Numerical integration of a many-body problem in the plane. A customer's review

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Abstract

We present a classical many-body problem in the plane with pairwise interaction forces that are velocity dependent and fall-off as the particles are far apart. The particles are also subject to the action of a constant magnetic field acting in the direction perpendicular to the plane of motion. We show that this model has periodic orbits for a wide class of initial conditions, all periods being integer multiples of a fundamental period. We explain the mechanism by which orbits with higher periods appear, which depends on the presence of rational branch points in the solution to a system of ODEs. A numerical integration of the equations of motion using a 4th order Runge-Kutta-Fehlberg method with variable time step has been performed. The numerical results confirm the theoretical predictions for the model, and orbits with period as high as 79 have been observed numerically. Despite the fact that the system of ODEs is coupled and non-linear, a simple integration method gives very good results for the stability of the orbits. Several animations of the particles' motion will be showed corresponding to different initial conditions.