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A Hamiltonian Dysthe equation for deep-water gravity waves with constant vorticity

In this talk I present a study of the water wave problem in a two-dimensional domain of infinite depth in the presence of nonzero constant vorticity. A goal is to describe the effects of uniform shear flow on the modulation of weakly nonlinear quasi-monochromatic surface gravity waves. Starting from the Hamiltonian formulation of this problem and using techniques from Hamiltonian transformation theory, we derive a Hamiltonian Dysthe equation for the time evolution of the wave envelope. Consistent with previous studies, we observe that the uniform shear flow tends to enhance or weaken the modulational instability of Stokes waves depending on its direction and strength. Our method also provides a non-perturbative procedure to reconstruct the surface elevation from the wave envelope, based on the Birkhoff normal form transformation to eliminate all non-resonant triads. This model is tested against direct numerical simulations of the full Euler equations and against a related Dysthe equation derived by Curtis, Carter and Kalisch (J. Fluid Mech., vol. 855, 2018, pp. 322–350) in the context of constant vorticity. Very good agreement is found for a range of values of the vorticity.