Structure preserving integrators for non-linear structural dynamics

A well known and major drawback of standard time integration schemes in the field of non-linear elastodynamics is their unstable behavior in the case of stiff material behaviour. To remedy this drawback, structure preserving integrators have been developed.

Spatial discretization:

The considered continuum bodies, which suffer large deformations, are discretized by the finite element method, using isoparametric interpolations. As constitutive law, e.g. a compressible neo-Hookean material is taken into account.

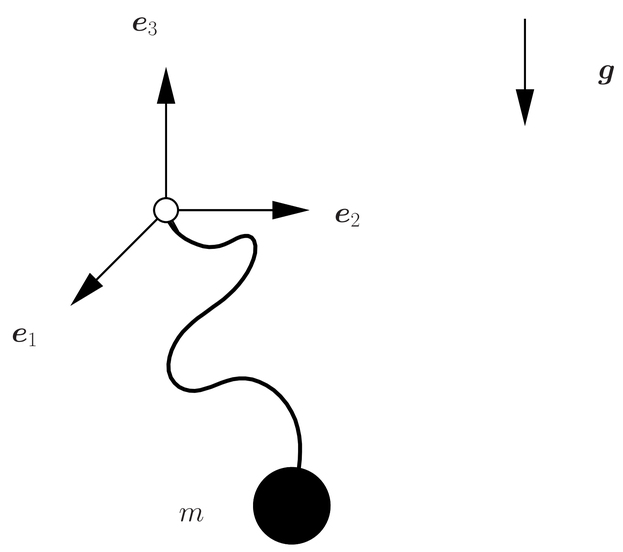
Time discretization:

A modified energy and momentum scheme, which preserves the energy, linear and angular momentum, as well as a modified variational integrator, which preserves the symplectic structure, linear and angular momentum, have been implemented.

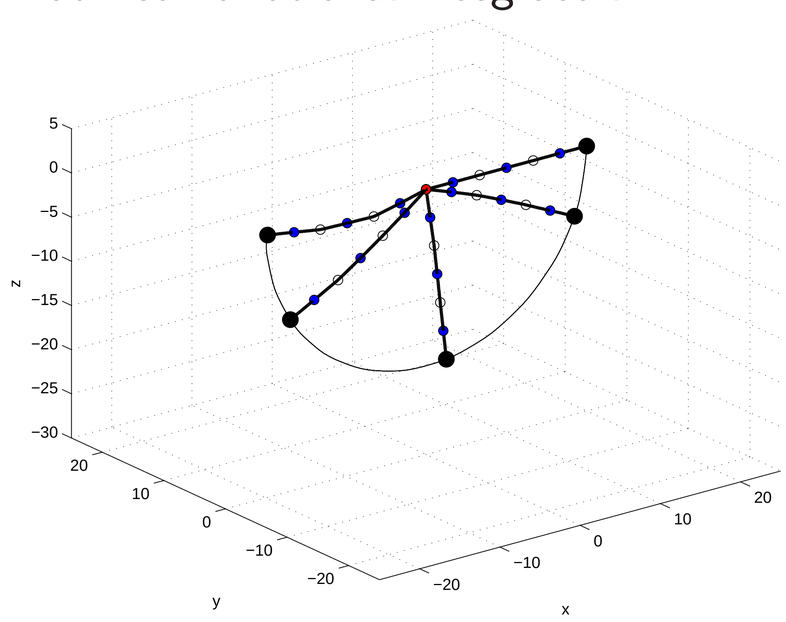
Numerical examples:

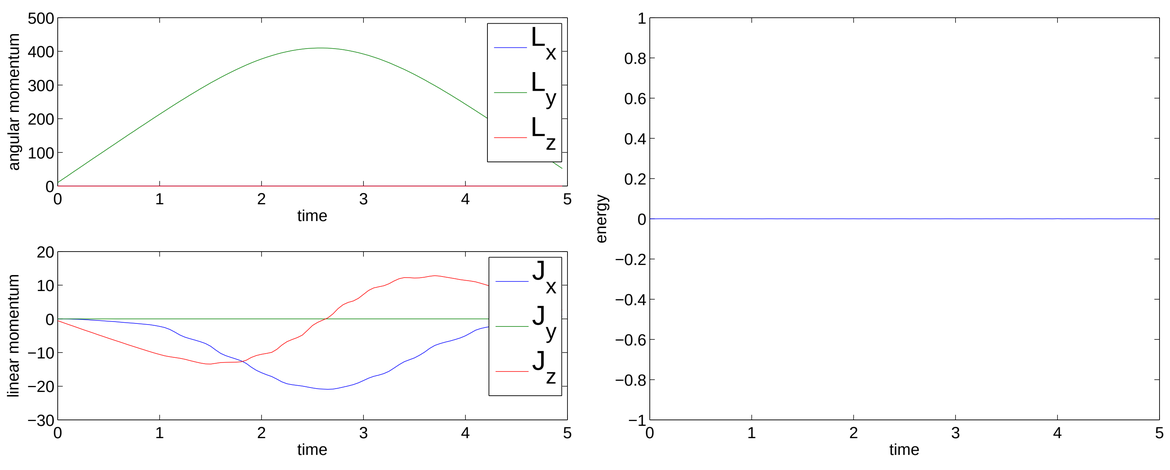
Two representative numerical examples are presented to expose the characteristics of the different approaches. The results are shown at the bottom.

