Factorization and Kernel Detection of the Stiffness Matrix

Pavla Jirůtková
IT4Innovations; Technical University of Ostrava, Department of Applied Mathematics
pavla.jirutkova@vsb.cz

Alexandros Markopoulos, Radek Kučera
IT4Innovations
alexandros.markopoulos@vsb.cz, radek.kucera@vsb.cz

Abstract

Large scale problems that are not solvable on usual personal computers can be solved only in parallel on supercomputers. Domain decomposition methods (DDM) come here into play. They are mathematical methods for solution of partial differential equations that solve a boundary value problem by splitting it into smaller independent boundary value problems on subdomains and iterating to coordinate the solution between adjacent subdomains. The one of successful DDM subclasses is the Total FETI (Finite Element Tearing and Interconnecting) method, where e. g. for static linear elasticity problem all subdomain stiffness matrices are singular and they have a-priori known kernels. The matrix whose columns form a basis of the kernel can often be assembled directly from the nodal coordinates. However, in some specific cases the kernel has to be generated numerically. We introduce our new heuristic approach to the kernel detection without necessity to know the information about nodal coordinates. In the method the detection of zero pivots is based on a random choice of the fixing degrees of freedom. The theoretical results are confirmed by numerical experiments.

References

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