科研費
KAKENHI

The two-day workshop on Recent Advances in Nonlinear Water Waves

Date : March 27 (Mon) & 28 (Tue), 2023

Place : The University of Tokyo (Faculty of Engineering Bldg.3, Room 424)

URL : http://murasige.sci.ibaraki.ac.jp/KAKEN_meeting_at_Tokyo_2023_SJIS.html

Program with abstract

March 27 (Mon)

14:00-14:10 Opening

14:10-15:00 Hidetaka Houtani (University of Tokyo)

Nonlinear processes in crest enhancement of modulated wave trains

Crest enhancement of modulated wave trains is investigated numerically and experimentally. This study shows that the three nonlinear processes, namely, spectral broadening, bound-wave production, and phase convergence, play vital roles in crest enhancement. During the nonlinear evolution of modulated wave trains, free wave spectra broaden owing to quasi-resonant interactions. This intensifies the bound wave production at high wavenumbers. Moreover, the phases of all the spectral components almost coincide at the peak of the modulation. Thus, the maximum crest height can exceed the Akhemediev breather prediction, which is a free-wave analytical solution of the nonlinear Schrödinger equation, within a weakly nonlinear potential theory regime. Experimental results also show that further crest enhancement exceeding the weakly nonlinear potential theory prediction can occur at the non-breaking/breaking margin owing to strong nonlinearity.

March 27 (Mon)

15:10-16:00 Takeshi Kataoka (Kobe University)

Experimental verification of strong nonlinearity of 1D ship wave

We conducted a simple laboratory experiment to verify strong nonlinearity of (horizontally) 1-dimensional ship waves which are formed behind a moving bottom topography. The experimental results are compared well with numerical and theoretical solutions that both exhibit strong nonlinearity of ship waves especially for small topography speeds (small Froude numbers). However, as the speed of the topography increases (as the Froude number increases), agreement between the experimental and numerical or theoretical results becomes poorer, perhaps because the length of our tank (3m) is not long enough to realize the steady state.

16:10-17:00 Ken-ichi Maruno (Waseda University)

Exact solutions and soliton interactions of two-dimensional soliton equations

Two-dimensional soliton equations such as the KP equation and the Davey-Stewartson (DS) system have broad classes of exact solutions. It is important to understand the soliton interaction in the two-dimensional soliton equations because interesting phenomena not seen in one-dimensional cases can be observed. In this talk, I will show some recent results about soliton interactions of the KP1 equation, the DS2 equation and long-wave short wave resonance models.

Experimental facility tour

18:00∼ *Banquet*

March 28 (Tue)

9:30-10:20 Sunao Murahsige (Ibaraki University)

Internal fronts and gravity currents

This work considers two-dimensional steady motion of internal waves, particularly internal fronts and gravity currents, generated at the interface between two homogeneous fluids of different densities, which are bounded above and below by two horizontal rigid walls. The conservation laws of mass, horizontal momentum and energy produce some exact relations of these waves. Also the exponential decays in the outskirts of these waves are exactly evaluated. In addition, it is shown that, on the assumption that the upper layer is at rest, a corner flow singularity at the separation point is required for unique determination of a solution of the gravity current.

10:30-11:20 Taro Kakinuma (Kagoshima University)

Generation and amplification of tsunamis due to air pressure waves over topography

Tsunamis were widely observed in January 2022 when the large eruption of Hunga Tonga–Hunga Ha'apai volcano occurred. Based on the numerical results from a nonlinear shallow-water model on velocity potential, I will explain several generation and amplification processes of tsunamis due to air pressure waves over seabed topography, including an abrupt change in water depth or a slope.

11:30-12:20 Amin Chabchoub (Kyoto University)

Freak waves in standing and quasi-standing waves

Lunch

March 28 (Tue)

14:00-14:50 Alberto Alberello (University of East Anglia)

A dissipative nonlinear Schrödinger equation for waves in sea ice

The nonlinear Schrödinger equation (NLS) is a model widely used for ocean waves. In this talk we use present a dissipative NLS (dNLS) with frequency-dependent dissipation to model to simulate the evolution of ocean waves in sea ice comprised of small floes. We first show the evolution of one carrier wave subjected to sidebands perturbation. The setup reproduces a Southern Ocean swell propagating into the marginal ice zone. Recurrence of the growth-decay cycles of the modulational instability is preserved also in the presence of dissipation, but in its phaseshifted form. Symmetry between the first order left and right sideband is broken due to the differential attenuation rate. We then discuss the evolution of a more realistic wave spectrum subjected to different levels of dissipation and compare results with benchmark linear predictions and field observations.

15:00-15:50 Guillaume Ducrozet (Ecole Centrale Nantes)

Generation of nonlinear waves in a wave tank environment

The realistic reproduction of sea states in experimental and numerical wave tanks is of great interest to the ocean engineering community. However, the control of the wave field is strongly challenged by nonlinear phenomena such as breaking and high-order nonlinearities, which are at the origin of significant variations of the wave properties along the tank. Considering this issue, the most common industry methodologies focus on reproducing the wave energy spectrum at a given location in the tank. The present work explores the limitations of such a practice, investigating the wave statistics emerging from a single energy spectrum generated at different positions of an experimental wave tank. The second part of the presentation will introduce a new methodology for the generation of waves in a dedicated facility. The objective is to control accurately the statistics of the sea state generated at an arbitrary location in the wave tank. The new method is validated in both numerical and experimental wave tanks.

16:00-16:50 Takuji Waseda (University of Tokyo)

Anomalous spectral downshifting under sea ice
and a brief report on the 64th JARE (Japanese Antarctic Research Expedition)

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Organizers : Hidetaka Houtani (Univ. of Tokyo), Taro Kakinuma (Kagoshima Univ.), Takeshi Kataoka (Kobe Univ.), Ken-ichi Maruno (Waseda Univ.), Sunao Murashige (Ibaraki Univ.)