VALPARAISO NUMERICO IV
Séptimo Encuentro de Análisis Numérico de Ecuaciones Diferenciales Parciales
Facultad de Ingeniería, Pontificia Universidad Católica de Valparaíso, Diciembre 11–13, 2013

A posteriori error estimates for an *hp* finite element method*

María G. Armentano†

Abstract

In this talk we first introduce an *hp* finite element method to solve two-dimensional fluid-structure spectral problems in polygonal domains, which arise from the computation of the vibration modes of a bundle of parallel tubes immersed in an incompressible fluid [1, 2, 4]. We prove the convergence of the method and we define an a posteriori error estimator of residual type which can be computed locally from the approximate eigenpair. We show its reliability and efficiency by proving that the estimator is equivalent to the energy norm of the error up to higher order terms, the equivalence constant of the efficiency estimate being suboptimal in the sense that it depends on the polynomial degree. Following the *hp* adaptive strategy given in [5] we present an *hp* adaptive algorithm and several numerical tests which show the performance of the scheme, including some numerical evidence of exponential convergence. Then, we also present an *hp* finite element adaptive scheme to solve a source problem on curved domains. We show the advantage of using curved triangles [6] and we exhibit the loss of convergence rate if we use standard triangular elements with straight edges [3].

Key words: a posteriori error estimates, *hp* finite elements method.

Mathematics subject classifications (1991): 65N30, 65N25, 65N15

References

[1] M. G. Armentano, C. Padra, R. Rodriguez and M. Scheble, *An hp finite element adaptive scheme to solve the Laplace model for fluid-solid vibrations.* Computer Methods in Applied Mechanics and Engineering, vol. 200 (1-4), pp. 178-188, (2011).

[2] M. G. Armentano, C. Padra, R. Rodriguez and M. Scheble, *An hp finite element adaptive method to compute the vibration modes of a fluid-solid coupled system.* CMES: Computer Modeling in Engineering & Sciences, vol. 84 (4), pp. 359-382, (2012).

[3] M. G. Armentano, C. Padra and M. Scheble, *An hp finite element adaptive scheme to solve the Poisson problem on curved domains.* Submitted (2013).

*This research was partially supported by ANPCyT (Argentina) under grants PICT 2006-01307 and PICT-2007-00910 and by Universidad de Buenos Aires (Argentina) under grant W143.

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

[4] Conca C, Osses A, Planchard J., *Asymptotic analysis relating spectral models in fluid-solid vibrations.* SIAM Journal on Numerical Analysis, vol.35 (3), pp. 1020-1048, (1998).

[5] J. M. Melenk and B. I. Wohlmuth, *On residual-based a posteriori error estimation in hp-FEM.* Advances in Cmputational Mathematics, vol. 15, pp. 311-331, (2001).

[6] M. Zlâmal, *Curved elements in the finite element method I.* SIAM J. Numer. Anal. vol. 10 (1), pp. 229-240, (1973).