A quasi-Sturm-Liouville like Galerkin method

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Abstract

Dynamical problems arising from the study of Rayleigh-Bénard convection have been recently studied by using a Galerkin numerical method. Specifically, the basis functions were chosen as solutions of Sturm-Liouville problems. However, pure Sturm-Liouville approximations require too much computational effort to efficiently obtain non steady solutions, whether periodic or not, due to the lack of orthogonality of their basis. [1]

The aim of this work is to explore the feasibility of a slightly different approach. By weakening somehow the requirements imposed to a Sturm-Liouville solution, one can use a certain set of pure trigonometric basis instead, then building expansions in a subspace of all Fourier expansions.

There is a loss, as an equally accurate expansion needs more terms than before. But there is also a gain, as the use of FFT techniques can make the computations involved faster. Preliminary work suggests that the use of these new expansions might allow to help broadening the range of well described cases.

References

[1] D. Puigjaner, J. Herrero, F. Giralt and C. Simó. Stability analysis of the flow in a cubical cavity heated from below. *Physics of fluids*, 16(10):3639–3655, 2004.