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ABSTRACTS

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AMPLITUDE EVOLUTION EQUATION FOR STABILITY ANALYSIS OF TWO-PHASE SHALLOW FLOWS

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Shallow water flows (in particular, shallow mixing layers) are analyzed in the literature by several methods: analytical, numerical and experimental[1]. In addition, methods of linear stability theory are found to be useful in determining when a particular base flow becomes unstable. Furthermore, weakly nonlinear theory is applied in cases where the base flow is unstable but the growth rate of the most unstable perturbation is small. Method of multiple scales [2] is often used in such cases in order to derive an amplitude evolution equation for the most unstable mode.

An amplitude evolution equation is derived in the paper from the shallow water equations under the rigid-lid assumption. It is assumed that the mixing layer is slightly curved and contains two-phase fluid (for example, carrier fluid with small solid particles in it). Furthermore, we assume that the distribution of particles in the fluid is uniform and there is no dynamic interaction between the particles and the flow. The perturbation stream function is expanded in power series with respect to a small parameter ϵ which indicates how close is the bed-friction number of the flow to the critical value. Using "slow" time and longitudinal variables we apply the method of mutiple scales in order to derive an evolutiuon equation for the amplitude. Using solvability condition at the third order in ϵ we show that the amplitude evolution equation in this case is the complex Ginzburg-Landau equation. The coefficients of the equation are calculated in closed form.

REFERENCES

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