Discrete Mechanics, Optimal Control and Formation Flying Spacecraft

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April 12, 2006

Abstract

A new approach to the solution of optimal control problems for mechanical systems is proposed. It is based on a direct discretization of the Lagrange-d'Alembert principle for the system (as opposed to using, for example, collocation or multiple shooting to enforce the equations of motion as constraints). The resulting forced discrete Euler–Lagrange equations then serve as constraints for the optimization of a given cost functional. We numerically illustrate the method by optimizing a low thrust satellite orbit transfer, the reconfiguration of a group of hovercraft in the plane and of a group of formation flying spacecraft as motivated by the Darwin (ESA) and TPF (NASA) space missions. This is joint work with Jerry Marsden (Caltech) and Sina Ober-Bloebaum (Paderborn).