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Nonlinear convection in unbounded vertical channels RISHAD SHAHMUROV, LAYACHI HADJI, University of Alabama — We investigate the linear and weakly nonlinear solutions to a convection problem that was first studied by Ostroumov in 1947. The problem pertains to the stability of the equations governing convective motion in an infinite vertical fluid layer that is heated from below. Ostroumov's linear stability analysis yields instability threshold conditions that are characterized by zero wavenumber for the Fourier mode in the vertical direction and by eigenfunctions that are independent of the vertical coordinate. Thus, any undertaking at determining the supercritical nonlinear solutions and their stability through a small amplitude expansion fails. This failure is attributed to the fact that the nonlinear interaction of the linear modes vanish identically. In this paper, we put forth exact and stable similarity type solutions to the Ostroumov problem. These solutions are characterized by the same linear threshold conditions as Ostroumov's solutions. Moreover, we are able to extend the analysis to the supercritical regime through a small amplitude analysis to obtain steady two-dimensional solutions for a small range of Prandtl numbers. These solutions are found to be stable to general two-dimensional, time-dependent disturbances.

Layachi Hadji
University of Alabama

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