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Numerical modeling of the thermoconvective phenomena in crystal growth

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ABSTRACT

This work lies within the scope of development of numerical methods for simulation of the thermophysical phenomena under phase change transition. Initially, we are interested in the study of the natural convection occurring in the case of fluid phase only to compare our finite volume results with available accurate solution given by spectral method. the Second order Finite volume approximation is used to discretize the set of Navier-stokes and energy equations formulated in primitive variables. A first standard configuration of square cavity with vertical walls differentially heated is considered. Various flow structures depending on the Rayleigh number are characterized and the heat transfer mechanisms within the fluid is analyzed. Good qualitative and quantitative agreements are obtained regarding spectral results comparison. A second square cavity heated from below is considered. This configuration is close to physical model of fluid phase used for crystal growth process. The analysis of the numerical solution obtained permits to identify the different transition modes of the flow (symmetrical, asymmetrical, time-dependent). After having successfully validated the method on various monophasic models, we are extending it to simulate problems with phase change transition under complex conditions (moving interface, rapid solidification, ...).

Keywords: *Computational fluid dynamics, Finite Volume, convection, Transition.*

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