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FAST SOLUTION OF MSC/NASTRAN SPARSE MATRIX PROBLEMS USING A MULTILEVEL APPROACH*

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Abstract. As part of the European Esprit project EUROPORT, 38 commercial and industrial simulation codes were parallelized for distributed memory architectures. During the project, sparse matrix solvers turned out to be a major obstacle for high scalability of the parallel version of several codes. The European Commission therefore launched the PARASOL project to develop fast parallel direct solvers and to test parallel iterative solvers on their applicability and robustness in an industrial framework.

This paper presents initial results using a special multilevel method as preconditioner for matrices resulting from MSC/NASTRAN linear static analysis of solid structures. P-elements in MSC/NASTRAN allow the polynomial degree of the base functions to be specified either globally or for each element. Solution dependent adaptive "refinement" of the p-level can be selected. Discretisations with lower p-level can therefore be used as coarser grids for a multilevel method.

Tests have been performed using such a method as preconditioner for a regular cube and a complicated industrial part, which were modelled by tetrahedrons and hexagonal elements. Preliminary performance comparisons on small test cases (about 10000 degrees of freedom) indicate that the multilevel approach is at least as fast as the currently available fastest iterative MSC/NASTRAN solver. Substantial performance improvements are expected for full-size industrial problems.

Key words. finite elements, multigrid methods, parallel computation.

AMS subject classifications. 65N30, 65N55, 65Y05.

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