We have recently analyzed the global two-dimensional (2D) stability of the staggered lid-driven cavity (LDC) flow with a higher order compact (HOC) approach. In the analysis, critical parameters are determined for both the parallel and anti-parallel motion of the lids and a detailed analysis has been carried out on either side of the critical values.

In this article, we carry out an investigation of flow stabilities inside a two-sided cross lid-driven cavity with a pair of opposite lids moving in both parallel and anti-parallel directions. On discretization, the governing 2D Navier–Stokes (N–S) equations describing the steady flow and flow perturbations results in a generalized eigenvalue problem which is solved for determining the critical parameters on four different grids. Elaborate computation is performed for a wide range of Reynolds numbers (Re) on either side of the critical values in the range $200 \leq Re \leq 10000$. For flows below the critical Reynolds number Re_c, our numerical results are compared with established steady-state results and excellent agreement is obtained in all the cases. For Reynolds numbers above Re_c, phase plane and spectral density analysis confirmed the existence of periodic, quasi-periodic, and stable flow patterns.