Learning multiscale models using nonlocal upscaling techniques

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In this talk, we present a novel nonlocal nonlinear coarse grid approximation using a machine learning algorithm. Multiscale models for complex nonlinear systems require nonlocal multicontinua approaches. These rigorous techniques require complex local computations, which involve solving local problems in oversampled regions subject to constraints. The solutions of these local problems can be replaced by solving original problem on a coarse (oversampled) region for many input parameters (boundary and source terms) and computing effective properties derived by nonlinear nonlocal multicontinua approaches. The effective properties depend on many variables (oversampled region and the number of continua), thus their calculations require some type of machine learning techniques. We present results for two model problems in heterogeneous and fractured porous media and show that the presented method is highly accurate and provides fast coarse grid calculations. The research is partially supported by the Hong Kong RGC General Research Fund (Project numbers 14304217 and 14302018) and the CUHK Faculty of Science Direct Grant 2018-19. This is a joint work with Yalchin Efendiev, Wing Tat Leung, Maria Vasilyeva and Mary Wheeler.