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A Hamiltonian Description of Overturning Water Waves

Extending the ideas of Craig (2017), we propose a geometric generalization of the Water Waves equations (the Zakharov-Craig-Sulem formulation of Euler's free-surface equations) in physical dimension 2 or 3 where the fluid's free surface is represented by a parametrized curve or surface instead of the graph of some function, thus providing a new model for possibly-overturning, inviscid and irrotational oceanic surface waves. Advection of the free surface is achieved in a Lagrangian manner.

We also introduce a novel variational principle with prescribed tangential velocity for breaking waves, along with the corresponding complete Hamiltonian structure describing both normal and tangential movements of the free surface.