EGU2020-6562
https://doi.org/10.5194/egusphere-egu2020-6562
EGU General Assembly 2020
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

A dynamic equation for 2D surface waves on deep water

Dmitry Kachulin[1,2], Alexander Dyachenko[1,3], and Vladimir Zakharov[1,3]
[1]Skolkovo Institute of Science and Technology, Moscow, Russian Federation
[2]Novosibirsk State University, Novosibirsk, Russian Federation
[3]Landau Institute for Theoretical Physics RAS, Chernogolovka, Russian Federation

Using the Hamiltonian formalism and the theory of canonical transformations, we have constructed a model of the dynamics of two-dimensional waves on the surface of a three-dimensional fluid. We find and apply a canonical transformation to a water wave equation to remove all nonresonant cubic and fourth-order nonlinear terms. The found canonical transformation also allows us to significantly simplify the fourth-order terms in the Hamiltonian by replacing the coefficient of four-wave Zakharov interactions with a new simpler one. As a result, unlike the Zakharov equation (written in k-space), this equation can be written in x-space, which greatly simplifies its numerical simulation. In addition, our chosen form of a new coefficient of four-wave interactions allows us to generalize this equation to describe two-dimensional waves on the surface of a three-dimensional fluid. An effective numerical algorithm based on the pseudospectral Fourier method for solving the new 2D equation is developed. In the limiting case of plane (one-dimensional) waves, we found solutions in the form of breathers propagating in one direction. The dynamics of such nonlinear traveling waves perturbed in the transverse direction is numerically investigated.

The work was supported by the Russian Science Foundation (Grant No. 19-72-30028).