PECULIARITIES OF INITIAL CONDITION SPECIFICATION IN A PROBLEM OF WAVE PACKET PROPAGATION IN LAYERED FLUID

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The problem of wave packet propagation along the interface of two semi-infinite fluids with different densities is considered within the framework of a weakly nonlinear model, taking surface tension into account. The method of multiple scales expansions is applied. The analytical analysis of admissible initial conditions is carried out in two stages. In the first stage, the initial perturbation of the free surface is specified as a smooth function symmetric about the central point. This function is expanded into a series of the first harmonics, taking into account the dispersion relation. In the second stage, a sequence of second harmonics is constructed that satisfies the evolution equation, namely, the nonlinear Schrödinger equation.

It was found that at the initial moment, the deviation of the central point of the contact surface, caused by the second harmonic, sharply increases with increasing surface tension, and then the deviation begins to decrease, taking negative values corresponding to a trough. Thus, the second harmonic is highly sensitive to the value of surface tension, especially at low values, and the region where the surface deviation is sensitive to changes in surface tension expands as the density ratio of the upper and lower fluids decreases.

Additionally, it was revealed, if surface tension is not considered in the problem formulation, the contribution of the second harmonic takes the form of a bright soliton. For small values of surface tension, oscillatory components are observed, with the peak at the central point increasing. With further increases in surface tension, the oscillations intensify, and their amplitudes become comparable to the deviation at the central point. At even higher values of surface tension, the deviations take on a form characteristic of a dark soliton, which fully corresponds to the presence of a trough at the central point.