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FAKULTÄT FÜR MATHEMATIK
Dekan Univ.-Prof. Dr. Christian Krattenthaler

Einladung zur öffentlichen Defensio von

Biswajit BASU

Thema der Dissertation:

Nonlinear wave-current interactions in water flows

Abstract:
The subject of this thesis is mathematical analysis of non-linear free surface waves interacting with currents. Large amplitude free surface two-dimensional (2D) water waves described by the Euler equations for incompressible and inviscid fluids under the influence of gravity over a finite depth are considered. With regard to the free boundary non-linear problem for large amplitude smooth travelling waves with underlying uniform currents, the qualitative nature of the flow and the pressure fields is investigated. The global existence of large amplitude 2D water waves have been proved resulting in the emergence of a new bifurcation branch. Bounds on the surface profile and wave height estimates have been derived. Conditions for the existence of solitary waves in 2D with uniform underlying current over a fixed mean depth have been proved. Investigations on the properties of the velocity field for steady periodic water waves over a flat bed have further been carried out for a generalized class of C^1 vorticity functions. Results are proved by exploiting the maximum principles based on a hodograph transformation of the fluid domain, thus generalizing some recently proven results. A new flowforce reformulation of the irrotational water waves have been developed. In this framework, the existence of small amplitude irrotational steady periodic water waves propagating over a flat bed and uniform underlying currents, with a given flow force is proved using a variational approach relying on the theory of Crandall-Rabinowitz. Some applications of the theoretical developments to problems in Geophysical Fluid Dynamics involving undercurrents have been presented.

Prüfungssenat:

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