A DATA-DRIVEN APPROACH FOR A MACROSCOPIC CONDUCTIVITY MODEL UTILIZING FINITE ELEMENT APPROXIMATION

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ABSTRACT

Macroscopic conductivity is useful in forming macroscopic models for porous media flow applications. It is also useful for setting up multiscale solvers. Following the idea in the second author's previous work [2], a microscale model is imbedded in a uniform conductivity media and mortar finite element method is used to obtain the data on the boundary of the microscale model for a given input data outside the uniform conductivity media. Real application data can be obtained through an observation but mortar finite element model is used to create data. For the microscale model, a macroscopic model is described by a tensor type conductivity and these values are obtained by solving an nonlinear optimization problem. The nonlinear problem is solved by using deep neural networks combined with the data [1] obtained from the mortar finite element model. Numerical results are presented for various test models and our approach is also compared to other existing methods in [2,3].

REFERENCES

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, *Deep Learning*, The MIT Press, 2016.
2. H.H.Kim, J.E.Kim, "Approximation of macroscopic conductivity for a multiscale model by using mortar methods," *Journal of Computational Physics*, Vol. 336, 2017, pp. 275-287.
3. Thomas Y. Hou, Xiao-Hui Wu, "A Multiscale Finite Element Method for Elliptic Problems in Composite Materials and Porous Media," *Journal of Computational Physics*, Vol. 134, 1997, pp. 169-189.