Optimum Control Forces for Multibody Systems with Intermittent Motion

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Abstract

It is common practice in the analysis of constrained multibody systems to apply the constraints as a set of separate algebraic equations and embed them into the governing equations for the specified time of the simulation. However more realistic systems are those where different constraints could be applied at different times, and hence the multibody system must be able to accommodate for the sudden changes. If the multibody system doesn't develop the appropriate initial conditions to satisfy the constraints whenever they are applied, the system performance will then be hampered and it will fail to accomplish its tasks.

If a multibody system is subjected to constraint equations that are released and applied at different times during the motion they characterize the so-called intermittent constraints. This paper objective is to address the continuity of motion when a dynamical system is suddenly subjected to constraint conditions. Motion discontinuity due to the initial constraint violation is avoided by prior control forces that adjust the motion and yield velocity and acceleration consistent at the point of application of the constraint. The optimum control forces are determined for a specified control interval. The method proposed provides an optimum adjustment of the system's motion and assures that the stresses developed at the system components are kept within acceptable limits. The procedures developed will be illustrated making use of inequality constraints applied to obstacle avoidance problems in robotics.

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