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A BILINEAR DISCRETIZATION OF THE MOTION OF A RIGID BODY IN AN IDEAL FLUID

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ABSTRACT

The Clebsch system is one of the few classical examples of rigid bodies in an ideal fluid whose equations of motion are known to be integrable and given by the following system:

$$\begin{cases} \dot{\mathbf{x}} = \mathbf{x} \times \frac{\partial H}{\partial \mathbf{p}} \\ \dot{\mathbf{p}} = \mathbf{x} \times \frac{\partial H}{\partial \mathbf{x}} + \mathbf{p} \times \frac{\partial H}{\partial \mathbf{p}} \end{cases} \tag{1}$$

where $H \in C^{\infty}(\mathbb{R}^6, \mathbb{R})$ is a quadratic polynomial in $\mathbf{x}$ and $\mathbf{p}$.

Applying bilinear method and using the gauge invariance and the time reversibility of the equations, we get gauge-invariant bilinear difference equations. Finally, we derive the explicit discrete system by considering bilinear transformation method and present sufficient number of the discrete conserved quantities for integrability. Bilinear discreteziaton leads to the discovery of four independent integrals, namely conserved quantities, of motion of the discrete-time system, which turn out to be much more complicated than the integrals of the continuous-time system.

References

[1] Abraham, R., Marsden, J.E. and Ratiu, T.S., Manifolds, Tensor Analysis, and Applications, V.75 of Applied Mathematical Sciences, Springer-Verlag, (1988).
[2] http://www.asir.org
[3] Lesser, M., The Analysis of Complex Nonlinear Mechanical Systems: A Computer Algebra Assisted Approach, World Scientific, Series A, Vol.17, (1995).
[4] Hirota, R., Kimura, K. and Yahagi, H., How to find the conserved quantities of nonlinear discrete equations, J.Phys.A:Math.Gen. 34, 1037710386, (2001).
[5] Zhivkov, A., Christov, O., Effective solutions of Clebsch and C. Neumann systems, Sitzungsberichte der Berliner Mathematischen Gesellschaft, (2001).
[6] Perelomov, A.M., A few remarks about integrability of the equations of motion of a rigid body in ideal fluid, Phys.Lett.A 80, no:2-3, 156158, (1980).

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