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COMBINED EXPANSIVE MODEL AND FE-DISCRETIZATION ADAPTIVITY OF THIN-WALLED STRUCTURES WITH COARSE-TO-FINE-SCALE PROLONGATIONS FOR MODEL ERROR ESTIMATES

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ABSTRACT

Finite element approximations of thin-walled elastic structures with mesh adaptivity controlled by error estimates for quantities of interest are combined with error-controlled model adaptivity for model expansion in disturbed subdomains of the coarse-scale computational model with a consistent 2D plate/shell theory into an adequate 3D theory. Model and discretization adaptivity is controlled by errors of quantities of interest [1, 2, 3].

An important problem is the element-wise prolongation of finite element solutions of the coarse-scale model into the solution space of the relevant fine-scale model, in order to define proper model errors and to regain the Galerkin orthogonality of the model error – combined with the upper bound property – approximately by a post-orthogonalization, for the orthogonality is lost by the prolongation [2, 3]. Here, the prolongation and post-orthogonalization matrices are derived for the plate/shell elements used in the examples.

Examples with convergence studies for combined model and discretization adaptivity are presented, and new studies for combined meso-macro-scale models will be outlined as well.

The intention of the lecture is to contribute to model validation and verification by computational model adaptivity within a deterministic framework for loads, actions, and reactions, which, of course, has to be accompanied by the experimental part of model validation.

The following example, Figs. 1 & 2, shows combined discretization and model adaptivity of a continuous haunched flat slab in an automatized process.

Both macro- and meso-scales for adaptive modeling will be used in future research as well, viewing the technological challenges including the micro-behavior of materials.

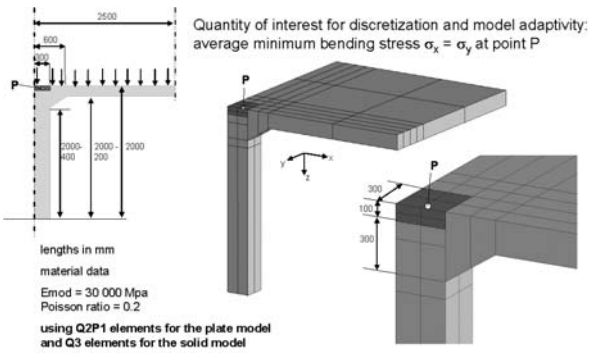

Figure 1: Model and discretization adaptivity of a continuous haunched flat slab with square fields on single columns with a constant static transverse load

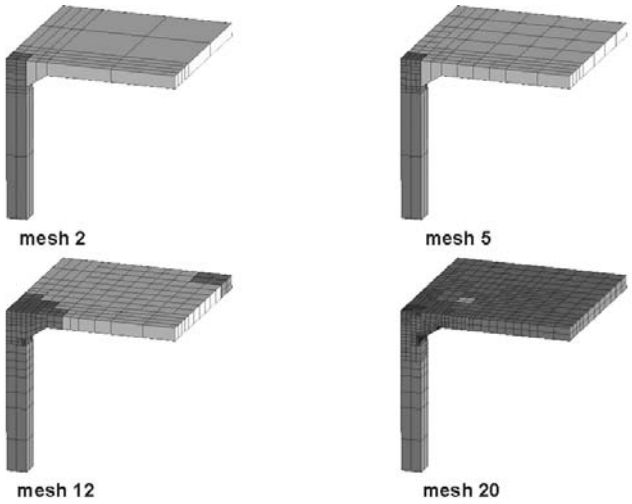

Figure 2: Model-adapted subdomains (dark) for meshes 2, 5, 12 and 20

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