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# RECENT PROGRESS IN THE THEORY OF THERMAL INSTABILITY USING *Mathematica*

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Abstract

The aim of this paper is to present our progress in the theory of thermal instability facilitated by the use of the *Mathematica*[1]. This progress enables the exact numerical solution of long-standing unsolved problems in the linear theory of thermal convection in horizontal layers and spherical shells of Newtonian or viscoelastic fluids in the presence or absence of rotation and/or magnetic field.

In the first part of the paper, our recent direct method for solving the several characteristic value problems arising in the linear theory of buoyancy-driven thermal convection in a horizontal layer of fluid heated from below in the absence or presence of rotation and/or magnetic field is presented. Necessary and sufficient conditions for the existence of non-trivial solutions of several characteristic value problems are derived in the general case, and then the method is favourably applied to study the thermal instability of a layer confined by any type of boundaries (Bénard problem). The method is rigorous, simple to apply, applicable to any type of boundaries: free, rigid, mixed, perfectly conducting or non-conducting, and moreover, it is easily implemented using *Mathematica*. Some unsolved convection problems with rotation and