Fluid Flows

Analysis and Modelling

Date: 24.IV.2024
Location: Sky Lounge
Faculty of Mathematics, University of Vienna
Oskar-Morgenstern-Platz 1, 1090 Vienna

In celebration of Professor R. S. Johnson 80th birthday and in honour of his contributions, this workshop aims to provide insight into recent developments in some research areas influenced by Professor Johnson's work, including asymptotic analysis, solitons, water waves and atmospheric flows.

9:30–9:45 Opening

9:45–10:30 J. Escher (Leibniz University Hannover): Some elliptic boundary-value problems in fluid mechanics

Abstract: Nonlinear edge waves may be described by quasi-linear equations with a principal part which are elliptic in some regimes. However, for solutions with a large gradient, the principal part fails to be elliptic in general. Existence results for periodic solutions are discussed. In the second part of the talk, linear elliptic transmission problems in a simple geometric set-up, but with point sources on some components of the boundary, are discussed.

10:30–11:15 R. I. Ivanov (Technological University Dublin): Long internal waves over variable bottom and solitons

Abstract: The effects of an uneven bottom on the internal wave propagation in the presence of stratification and underlying non-uniform currents is studied by means of a Hamiltonian approach. The presented models incorporate both wave-current interactions and a variable bathymetry. A physical example is given by the equatorial internal waves in the presence of the Equatorial Undercurrent. The internal wave is formed at the interface between two fluid layers with different characteristics. Physically the interface coincides approximately with the so-called thermocline and the pycnocline. The motion of the interface in the long wave approximation is modelled by a KdV-mKdV type equation (Gardner equation) with depth-dependent variable coefficients, accommodating solitons. This is joint work with C. I. Martin (Babes-Bolyai University, Cluj-Napoca, Romania) and M. D. Todorov (Bulgarian Academy of Sciences).

11:15–11:30 Tea and Coffee

11:30–12:15 J. Weber (University of Vienna): New results on global bifurcation of travelling periodic water waves

Abstract: While the research on water waves modelled by Euler's equations has a long history, mainly in the last two decades travelling periodic rotational waves have been constructed rigorously by means of bifurcation theorems. After introducing the problem, I will present a new reformulation in two dimensions in the pure-gravity case, where the problem is equivalently cast into a form amenable to Rabinowitz's global bifurcation theorem. The main advantages (and the novelty) of this new reformulation are that no simplifying restrictions on the geometry of the surface profile and no simplifying assumptions on the vorticity distribution (and thus no assumptions regarding the absence of stagnation points or critical layers) have to be made. Within the scope of this new formulation, global families of solutions, bifurcating from laminar flows with a flat surface, are constructed. Moreover, I will discuss the possible alternatives for the global set of solutions, as well as their nodal properties. This is joint work with Erik Wahlén.

12:15–13:00 P. Korn (Max-Planck-Institute for Meteorology, Hamburg): Sea-ice, its dynamics and its role in the climate system

Abstract: Sea-ice is a material with complex mechanical and thermodynamical properties whose dynamics span a vast range of spatio-temporal scales. Located in between atmosphere and ocean, it interacts with both components and plays an important role in the dynamics of the climate. In this talk I review the physical modelling of sea-ice, the mathematical analysis of sea-ice equations and the discrete representation of sea-ice in climate models.

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