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Exact Analytic Solution for the Rotation of a Rigid Body having Spherical Ellipsoid of Inertia and Subjected to a Constant Torque

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The exact analytic solution is introduced for the rotational motion of a rigid body having three equal principal moments of inertia and subjected to an external torque vector which is constant for an observer fixed with the body, and to arbitrary initial angular velocity. In the paper a parametrization of the rotation by three complex numbers is used. In particular, the rows of the rotation matrix are seen as elements of the unit sphere and projected, by stereographic projection, onto points on the complex plane. In this representation, the kinematic differential equation reduces to an equation of Riccati type, which is solved through appropriate choices of substitutions, thereby yielding an analytic solution in terms of confluent hypergeometric functions. The rotation matrix is recovered from the three complex rotation variables by inverse stereographic map. The results of a numerical experiment confirming the exactness of the analytic solution are reported. The newly found analytic solution is valid for any motion time length and rotation amplitude. The present paper adds a further element to the small set of special cases for which an exact solution of the rotational motion of a rigid body exists.

Comments:	"Errata Corridge Postprint" In particular: typos present in Eq. 28 of the Journal version are HERE corrected
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