MS5L_12427

XXI International Congress of Theoretical and Applied Mechanics
Warsaw, Poland, August 15–21, 2004

Transition to Chaotic Marangoni Convection in Liquid Bridge

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Marangoni convection is investigated in cylindrical column using a liquid with Pr = 4. The present results are targeting on the study of the non-linear characteristics of the flow under zero-gravity conditions. The transitions to periodic, quasi-periodic and chaotic flows are investigated numerically. The 3-D oscillatory flow is a result of a supercritical Hopf bifurcation and the periodic orbit represents the unique stable solution near the onset of the instability. The non-linear system admits regime of bi-stability. A traveling wave with azimuthal wave number m = 2 bifurcates from the basic branch of axisymmetric steady state; this branch remains stable in the considered range of parameters. A second stable branch with azimuthal wave number m = 3 appears for higher Marangoni numbers and reveals other periodic, quasi-periodic and chaotic properties. The transitions between the two stable orbits with m = 2 and m = 3 have never been observed.

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