ICCM2014
28-30th July, Cambridge, England

Beyond finite element method: towards robust and accurate meshless method for computational biomechanics for medicine

***K. Miller[1,2], H. A. Chowdhury[1], G.R. Joldes[1] and A. Wittek[1]**

[1]Intelligent Systems for Medicine Laboratory. The University of Western Australia
Crawley/Perth, Western Australia
[2]Institute of Mechanics and Advanced Materials, Cardiff University. Wales, UK

*Corresponding author: karol.miller@uwa.edu.edu

Our vision is to enable a surgeon to simulate surgery within the operating theatre in real time, using readily-available computing facilities and to visualise the results immediately. Achieving this goal requires the creation of an easily-manipulated computational grid, allowing the user to intuitively zoom-in or out of regions of interest (ROI), as well as robust, accurate and extremely fast solution methods for the fundamental equations which describe the biomechanical behaviour of the subject. The key requirement is that the user – ultimately a surgeon - should not require specialist knowledge in the field of numerical computations, hence the operation of such a system must be robust and reliable, and the results presented to the surgeon must be repeatable, consistent, and within guaranteed bounds of accuracy. In this keynote I will consider numerical techniques that will bring us closer to the fulfillment of this vision: i) generation of adaptive and flexible distributions of nodes within the medical image domain to be used with a meshless solution method; ii) a new robust meshless method based on interpolating shape functions that incorporates new adaptive volumetric integration scheme, which allows control over integration accuracy; iii) new accurate 3D scattered data interpolation necessary for real-time medical image updating using the new interpolating shape functions.

Keywords: computational biomechanics, meshless methods, interpolating shape functions, adaptive numerical integration