Some results on numerical propagation when integrating Hamiltonian relative periodic orbits

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Many Hamiltonian systems that appear in physical applications (such as rigid bodies, N-body problems or molecular problems) possess a supplementary structure provided by a symmetry groups.

One of the points in which the Hamiltonian system is affected by the symmetry group concerns to the analysis of relative equilibrium solutions and relative periodic solutions. They respectively project to equilibria and periodic solutions of the Hamiltonian reduced by the symmetry group. Some theoretical works have analyzed existence and stability of this kind of solutions [4,5,6].

In a numerical sense, it is interesting to study the influence of the symmetries when approximating to these solutions or to small perturbations. In [2,1] some results about error growth in the case of relative equilibrium integration have been obtained, within the context of geometric integration [3]. In this talk, we make a first approach to the numerical analysis of relative periodic orbits. We try to study the structure of the error in order to obtain some conclusions about the behaviour of the integrators.

References

[1] B. Cano and A. Durán, *A technique to improve the error propagation when integrating relative equilibria*, BIT 44(2004) 215-235.

[2] A. Durán and J.M. Sanz-Serna, *The numerical integration of relative equilibrium solutions. Geometric theory*, Nonlinearity 11(1998) 1547-1567.

[3] E. Hairer, Ch. Lubich and G. Wanner, *Geometric Numerical Integration. Structure-Preserving Algorithms for Ordinary Differential Equations*, Springer Series in Comput. Mathematics, Vol. 31, Springer-Verlag 2002.

[4] J. E. Marsden, *Lecture on Mechanics*, Cambridge University Press, 1992.

[5] J. P. Ortega, *Symmetry, Reduction and Stability in Hamiltonian Systems*, Ph.D. Thesis, University of California, 1998.

[6] C. Wulff and M. Roberts, *Hamiltonian systems near relative periodic orbits*, SIAM J. Appl. Dyn. Syst. 1 (2002) 1-43.