Univ of Utah — We consider the sloshing problem for an incompressible, inviscid, irrotational fluid in a container, including effects due to surface tension on the free surface. We restrict ourselves to a constant contact angle and we seek time-harmonic solutions of the linearized problem, which describes the time-evolution of the fluid due to a small initial disturbance of the surface at rest. As opposed to the zero surface tension case, where the problem reduces to a partial differential equation for the velocity potential, we obtain a coupled system for the velocity potential and the free surface displacement. We derive a new variational formulation of the coupled problem and establish the existence of solutions using the direct method from the Calculus of Variations. In the limit of zero surface tension, we recover the variational formulation of the classical Steklov eigenvalue problem, as derived by B. A. Troesch. For the particular case of an axially symmetric container, we propose a finite element numerical method for computing the sloshing modes of the coupled system. The scheme is implemented in FEniCS and we obtain a qualitative description of the effect of surface tension on the sloshing modes.

Chee Han Tan
Univ of Utah

Date submitted: 31 Jul 2016 Electronic form version 1.4