Reduced order modelling using neural networks for predictive modelling of 3D-magneto-mechanical problems with application to magnetic resonance imaging scanners

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The design of magnets for Magnetic Resonance Imaging (MRI) scanner requires requires multiple parameters and loading conditions to be investigated to aid with design and the manufacturing process. The coupled physical processes involved mean that a 3D magneto mechanical problem must be simulated where parameters, such as the excitation frequency and electric conductivity, are varied. Full order model simulations using finite elements require fine discretisations using dense meshes and/or high order elements and so can take up a significant amount of time and resources within the design process and, thus, can be costly. Previous work by our group has focused on the application of Proper Orthogonal Decomposition (POD) Reduced Order Models (ROM), but this has a highly invasive computational implementation. With the further coupling of additional physics in mind, alternative approached based on neural network based ROMs will be presented. In the talk, we will compare the performance of several different such ROMs for predicting the magneto-mechanical coupled simulations in both the frequency and shield conductivity parameter space using a test magnet configuration. We will conclude with some future work which include the efficient and accurate simulation of quench inside an MRI magnet with the use of machine learning for prediction.

References:

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