Capillary-Gravity Periodic Waves of Two-layer Fluids over an Obstruction

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ABSTRACT

The objective of this research is to study two-dimensional capillary-gravity waves on the interface between immiscible, inviscid and incompressible fluids of different constant densities bounded by two horizontal rigid boundaries with a small obstruction with compact support. In this thesis, without assuming that the fluid is constant depth at far upstream, we derive a forced modified-K-dV equation and new types of steady-state solution are found numerically and time stability of steady-state solution is studied numerically.

INTRODUCTION

In this study, we consider two-dimensional flow of two immiscible, inviscid and incompressible fluids of different but constant densities with surface tension at interface and bounded by two horizontal rigid boundaries. Fluid domain is represented Figure. 1.

Research in stratified flows began with meteorological and oceangraphic reasons. Many results obtained previously can be recovered by the solution of the FK-dV, FMK-dV and FEK-dV [1] [2] [3] but owing to assumption of far upstream fluid condition (i.e height of flow is constant $\eta = 0$), previous researches are confined mainly to problem related with solitary waves.

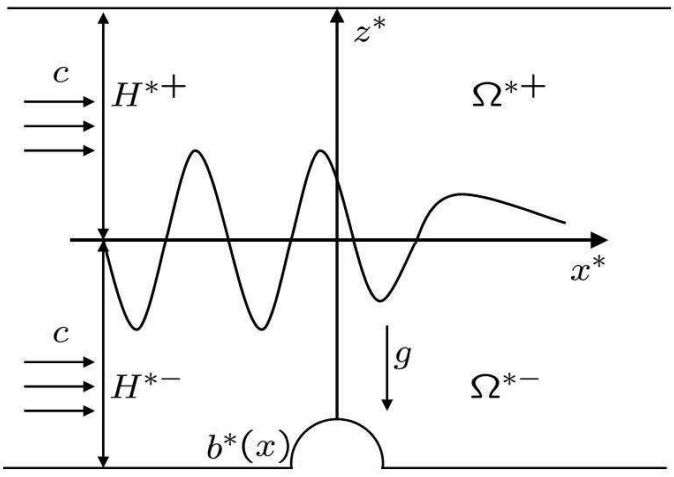

Figure 1. Fluid Domain

The derivation of FK-dV of one-layer is carried out by C.H. Lim and J.W. Choi [4] [5]. In this study, the FMK-dV equation was derived without assumption of constant height at far upstream fluid for the research of periodic waves of FMK-dV in two-layer fluids [2].

The first objective of this research is to study possible solution which has a shape of periodic wave of two-layer fluids ahead of an obstruction. For the research of periodic waves in fluid domain, we have to derive the modeling equation without assumption of constant height at far upstream fluid. Using numerical scheme, we find solutions of steady flow which have periodic wave ahead of an obstruction in various situations. Also in this research, we study numerical time stability of steady state solution by Pseudo-Spectral method with F.F.T.

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