Ultrascalable Implicit Finite Element Analyses in Solid Mechanics with over a Half a Billion Degrees of Freedom

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SC '04: Proceedings of the 2004 ACM/IEEE conference on Supercomputing Page 34
https://doi.org/10.1109/SC.2004.62

Published: 06 November 2004 Publication History

Abstract

The solution of elliptic diffusion operators is the computational bottleneck in many simulations in a wide range of engineering and scientific disciplines. We present a truly scalable-ultrascalable-algebraic multigrid (AMG) linear solver for the diffusion operator in unstructured elasticity problems. Scalability is demonstrated with speedup studies of a non-linear micro-finite element analyses of a human vertebral body with over a half of a billion degrees of freedom on up to 4088 processors on the ACSI White machine. This work is significant because in the domain of unstructured implicit finite element analysis in solid mechanics with complex geometry, this is the first demonstration of a highly parallel and efficient application of a mathematically optimal

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