

Generating Optimal Motions of Constrained Multibody Systems

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A general approach to optimal motion synthesis of controlled multibody systems is presented. It applies to a wide range of actuated mechanical systems such as industrial manipulators, parallel robots and walking machines. The method is developed in order to account for time-varying topology of systems having closed kinematic chains possibly subjected to one-sided contacts. Based on Lagrangian dynamics of constrained mechanical systems, an optimal control problem is stated. It consists in minimizing an integral amount of actuating torques while satisfying a complete set of constraints defining feasible movements. A parametric optimization technique based on approximating joint motion coordinates using spline functions of class C3 is developed to solve this primary problem. Optimization parameters are the values of generalized coordinates at control points. The original optimal control problem is recast as a non-linear constrained optimization problem. The latter can be solved efficiently using computing codes implementing SQP algorithms.

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