Parallel Implementation of a Low Order Algorithm for Dynamics of Multibody Systems on a Distributed Memory Computing System

Kurt S. Anderson *

Department of Mechanical, Aerospace, and Nuclear Engineering

Rensselaer Polytechnic Institute, Troy, NY 12180-3590

and

Shanzhong Duan †

Autodesk Inc.

Mechanical Division, Novi, MI 48375

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Abstract

In this paper, a new hybrid parallelizable low order algorithm, developed by the authors for multibody dynamics analysis is implemented numerically on a distributed memory parallel computing system. The presented implementation can currently accommodate the general spatial motion of chain systems, but key issues for its extension to general tree and closed loop systems are discussed. Explicit algebraic constraints are used to increase coarse grain parallelism and to study the influence of the dimension of system constraint load equations on the computational efficiency of the algorithm for real parallel implementation using the Message Passing Interface (MPI). The equation formulation parallelism and linear system solution strategies which are used to reduce communication overhead are addressed. Numerical results indicate that the algorithm is scalable, that significant speed-up can be obtained, and that a quasi logarithmic relation exists between time needed for a function call and numbers of processors used. This result agrees well with theoretical performance predictions. Numerical comparisons with results obtained from independently developed analysis codes have validated the correctness of new hybrid parallelizable low order algorithm and demonstrated certain computational advantages.

*Associate Professor

†Senior Engineer