Using the Proper Generalized Decompositions to compute the Dominant Mode of a nuclear reactor.

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Most models used in science and engineering are multidimensional and its resolution has a large cost from the computational point of view. It is therefore interesting to study dimensional reduction techniques to approximate the initial models with reduced models that are less expensive to be solved than the initial model. One of the most used methods for model reduction of models based on partial differential equations is the POD (proper orthogonal decomposition) [1], which essentially relies on the development of the model solution as a combination of proper orthogonal functions.

For domains with a separable structure, it has been recently proposed another reduction technique called PGD (proper Generalized decomposition) [2], based on the assumption that the solution of the problem can be expanded as a sum of functions expressed as a product of separable functions.

These methods are based on the weak formulation of the multidimensional model, and obtain the different functions of the representation of the solution by an iterative procedure solving one-dimensional problems in each one of the spatial directions of the domain where the multidimensional problem is defined. This technique has been developed to solve static and transient problems.

In this work, we propose a method based on this separated representation to obtain the dominant eigenvalue, and the corresponding eigenfunction, of the differential eigenvalue problem, corresponding to the Lambda Modes problem of a nuclear power reactor. This method combines the separate representation of the solution of the problem with Newton's method [3]. This method will be usefull, specially when the size of the matrices associated with the multidimensional problem are very large.

References

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