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A numerical approach based on the fourier-spectral element method for a linear stability analysis on thermal convection in rotating axisymmetric containers

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We present the application of a fourier-spectral element code [1, 2] to perform a linear stability analysis of non-axisymmetric thermal driven flows in a rotating cylindrical gap with (a) a flat bottom and (b) an inclined bottom topography.

The model of the differentially heated, rotating cylindrical gap filled with a fluid is since more than four decades extensively used for laboratory experiments as well as for numerical simulation of baroclinic wave instabilities. While a number of experiments are performed in set-ups with a flat bottom topography, the $\beta-$ effect is considered in models with an inclined bottom.

Linearisation about a basic state is the natural way to go to determine stability curves. If performed about an axisymmetric basic state, linearisation decouples the modes in ϕ, the azimuthal coordinate, and breaks an original 3D problem in 2D ones which can be studied independently, i.e. one can then test each Fourier mode m, the azimuthal wave number, individually.

[1] Fournier, A., Bunge, H.-P., Hollerbach, R., and Vilotte, J.-P, 2004, *Application of the spectral-element method to the axisymmetric Navier-Stokes equation*, Geophys. J. Int., 156(3), 682-700

[2] Fournier, A., Bunge, H.-P., Hollerbach, R., and Vilotte, J.-P, 2005, *A Fourier-spectral element algorithm for thermal convection in rotating axisymmetric containers*, Journal of Computational Physics, 204(2)