ADAPTIVE MODELING FOR PARTITIONED-DOMAIN CONCURRENT MULTISCALE CONTINUUM MODELS

KRISTOFFER G. VAN DER ZEE[*], SERGE PRUDHOMME[†] AND J. TINSLEY ODEN[‡]

[*] Multiscale Engineering Fluid Dynamics
Technische Universiteit Eindhoven
e-mail: k.g.v.d.zee@tue.nl   web: www.tue.nl/vanderzee

[†] Department of Mathematics and Industrial Engineering
École Polytechnique de Montréal
e-mail: serge.prudhomme@polymtl.ca

[‡]Institute for Computational Engineering and Sciences (ICES)
The University of Texas at Austin
e-mail: oden@ices.utexas.edu

Key words: adaptive modeling, partitioned-domain concurrent multiscale modeling, a posteriori error estimates, shape derivatives

Abstract. In this contribution adaptive modeling strategies are considered for the control of modeling errors in so-called partitioned-domain concurrent multiscale models. In these models, the exact fine model is considered intractable to solve throughout the entire domain. It is therefore replaced by an approximate multiscale model where the fine model is only solved in a small subdomain, and a coarse model is employed in the remainder.

We review two approaches to adaptively improve the approximate model in a general framework assuming that the fine and coarse model are described by (local) continuum models separated by a sharp interface. In the classical approach [1] an a posteriori error estimate is computed, and the model is improved in those regions with the largest contributions to this estimate. In the recent shape-derivative approach [2] the interface between the fine and coarse model is perturbed so as to decrease a shape functional associated with the error. Several numerical experiments illustrate the strategies.

[1] J. T. Oden and S. Prudhomme. Estimation of modeling error in computational mechanics. *J. Comput. Phys.*, 182:496–515, 2002.

[2] H. Ben Dhia, L. Chamoin, J. T. Oden, and S. Prudhomme. A new adaptive modeling strategy based on optimal control for atomic-to-continuum coupling simulations. *Comput. Methods Appl. Mech. Engrg.*, 200:2675–2696, 2011.