Coastal Zone Modelling of Ocean Waves Over Variable Bathymetry with Finite Gap Theory

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I consider coastal zone modeling of ocean surface waves using finite gap theory (FGT) for integrable Hamiltonian systems. In this characterization of ocean waves, the Riemann matrix contains the nonlinear modes of the sea state (sine waves, Stokes waves and solitons). By suitably modifying the Riemann spectrum over the variable bathymetric features, I am able to model the actual sea surface to high order, up to genus 100 in FGT and for thousands of linear Fourier modes. I apply the model to actual ocean wave data out to 15 meters water depth. The model is "hyperfast" in the sense that it is hundreds of times faster than typical Boussinesq models.