
SANTIAGO NUMÉRICO I

Cuarto Encuentro de Análisis Numérico de Ecuaciones Diferenciales Parciales

Facultad de Matemáticas, Pontificia Universidad Católica de Chile, Enero 14 - 16, 2009

An *a posteriori* error analysis for the stream function and vorticity formulation for the Stokes Problem*

TOMÁS P. BARRIOS[†] J. MANUEL CASCÓN[‡] AND GALINA C. GARCÍA[§]

Abstract

In this paper we describe an *a posteriori* error estimator of the finite element solution for Stokes problem in stream function and vorticity formulation. We derive a reliable and efficient *a posteriori* error estimator. Our approach introduces an appropriate dual problem that allows us to prove efficiency in natural norms. In this sense, it can be seen as an extension of the applicability of the error indicator developed in [1] to the standard stream function-vorticity formulation. We present several numerical experiments confirming the theoretical properties of the estimator, and illustrating the capability of the corresponding adaptive algorithm to localize the singularities and the large stress regions of the solution. Finally, we apply the adaptive strategy to a large-scale ocean circulation model to reduce the spurious oscillations which arise when convective terms are dominant.

References

- [1] M. AMARA, M. BEN YOUNES AND BERNARDI, C., *Error indicators for the Navier-Stokes equations in stream function and vorticity formulation*. Numerische Mathematik, vol. 80, pp. 181-206, (1998).
- [2] V. Girault and P.-A. Raviart. *Finite Element Methods for Navier Stokes Equations: Theory and Algorithms*. Springer-Verlag, Berlin, 1986.
- [3] A. SCHMIDT AND K. G. SIEBERT. *Design of Adaptive Finite Element Software: The Finite Element Toolbox ALBERTA*, LNCSE 42, Springer-Verlag Berlin Heidelberg 2005.

*This research was partially supported by FONDECYT Grants No. 11060014 and 1080244 (Chile) and Grant CGL2008-06003-C03-03/CLI (Spain).

[†]Departamento de Matemática y Física Aplicada, Facultad de Ingeniería, Universidad Católica de la Santísima Concepción, Casilla 297, Concepción, Chile, e-mail: tomas@ucsc.cl

[‡]Departamento de Matemática, Universidad de Salamanca, 37008, Salamanca, España, e-mail: casbar@usal.es

[§]Departamento de Matemáticas y Ciencia de la Computación, Facultad de Ciencia, Universidad de Santiago, Casilla 307, Correo 2, Santiago, Chile, e-mail: galina@fermat.usach.cl

- [4] R. VERFÜRTH, A Review of A Posteriori Error Estimation and Adaptive Mesh-Refinement Techniques. Wiley-Teubner (Chichester), 1996.