Oscillatory swirling flows in a cylindrical enclosure with co-/counter-rotating end disks submitted to a vertical temperature gradient

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Description
Oscillatory swirling flows in a cylindrical enclosure, having aspect ratio (height/radius) γ= 2, filled with a liquid metal, and submitted to a destabilizing vertical temperature gradient (system heated from below) is investigated by means of direct numerical solution of the governing (continuity, radial and axial momentum, swirl and energy) equations. The bottom and top disks are assumed to rotate at equal (co-rotating) and opposite (counter-rotating) angular velocities. The critical Reynolds number, Recr and the critical frequency of oscillations, Fcr are calculated as a function of the Richardson number, Ri, ranging between 0 and 4. Stability diagrams are presented, reflecting the results of the numerical investigation, which put in evidence the dependence of Recr and Fcr on Ri. In particular, it is found that the increase of Ri causes the decrease of Recr. The study is accompanied by a grid refinement and validation analysis based on comparison with other relevant results in the literature.