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

OxFEMM, a scalable coupled Finite Element-Meshless Method program

Dongli Li [1], Julian Garcia-Grajales [2], Daniel Barba [3] and Antoine Jerusalem [4]

[1] University of Oxford, dongli.li@eng.ox.ac.uk
[2] University of Oxford, jagojuli86@gmail.com
[3] University of Oxford, daniel.barbacancho@eng.ox.ac.uk
[4] University of Oxford, antoine.jerusalem@eng.ox.ac.uk

Key Words: *Finite Element Method, Meshless Method, OxFEMM, Parallel Simulations*

Meshless Methods (MM) appear as a good alternative to the Finite Element Method (FEM) in several scenarios, e.g., when involving large inhomogeneous deformation. However, MM is often limited by its inability to efficiently deal with Dirichlet boundary conditions or scalability through parallelisation. To this end, we propose here OxFEMM, a parallel in-house program coupling FEM an MM, and it is able to cope with the modelling of large deformation without overly compromising on computational efficiency.

Here we present the key features of the proposed program. The MM is implemented based on the maximum entropy approximation scheme [1] and the parallelisation is implemented by making use of the METIS library with FEM and MM independently partitioned. The results show that OxFEMM can tackle simulations with excessive deformation where FEM is limited without much comprise on the computational cost as opposed to MM. Analysis of influences on parallel MM simulation accuracy will also be discussed and evaluated in terms of convexity of the MM partitions.

OxFEMM is tested in an application where the advantages of both computational methods need to be employed: axonal growth. This problem is particularly challenging to study through numerical methods due to complex neuronal structures and behaviours, and understanding the dynamics of neuron growth is important for predicting neuronal connectivity.

REFERENCES

[1] Sukumar, N. and Wright, R. (2007). Overview and construction of meshfree basis functions: from moving least squares to entropy approximants. International Journal for Numerical Methods in Engineering, 70:181–205.