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ADVANCED THEORIES TO COMPUTE ASTEROID MEAN ELEMENTS

Z. KNEŽEVIĆ

Astronomical Observatory, Volgina 7, 11160 Belgrade-74, Yugoslavia

Abstract. Asteroid mean orbital elements are obtained from osculating ones by removal of the short periodic perturbations. They represent the first step in the computation of asteroid proper elements, which are, in turn, obtained from the mean ones by removal of the long periodic perturbations. The algorithms for the purpose of computation of the mean elements used so far are accurate only to first order in the masses of the perturbing planets; still, the obtained mean elements have satisfactory accuracy for most of the asteroid belt. The degraded accuracy appears in the neighbourhoods of the main mean motion resonances, especially the 2 : 1. A number of algorithms capable of pushing this approximation to higher order is considered here; these are either the so called Breiter–type methods, or iterative methods. The former are obtained by applying some higher order numerical integration scheme, such as Runge-Kutta, to perform the transformation removing the short periodic perturbations from the initial conditions and fast angular variables from the equations of motion. The latter are fixed point iterative schemes, with the first oder theory as an iteration step, used to compute the inverse map from mean to osculating elements. The results of tests of several methods of both kinds, on a sample of asteroid orbits taken up to the edge of the 2 : 1 resonance, are presented and discussed. They indicate that the iterative methods are superior, in this specific application, to the Breiter–type methods. This is due to the cancellations occurring between second order perturbation terms: incomplete second order theories are thus less reliable than complete, fixed frequency theories of the first order.