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An algorithm for the matrix-free solution of quasistatic frictional contact problems. (English)

Zbl 0948.74060

Int. J. Numer. Methods Eng. 44, No. 9, 1205-1226 (1999).

Summary: A contact enforcement algorithm has been developed for matrix-free quasistatic finite element techniques. Matrix-free (iterative) solution algorithms such as nonlinear conjugate gradients and dynamic relaxation are desirable for large solid mechanics applications where direct linear equation solving is prohibitively expensive, but in contrast to more traditional Newton-Raphson and quasi-Newton iteration strategies, the number of iterations required for convergence is typically of the same order as the number of degrees of freedom of the model. It is therefore crucial that each of these iterations be inexpensive to perform, which is of course the essence of a matrix free method.

In applying such methods to contact problems, we emphasize here two requirements: first, that the treatment of the contact should not make an average equilibrium iteration considerably more expensive; and second, that the contact constraints should be imposed in such a way that they do not introduce spurious energy that acts against the iterative solver. These practical concerns are utilized to develop an iterative technique for accurate constraint enforcement that is suitable for nonlinear conjugate gradient and dynamic relaxation iterative schemes.

MSC:

74S05 Finite element methods applied to problems in solid mechanics

74M15 Contact in solid mechanics

Cited in 3 Documents

Keywords:

contact enforcement algorithm; matrix-free quasistatic finite element techniques; average equilibrium iteration; contact constraints; nonlinear conjugate gradient; dynamic relaxation iterative schemes

Software:

ABAQUS/Standard

Full Text: DOI

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