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Sano Computational Medicine Seminars

Monday, 18 January 2021, 14:00-15:30 (CET)

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Ian Halliday

Sheffield Hallam University, United Kingdom

https://www.shu.ac.uk/about-us/our-people/staff-profiles/ian-halliday

Multi-Component Lattice Boltzmann Equation simulation of blood from the cellular scale to the continuum scale

Abstract

Lattice Boltzmann Equation (LBE) simulation method is a meso-scopic (distribution function-based) numerical technique, well adapted for computing certain classes of fluid flow, including complex multi-component flow, not least because of an intrinsic parallel implementability.

Blood is a colloid, comprised of plasma (an incompressible Newtonian fluid) in which are suspended a high concentration of very deformable vesicles, typically of micron size. The complex rheological properties of blood, when regarded as a continuum (e.g. constitutive relations between hemodynamic shear rates and stress) rest on this cellular-scale structure. Furthermore, flow modalities at the capillary scale cannot be understood without recourse to blood's "micro-structure".

This talk will seek to show how one particular multi-component LBE method, for immiscible fluids (the chromo-dynamic variant [1,2]) may be modified to encapsulate the micron-scale dynamics of blood, contrast this approach with other, more mature LBE-based methodologies, such as Hemecell [3], and consider some relevant applications of the method which exploit its key advantages.

References

[1] S V Lishchuk, I Halliday and C M Care Phys Rev E 77 (3) (E036702), 2008
[2] I Halliday, T J Spencer, S V Lishchuk, C M Care and G Pontrelli, Phys. Rev. E 87, 023307, 2013
[3] https://www.hemocell.eu/

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