DISCRETE MECHANICS: VARIATIONAL INTEGRATORS AND OPTIMAL CONTROL

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We present some recent advances in discrete mechanics, their numerical implementation and their application to problems of engineering and physical interest.

First of all, some basic features of discrete mechanics (see Marsden and West [1]) are recalled. These lead to variational integrator methods, which are similar to finite element methods, but that extend these ideas from space to the space time context. The methods include symplectic integrators in the case of conservative systems.

Second, some recent advances in applying this theory to time evolution problems will be reviewed; see, for instance, Lew, Marsden, Ortiz and West [2]. In particular, we will focus on recent methods developed with M. Desbrun and our groups on a way to design variational integrators such that the time step map is determined not by solving a system of nonlinear implicit equations but by a minimization of a special function. Applications of these ideas to, for instance, elastodynamics will be considered.

Third, the application of discrete mechanics to optimal control will be given (see Junge, Marsden and Ober-Blöbaum [3]) will be given with applications to optimization of groups of vehicles, and optimal swimming (see Kanso and Marsden [4]). Recent progress in hierarchical and parallelization methods that enable one to extend the techniques to large groups of vehicles (such as groups with large numbers of microsatellites) will be presented.

References

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