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Simulation of planar mechanisms with revolute clearance joints using the multipatch based isogeometric analysis

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Abstract

The dynamic analysis of planar mechanisms with multiple revolute clearance joints is performed using the isogeometric analysis for the first time. A general multiple patches based revolute clearance joint model, which can be integrated into other parts or structures without changing the procedure of contact treatment, is proposed. A stable and optimized contact detection algorithm that accompanies the joint model is also introduced. Benefit from the high order NURBS basis functions, the geometrically exact covariant formulations of contact geometry, contact force and its Jacobian matrix are implemented. The implicit generalized-α method is employed to solve the time dependent nonlinear system equations. The effect of joint clearance on rigid and flexible mechanisms is studied through numerical examples. The accuracy and efficiency of the proposed approach are verified through a comparison with other conventional methods. The proposed approach exhibits great stability in long-term simulation regardless of the number of clearance joints, the size of clearance, the flexibility of the link and bearing. Results show that isogeometric analysis can provide a unified framework for joint clearance analysis of rigid and flexible systems. In the field of analyzing the combined effect of joint clearance and bodies' large flexibility, the proposed method has significant advantages.

Keywords:
isogeometric analysis, revolute clearance joint, flexible mechanism, contact detection, multiple NURBS patches

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