AN EFFICIENT ALGORITHM FOR DETECTING INTERFERING QUADRILATERALS*

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Contact interface, which is commonly used to detect and resolve the interference between two bodies, has long become an essential feature in modern computer programs for structure/continuum simulation. Since a significant portion of the aggregate computation time is spent on such contact interfaces, the efficiency of the contact algorithm has a direct impact on a program's overall effectiveness. In explicit structural/continuum finite element codes such as DYNA3D[1], the exterior of the bodies under consideration is usually represented by a collection of quadrilateral segments. Detecting contact between these bodies thus becomes a series of queries on whether a pair of quadrilaterals intersect each other.

In this paper, a fast and reliable algorithm in detecting the interference between two quadrilaterals is presented. By selecting a proper local coordinate system, the proposed method simplifies a three dimensional geometric problem into a two dimensional one and reduces the solutions of the necessary equations to simple analytical forms. Through a progressive approach, far apart pairs are quickly eliminated, and all possible interference scenarios are considered to ensure the reliability.

The proposed algorithm proves to be very robust and easy to implement. It not only can be used in contact detection, but also is applicable in hidden surface elimination in computer graphics.

References

[1] Current Developer: J.I. Lin, "DYNA3D: A Nonlinear, Explicit, Three-Dimensional Finite Element Code for Solid and Structural Mechanics - User Manual," University of California, Lawrence Livermore National Laboratory (1993), UCRL-MA-107254.

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