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FURTHER INSIGHTS INTO VMS A POSTERIORI ERROR ESTIMATION AND ERROR POLLUTION

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The genesis of stabilized methods was established in [1] from the standpoint of the variational multiscale theory (VMS). It was shown that, by splitting the solution into *resolved* and *unresolved* scales, stabilized methods take into account an approximation of the *unresolved* scales or *error* into the finite element solution.

Recently, this theory has been exploited to extract error information, and formulate *explicit* a posteriori error estimators which are consistent with the assumptions inherent to stabilized methods [2, 3, 4]. The proposed technology, which is especially suited for fluid flow problems, is very economical and can be implemented in standard finite element codes. It has been shown that, in practice, the method is robust uniformly from the diffusive to the hyperbolic limit [3].

In this presentation new highlights will be given about global, element and fine-scale Green's functions, leading to simple algorithms to estimate the error pollution.

The success of the method can be explained by the fact that in stabilized methods the element local problems for the fine-scale Green's function capture most of the error and the error intrinsic time-scales are an approximation to the solution of the dual problem.

REFERENCES

[1] T.J.R. Hughes, Multiscale phenomena: Green's functions, the Dirichlet-to-Neumann formulation, subgrid scale models, bubbles and the origins of stabilized methods. *Comput. Meth. Appl. Mech. Engrg.* **127**, 387–401, (1995).

[2] G. Hauke, M.H. Doweidar and M. Miana, The multiscale approach to error estimation and adaptivity. *Comput. Meth. Appl. Mech. Engrg.* **195**, 1573–1593, (2006).

[3] G. Hauke, D. Fuster and M.H. Doweidar, Variational Multiscale a-Posteriori Error Estimation for Multi-dimensional Transport Problems. *Comput. Meth. Appl. Mech. Engrg.* **197**, 2701–2718, (2008).

[4] G. Hauke, D. Fuster, F. Lizarraga, Variational Multiscale a-Posteriori Error Estimation for Systems: The Euler and Navier-Stokes Equations. *Comput. Meth. Appl. Mech. Engrg.* (submitted).