
SANTIAGO NUMÉRICO II

Quinto Encuentro de Análisis Numérico de Ecuaciones Diferenciales Parciales
Facultad de Matemáticas, Pontificia Universidad Católica de Chile, Diciembre 9–11, 2010

An hp finite element adaptive method for fluid-solid interactions *

M. G. ARMENTANO [†] C. PADRA [‡] R. RODRÍGUEZ [§] M. SCHEBLE [¶]

Abstract

In this paper we propose an hp finite element method to solve a two-dimensional fluid-structure vibration problem. This problem arises from the computation of the vibration modes of a bundle of parallel tubes immersed in an incompressible fluid. We use a residual-type a posteriori error indicator to guide an hp adaptive algorithm. Since the tubes are allowed to be different, the weak formulation is a non-standard generalized eigenvalue problem. This feature is inherited by the algebraic system obtained by the discretization process. We introduce an algebraic technique to solve this particular spectral problem. We report several numerical tests which allow us to assess the performance of the scheme.

References

- [1] Armentano MG, Padra C. A posteriori error estimates for the Steklov eigenvalue problem. *Applied Numerical Mathematics* 2008; **58**:593–601.
- [2] Armentano MG, Padra C, Rodríguez R, Scheble M. An hp finite element adaptive scheme to solve the Laplace model for fluid-solid vibrations. Preprint DIM 2009-19, Universidad de Concepción, Concepción, 2009, to appear in CMAME.

*This work was partially supported by ANPCyT (Argentina) under grant PICT 2006-01307. The first author was partially supported by ANPCyT (Argentina) under grant PICT-2007-00910 and by Universidad de Buenos Aires (Argentina) under grant X007. The first and second authors are members of CONICET (Argentina). The third author was partially supported by FONDAP and BASAL projects, CMM, Universidad de Chile (Chile).

[†]Departamento de Matemática, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, 1428, Buenos Aires, Argentina, e-mail: garmenta@dm.uba.ar

[‡]Centro Atómico Bariloche, 4800, Bariloche, Argentina, e-mail: padra@cab.cnea.gov.ar

[§]CI²MA and Departamento de Ingeniería Matemática, Facultad de Ciencias Físicas y Matemáticas, Universidad de Concepción, Casilla 160-C, Concepción, Chile, e-mail: rodolfo@ing-mat.udec.cl

[¶]Centro Atómico Bariloche, 4800, Bariloche, Argentina e-mail: scheble@cab.cnea.gov.ar

- [3] Bermúdez A, Rodríguez R, Santamarina D. A finite element solution of an added mass formulation for coupled fluid-solid vibrations. *Numerische Mathematik* 2000; **87**:201–227.
- [4] Conca C, Planchard J, Vanninathan M. *Fluid and Periodic Structures*, Wiley: Chichester, 1995.
- [5] Melenk JM and Wohlmuth BI. On residual-based a posteriori error estimation in *hp*-FEM. *Advances in Computational Mathematics* 2001; **15**:311–331.