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Multiple equilibria, bifurcations and selection scenarios in cosymmetric problem of thermal convection in porous medium

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Abstract

We study convection in a two-dimensional container of porous material saturated with fluid and heated from below. This problem belongs to the class of dynamical systems with nontrivial cosymmetry. The cosymmetry gives rise to a hidden parameter in the system and continuous families of infinitely many equilibria, and leads to non-trivial bifurcations. In this article we present our numerical studies that demonstrate nonlinear phenomena resulting from the existence of cosymmetry. We give a comprehensive picture of different bifurcations which occur in cosymmetric dynamical systems and in the convection problem. It includes internal and external (as an invariant set) bifurcations of one-parameter families of equilibria, as well as bifurcations leading to periodic, quasiperiodic and chaotic behaviour. The existence of infinite number of stable steady-state regimes begs the important question as to which of them can realize in physical experiments. In the paper, this question (known as the selection problem) is studied in detail. In particular, we show that the selection scenarios strongly depend on the initial temperature distribution of the fluid. The calculations are carried out by the global cosymmetry-preserving Galerkin

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