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

Cut-Cell Methods and their Application in Biomedical Source Analysis

Christian Engwer[1] **and Andreas Nüßing**[2]

[1] Applied Mathematics: Institute for Analysis and Numerics, University of Münster, Einsteinstr. 62, 48149 Münster, Germany, christian.engwer@uni-muenster.de
[2] Applied Mathematics: Institute for Analysis and Numerics, University of Münster, Einsteinstr. 62, 48149 Münster, Germany, andreas.nuessing@uni-muenster.de

Keywords: *cut-cell methods, biomedical source analysis, DUNE*

Cut-cell methods offer a flexible way to avoid meshing when solving partial differential equations in different fields of applications, using for example the geometric information provided by a level-set segmentation of imaging data.

Among others, one specific application where cut-cell methods are beneficial, is the field of source analysis using electroencephalography signals (EEG). Based on magnetic resonance images (MRI) of the human head, patient specific models are used to investigate the cause of differences in the electric potential on the head surface. Source analysis is used in biomedical and neuroscientific research as well as clinical applications, such as epilepsy diagnosis.

Cut-cell methods offer the advantage of avoiding the effort of creating a geometry conforming tetrahedral mesh or the decrease in the accuracy of the model geometry when using a structured hexahedral mesh. The practical use of cut-cell methods poses several challenges, such as the numerical integration over the implicitly defined domains and surfaces, as well as the efficient solution of the resulting linear systems or the treatment of multiple domains.

We will present recent results using different cut-cell methods with a focus on practical aspects and implementational issues. The methods are implemented using the DUNE software framework (http://dune-project.org).

REFERENCES

[1] C. Engwer and A. Nüßing, Geometric Reconstruction of Implicitly Defined Surfaces and Domains with Topological Guarantees. *ACM Trans. Math. Softw.*, Vol **44**, No 2, pp. 14:1–14:20, 2017

[2] A. Nüßing, C. H. Wolters, H. Brinck and C. Engwer, The Unfitted Discontinuous Galerkin Method for Solving the EEG Forward Problem. *IEEE Trans. Biomed. Eng.*, Vol **63**, No 12, pp. 2564-2575, 2016