**Authors:**Stefan Holzinger and Johannes Gerstmayr

**Affiliation:**
Department of Mechatronics
University of Innsbruck
Technikerstraße 13
6020 Innsbruck, Austria

**Email:**Stefan.holzinger@uibk.ac.at
Johannes.gerstmayr@uibk.ac.at

**Title:**
Application of explicit Lie group integrators to engineering applications

**Abstract:**

In many engineering applications, there has recently been an increasing interest in explicit time integrators for ordinary differential equations that use Lie group methods. Especially Runge-Kutta-Munthe-Kaas type methods are of special interest because the tedious decision for the choice of rotation parameters between redundant Euler parameters and singularity-affected Euler angles is obsolete. In a recent paper of the authors, novel update formulas for Lie group integration have been proposed, which allow to compute direct and consistent updates for the rotation vector or the Euler angles in every time step. Therefore, singular points can be surmounted, while preserving a non-redundant parameterization of rotations. Due to the non-redundant formulation of rotation parameters, the method can be easily integrated into existing multibody codes, such as our internal code Exudyn. In this work, we propose a generalization of previously used classical fourth order Runge-Kutta methods to several fixed-step as well as embedded Runge-Kutta methods with automatic step size control which are widely used in practice. The intention is to perform tests with more advanced multibody systems in order to observe the excellent convergence behavior of such Lie-group methods – in extension of the heavily studied freely rotating rigid body – showing a flyball governor with compliant joints and a high-speed rotor.