A study of the evolution and stability of resonant interfaces between two finite fluids.

The evolution and stability of interfaces which arise between two fluids of finite vertical extent, caused by the interaction of two different
harmonics of the fundamental, are very important for a number of applications, for example, stabilizing stratified oil and water in pipe flow, the creation of rogue waves and the understanding of the role of
dissipation. This however, requires an in-depth study of the waves which may be formed at the horizontal interface of two ideal fluids each of
finite vertical extent. The forces acting on the system are those of gravity and surface tension. It is assumed that when the system is unexcited the
interface is horizontal and the fluids have different velocities parallel to the interface.

Moreover, it is well-known that for certain distinguished values of the parameters resonance can occur in the sense that the linearised problem has a two dimensional solution space spanned by the Mth and Nth
harmonics of the motion and most of the work will be concerned with this situation. Having solved the linear problem, we would then proceed to the nonlinear problem. This problem would be studied via three or four coupled nonlinear partial differential equations which model, up to cubic order, the evolution of the interface. Finally the stability of these interfaces to small perturbations would be examined.