6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11 – 15 June 2018, Glasgow, UK

A FICTITIOUS DOMAIN METHOD WITH HIGHER-ORDER ACCURATE INTEGRATION IN CUT ELEMENTS

Thomas-Peter Fries, Samir Omeroviç

Institute of Structural Analysis, Graz University of Technology,
Lessingstr. 25/II, 8010 Graz, Austria,
fries@tugraz.at, www.ifb.tugraz.at

Key Words: *Fictitious domain method, Embedded domain method, higher-order FEM.*

A higher-order accurate fictitious domain method is presented where the geometry is implied by multiple level-set functions [1]. A background mesh composed by higher-order Lagrange elements provides the finite element shape functions employed as the approximation basis. For the numerical integration of the weak form of the governing equations, cut elements are decomposed into higher-order sub-elements following [1,2]. Boundary conditions are enforced with Lagrange multipliers or based on Nitsche's method. To ensure a well-conditioned system of equations, nodes of the background mesh are manipulated such that elements with extremely small contributions to the domain of interest are avoided.

Numerical results are achieved for two- and three-dimensional applications in linear elasticity. The results are compared to those obtained for the Conformal Decomposition FEM (CDFEM), as proposed in [3], where the sub-elements are not only used for the integration but for providing the basis functions of the approximation. It is found that the fictitious domain method also achieves optimal convergence rates but with improved conditioning compared to the CDFEM. However, the effort for enforcing boundary conditions is significantly more cumbersome than in the CDFEM.

REFERENCES

[1] T.P. Fries, S. Omerović, D. Schöllhammer, J. Steidl: Higher-order meshing of implicit geometries—part I: Integration and interpolation in cut elements, *Comp. Methods in Appl. Mech. Engrg.*, **313**, 759-784, 2017.

[2] K.W. Cheng, T.P. Fries: Higher-order XFEM for curved strong and weak discontinuities, *Internat. J. Numer. Methods Engrg.*, **82**, 564-590, 2010.

[3] T.P. Fries: Higher-order Conformal Decomposition FEM (CDFEM), *Comp. Methods in Appl. Mech. Engrg.*, **328**, 75-98, 2018.