An Extension to Nitsche Type Mortaring for Non-conforming Finite Elements

Sebastian Eiser[*,†], Andreas Hüppe[†] and Manfred Kaltenbacher[†]

[*] KAI Competence Center
Technologiepark Villach, Europastraße 8, 9524 Villach, Austria.
sebastian.eiser@k-ai.at www.k-ai.at

[†] Technical University Vienna
Institute for Mechanics and Mechatronics
Getreidemarkt 9, 1060 Vienna, Austria.
{manfred.kaltenbacher, andreas.hueppe}@tuwien.ac.at www.mec.tuwien.ac.at

A Non-conforming FE method is a *domain decomposition* technique, which allows incompatible meshes on the subdomain boundaries. Independent meshing of the subdomains increases the flexibility of finding an optimal discretization in each of them and enables multi-scale analysis, where regions of interest are substantially finer resolved than others. For example, resolving the sub-micrometer scaled features in a semiconductor device while simultaneously taking the centimeter sized package into account is usually not possible [1].

The *mortar* FE method [2] utilizes Lagrange multpliers to correctly transfer fluxes across the incompatible subdomain boundaries. The inclusion results in a *saddle-point* problem which cannot be solved using standard numerical schemes. *Nitsche* type mortaring [3] neither introduces new unknowns nor changes the resulting linear system, but requires a mesh dependent penalty factor. Additionally, both methods are evaluating the coupling surface integrals on a common intersection surface mesh, which can introduce numerical errors and requires sophisticated geometry algorithms.

We are presenting an enhancement of the Nitsche type mortaring which does not require any mesh intersection operations, thus eliminating a major obstacle of accurate analysis. This is accomplished by introducing an artificial coupling interface between the subdomains, on which the unknown is approximated by means of *B-Spline* functions. The value of the unknown on the non-conforming interface is transferred only through the artificial layer, thus no surface integral involving both subdomain boundaries has to be performed.

The Poisson problem is used to fully characterize the new method by employing h and p-refinement and comparing the result to the analytical solution and the *a-priori* estimate. Furthermore, its accuracy is benchmarked against the mortar and Nitsche non-conforming methods as well as to the standard conforming method. Finally, to demonstrate the method's applicability to real-world engineering problems, a coupled *electro-thermal* simulation of a power semiconductor device with finely resolved features is shown.

REFERENCES

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