

ABSTRACT

An efficient Matlab code to solve Bénard-Marangoni problems

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The Bénard-Marangoni problem arises due to the mutual influence of both buoyancy and surface-tension driven forces on the stability limit of a fluid. This knowledge has played a vital role in the study of the atmosphere, oil extraction from porous media, crystal growth in space and in the chemical engineering of paint, colloids and detergents.

In this research project, a numerical method of solution is presented for solving a general Bénard-Marangoni problem using Matlab, a special-purpose computer program optimized to perform scientific and engineering calculations. A linear stability analysis was performed using the Newtonian fluid and the Jeffreys' viscoelastic fluid with and without internal heat generation.

The analysis is based on the solution of a characteristic equation from which Newton's method was used to estimate the required unknown values of this equation. Marginal stability curves were plotted and their corresponding critical Rayleigh number was found. The effect of varying different parameters on the critical Rayleigh number was also examined in this research project.

Keywords: Bénard-Marangoni problems; Matlab; Newtonian fluid; Jeffreys' viscoelastic fluid; critical Rayleigh number.