

Variational Integrators: high order, multirate dynamics and optimal control

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Variational principles are powerful tools for the modelling and simulation of conservative mechanical and electrical systems. As it is well-known, the fulfilment of a variational principle leads to the Euler-Lagrange equations of motion describing the dynamics of such systems. A discretisation of the variational principle leads to unified numerical schemes called variational integrators with powerful structure-preserving properties such as symplecticity, momentum preservation and excellent long-time behaviour.

After a broad introduction to variational integrators we will focus on different recent research aspects. These include high and mixed order construction and convergence analysis of variational integrators, a multirate version for the efficient simulation of dynamics on different time scales as well as their use in solving optimal control problems. The theoretical results will be demonstrated numerically by means of several applications.