tions, such as monitoring of air quality, breath analysis for medical diagnosis, and industrial process control. In these sensors a sinusoidally modulated laser source excites the trace gas to generate a pressure-temperature wave that is detected by a quartz tuning fork. To date, mathematical modeling of trace gas sensors has focused on either the acoustic or the thermal components of the wave only. A model that fully couples temperature, pressure and fluid velocity, as derived by Morse and Ingard, has only been considered for relatively simple domains. In this paper we present the first 3D finite element model of the thermoacoustic equations in the presence of the tuning fork, coupled with temperature diffusion in the sensor. We employ a perfectly matched layers (PML) method to truncate our computational domain, and benchmark it against the analytic solution in the free-space. As the resulting discretized system is poorly conditioned, we present a parallelizable block preconditioning approach. In order to precondition the highly indefinite Helmholtz block with PML, we test a novel idea based on domain decomposition, where we couple an algebraic multigrid solver in the computational domain to a direct solver in the PML region.

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MS253

Preconditioners for Stokes Flow with Highly Heterogeneous Viscosity Structure: Saddle-Point Smoothing Via Local Incomplete Factorization

The solution of stationary Stokes flow with highly heterogeneous, non grid-aligned viscosity structure is a prevalent computational bottleneck in geodynamics simulation. Scalable, robust multigrid methods are important to allow for the long timescale, 3D, whole-planet simulations used to investigate the formation of structures in the Earth and other planets. To this end, we present results using incomplete local ILDL factorizations as smoothers within a geometric multigrid hierarchy for stationary Stokes flow problems, demonstrating a new scalable and robust technique.

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MS254

Multipreconditioned GMRES for Shifted Systems

We propose using the Multipreconditioned Generalized Minimal Residual (MPGMRES) method for solving shifted linear systems $(A+\sigma_j I)x_j = b$ for $j = 1, \ldots, n_\sigma$ using multiple shift-and-invert preconditioners. The multipreconditioned space is obtained by applying the preconditioners to all search directions and searching for a minimum norm solution over this larger subspace. We show that this space grows linearly and show results for systems arising from an example problem in subsurface imaging.

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MS254

Adaptive Coarse Spaces for FETI-DP Domain Decomposition Methods

We present a family of adaptively chosen coarse spaces for FETI-DP domain decomposition methods for the equations of linear elasticity in 3D with arbitrarily large jumps in the material coefficients. The coarse spaces are defined by local eigenvectors which are obtained from adaptive eigenvalue computations related to a given tolerance. The new family of algorithms roots in an earlier algorithm by Mandel and Sousedik. For one of our new algorithms a rigorous proof and a condition number estimate will be given. This estimate is independent of the coefficient jumps, which do not have to align with the subdomain boundaries. It also holds for the case of almost incompressible elasticity. This estimate and its proof are new for three dimensions. Additional variants of this algorithms are obtained, using different simplifications and heuristics. For some problems, this leads to computationally more efficient versions. A comparsion of the different algorithms