The aim of our work is to develop efficient numerical methods for computing eigenvalues for the stability analysis of a problem involving the motion of a fluid within a cylindrical container heated non-homogeneously at the bottom [3]. The partial differential equations that model this problem are discretized with a Chebyshev collocation method with appropriate conditions for the pressure field [1]. So the steady states are numerically calculated. Its linear stability is formulated with a generalized eigenvalue problem. This eigenvalue problem presents an original block matrix structure where one of the submatrices is singular. The numerical approach (generalized Arnoldi method) utilizes the idea of preconditioning the eigenvalue problem with a modified Cayley transformation before applying Arnoldi method [2, 4]. This method allows affective computation of the critical eigenvalues which determine whether the steady flow is stable or unstable and to calculate the bifurcation points. Both types of bifurcations, stationary and oscillatory, are detected. A comparison in computing time between this method and the QZ method shows the computation is more efficient with the generalized Arnoldi method. Via pseudospectra calculations the reliability of the eigenvalue calculations and bifurcations is proved.


