Applied Mathematics and Water Wave Mechanics

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Abstract

Historically speaking, there is a close tie between applied mathematics and water wave mechanics. In this talk, a brief introduction to the mathematical modelling of water waves will be presented. Particular interest will be paid to the study of tsunamis generated by an underwater landslide. By analyzing the Laplace equation subject to linearized boundary conditions and also the linearized wave equation, several insights can be gained into the wave generation process of landslide tsunamis: 1) the tsunami generated by an underwater landslide consists of a free wave component that propagates freely and a locked wave component that follows the landslide; 2) the leading wave of the free wave component is primarily governed by the volume enclosed by the landslide, not its exact shape; 3) the locked wave component posesses the same amount of wave energy as the free wave component; 4) the locked wave component may appear deceivingly small in wave amplitude but with large flow velocities; 5) a maximum total wave energy exists as a function of the landslide travel time, which corresponds to the worst-case scenario. This talk shall outline the mathematical derivation for the above findings and seeks to highlight the practical value of the mathematical analysis.

Keywords water wave mechanics, tsunamis, Laplace equation, wave equation