Rope pendulum

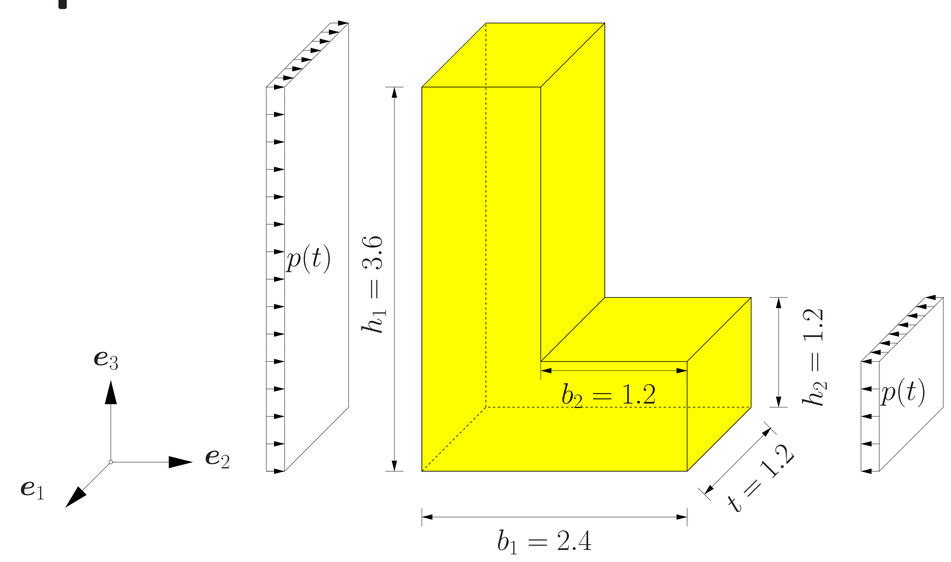


As a first example a rope pendulum (configurations corresponding to $t = 0, 1.25, 2.5, 3.75, 5$) under the influence of gravity is simulated by using quadratic shape functions and a modified variational integrator.

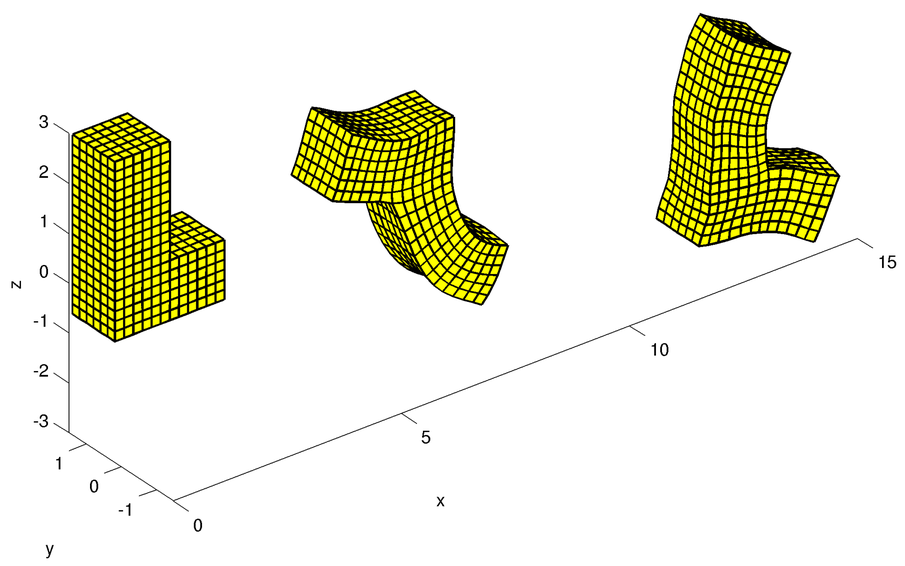




L-shape



The second example represents a L-shaped block (configurations corresponding to $t = 0, 8, 16$), modeled with neo-Hookean material, under the influence of pressure as shown above. Therefore a modified energy-momentum scheme has been used.



M. Franke, P. Betsch, C. Hesch
Numerische Mechanik
http://www.uni-siegen.de/fb11/nm/
UNIVERSITÄT SIEGEN