
A High-Performance Implementation of a Robust Preconditioner for Heterogeneous Problems

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We present an efficient implementation of the highly robust and scalable GenEO preconditioner in the high-performance PDE framework DUNE PDELAB. The GenEO coarse space is constructed by combining low energy solutions of a local generalised eigenproblem using a partition of unity. In this paper we demonstrate both weak and strong scaling for the GenEO solver on over 15,000 cores by solving an industrially motivated problem with over 200 million degrees of freedom. Further, we show that for highly complex parameter distributions arising in certain real-world applications, established methods become intractable while GenEO remains fully effective. The purpose of this paper is two-fold: to demonstrate the robustness and high parallel efficiency of the solver and to document the technical details that are crucial to the efficiency of the code.

Keywords: Partial Differential Equations, Domain Decomposition, Preconditioning, High Performance Computing.