Combining machine learning and adaptive coarse spaces to design robust and efficient FETI-DP methods in 3D

Janine Weber[a] and Alexander Heinlein[a] and Axel Klawonn[a] and Martin Lanser[a]

[a] *University of Cologne*

The convergence rate of classical DDM in general deteriorates severly for large variations or jumps within material properties, resulting in large variations in the spectrum of the system. In order to retain robustness of DDM for such problems, the coarse space can be enriched by additional coarse basis functions, which are computed from the solutions of local generalized eigenvalue problems. As a drawback, the set-up and the solution of the generalized eigenvalue problems typically take up a significant part of the total time to solution, especially in three dimensions. In particular, for many realistic model problems, only the solution of a small number of the eigenvalue problems is necessary to design a robust coarse space. In general, it is difficult to predict a priori which of the eigenvalue problems are needed. Here, we use machine learning techniques to predict where eigenvalue problems have to be solved, often reducing its number significantly. When applying these machine learning techniques to problems in three dimensions - in comparison to two dimensions - essential differences and additional difficulties appear.

In this talk, we extend our results for two dimensions to three dimensions considering both, regular and graph partitioned decompositions. We provide numerical results for linear diffusion and elasticity problems and realistic coefficient distributions.