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Algebraic Multigrid for Elasticity

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We are interested in the efficient solution of large systems of PDEs arising from elasticity applications. When solving linear systems derived from systems of PDEs with AMG, two accepted approaches are treating variables corresponding to the same unknown separately (the "unknown" approach) and treating variables corresponding to the same physical node together (the "nodal" approach). While the unknown approach is typically chosen for elasticity problems, convergence is often far from ideal.

In this talk, we investigate improving the interpolation of the rigid body modes. In particular, we propose extending the AMG interpolation operator to exactly interpolate the rotational rigid body modes by adding additional degrees of freedom (dofs) at each node. Our approach is an unknown-based approach that builds upon any existing AMG interpolation strategy and requires nodal coarsening. The approach fits easily into the AMG framework and does not require any matrix inversions. We demonstrate the effectiveness on several 2D and 3D elasticity problems.