A study on regular and chaotic convection in a Newtonian fluid-saturated anisotropic-porous enclosure

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ABSTRACT

Stability analyses of the Rayleigh-Benrad convection (RBC) problem in a thermally anisotropic porous enclosure in a temperature-dependent heat source are analytically made using a weighted residual Galerkin scheme. The linear stability analysis of the study reveals that the conductive system is stabilized by increasing anisotropy parameter, Darcy number, and destabilizes with internal heat source strength. A weakly non-linear stability analysis is performed to derive the three-modal Lorenz model, and equilibrium points are obtained. The conductive equilibrium point is asymptotically stable, and is the sink, whereas the convective equilibrium points are asymptotically stable up to a threshold Rayleigh number; after that, hopf bifurcation or chaotic motions set in. The effect of an increase in the values of the internal heat source parameter and the thermal anisotropic parameter postpones the onset of chaotic convection. Also, the amount of heat transport is estimated at the lower boundary of an enclosure, and it is seen that the amount of heat transfer is maximum in the presence of a heat source.