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A novel Implicit Locally Conservative Galerkin Method (ILCG) for bioheat transfer calculations in a human body.

H. M. HASAN[1] AND P. NITHIARASU[*1]

[1]Zienkiewicz Centre for Computational Engineering, Swansea University, Swansea SA2 8PP, United-Kingdom

[1]h.m.hasan.743207@swansea.ac.uk

[*1]p.nithiarasu@swansea.ac.uk

Abstract: In this work, an Implicit Locally Galerkin method (ILCG) approach is developed for solving combined fluid flow and heat transfer in a human body. First, the normal LCG technique with an averaging procedure is used. In such a method, additional spatial stabilization is needed when the convection is dominant. However, if the semi-implicit method is implemented, we can avoid the need for additional stabilzation upto certain CFL limit. In addition the semi-imlicit method is substantially simplified as the standard Newton-LU method can now be used. Such techniques result in efficient and very economically efficient computational strategies for the element matrices generated by SILCG method (i.e. 2 x 2 per element). An immediate benefit is that the slow convergence issue associated with large matrices is eliminated here. Also, the quadratic convergence rate of the original Newton method is maintained as the matrix is very small. The results are compared against the data in literature and a very good agreement is observed. Finally, the computational speed is compared between SILCG and other methods to demonstrate the efficiency of the proposed method.

Keywords: Finite element method; implicit locally conservative Galerkin (ILCG); Bio-heat transfer

*Corresponding Author Email: P.Nithiarasu@Swansea.ac.uk