Capillary Gravity Water Waves Linearized at Monotone Shear Flows: Eigenvalues and Inviscid Damping

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Abstract We consider the 2-dim capillary gravity water wave problem – the free boundary problem of the Euler equation with gravity and surface tension – of finite depth $x_2 \in (-h, 0)$ linearized at a uniformly monotonic shear flow $U(x_2)$. Our main results consist of two aspects, eigenvalue distribution and inviscid damping. We first prove that in contrast to finite channel flow and gravity wave, the linearized capillary gravity wave has two branches of eigenvalues for high wave numbers. Under some certain conditions, we provide a complete picture of the eigenvalue distribution. Assuming there are no singular modes, we obtain the linear inviscid damping. Compare to the existing results in the finite channel flow, we identify the leading asymptotic terms of velocity and obtain the stronger decay for the remainders. This is a joint work with Chongchun Zeng.