1014-65-496 **Melvin Leok*** (mleok@umich.edu), Department of Mathematics, 2074 East Hall, 530 Church Street, Ann Arbor, MI 48109-1043. *Lie group variational integrators and their applications to geometric control.*

We introduce Lie group variational integrators, which are based on a discretization of Hamilton's principle that preserves the Lie group structure of the configuration space without the use of local charts, reprojection, or constraints.

These yield highly efficient geometric integration schemes for rigid body dynamics that automatically remain on the rotation group. By representing the attitude as a rotation matrix, we avoid coordinate singularities associated with local charts such as Euler angles, thereby giving a global representation of the configuration that is of particular importance for the accurate and efficient simulation of chaotic motion.

As can be seen from the discrete system of equations,

$$\begin{aligned} J\omega_{k+1} &= F_k^T J\omega_k + hM_{k+1}, \\ hJ\omega_k &= \frac{\sin|f_k|}{|f_k|} Jf_k + \frac{1-\cos|f_k|}{|f_k|^2} f_k \times Jf_k, \\ R_{k+1} &= R_k e^{S(f_k)}, \end{aligned}$$

the preservation of the Lie group structure arises from expressing the update of the numerical solution in terms of the exponential of a Lie algebra element.

These numerical methods have been applied to the control of the 3D pendulum system, which result in more accurate numerical solutions. (Received September 21, 2005)