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基于MPI机群环境下的广义逆力法并行化初探

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摘要 广义逆力法是一种以力法为力学概念基础, 以广义逆矩阵理论为数学理论基础, 以迭代求解为求解方式的新算法。该法主要针对材料非线性问题, 由于无需像传统的基于位移法的逐步增量法那样逐步递进计算, 所以也称特大增量步算法。广义逆力算法的迭代过程可以分为整体阶段和局部阶段, 分别可以进行时间上的并行计算和空间上的并行计算。这种可并行性是算法本身所天然蕴含的, 不同于结构并行计算领域内传统的基于子结构的并行计算, 是一种全新的并行计算思路。机群系统是随着微处理器技术和计算机互连网络技术的迅速发展而出现的一种并行计算系统, 它正以其易扩展、易维护、易升级、价格低等优势迅速地扩大着自身的应用范围。基于消息传递方式的并行环境, 做为一种目前事实上最流行和通用的并行环境, 正在逐渐成为这种编程模型的代表和事实上的标准。广义逆力法在基于MPI机群环境下的初步并行化中有着良好的表现, 从实践上印证了该算法的可并行性。严格控制计算时间和通讯时间的比例, 合理分配各个计算节点的负载是获得较好并行效率的关键点。

关键词 [岩土力学](#); [并行计算](#); [广义逆力法](#); [机群](#); [MPI](#)

分类号

PARALLELIZATION OF THE FORCE METHOD BASED ON GENERALIZED INVERSE MATRIX IN THE CLUSTER SYSTEM WITH MPI

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Abstract

Generalized inverse matrix(GIM) is a new force method based on the generalized inverse matrix theory, which is an iteration method for solving material nonlinear problems. Unlike the classical force method, GIM does not need to consider the basic structure, so it is also feasible for computer to calculate. This method brings the force method a new light in the computer calculation field. GIM has some natural parallel-calculating characteristics, which are different from the classical substructural algorithm. In GIM, the system control equations are divided into a linear group, which includes the equilibrium equation and the compatibility equation, and into a nonlinear group, which includes the constitutive equation. The iteration procedure starts from a special solution of the equilibrium equation which is achieved by using the GIM theory. The whole iteration procedure can be divided into the global stage and the local stage. In the global stage, the linear group is used, while in the local stage, the nonlinear group must be considered. The calculation can be perform in a parallel way according to the time in the global stage and the space in the local stage. The parallelization process of GIM is present. Several different methods of parallelization are given and compared. The parallelization is considered in the

cluster system with message passing interface(MPI). MPI is a kind of parallel environment which is widely used nowadays. Cluster system is a system of many computers linked by high-speed network. The parallelization of GIM in such an environment works well, which proves the parallel-calculating characteristics of GIM to have better performance. The ratio of the time between communication and calculation is an important key during the parallelization. And the parallel program must be compatible with both the hardware and software environment of parallelization.

Key words [rock and soil mechanics](#); [parallel-calculating](#); [GIM](#); [cluster](#); [MPI](#)

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