The Morbiter software numerically averages an osculating orbit’s equations of motion (EOM) to arrive at the mean orbit’s EOMs, which are then numerically propagated to obtain the long-term orbital ephemerides. The long-term evolution characteristics, and stability, of an orbit are best characterized using a mean element propagation of the perturbed, two-body variational equations of motion. The average process eliminates short period terms, leaving only secular and long period effects. Doing this avoids the Fourier series expansions and truncations required by the traditional analytic methods.

The numerical methods require no analytic approximation, and the averaging theory and software implementation work at any solar system body JPL’s Monte mission analysis and navigation software was used as the underlying trajectory system (to the extent possible) for this innovation.

Morbiter is a package of Python scripts that implement the algorithms, and uses Monte for basic astrodynamics constructs and functions such as trajectories, ephemerides, coordinate systems, astro-dynamics constants, and, in most cases, the perturbation acceleration methods. Python is an interpreted language that provides an ideal platform for rapid development of algorithms; however, there is a performance penalty for using Python script-based applications. An end-user, future version of Morbiter that is fully compiled will not suffer from this speed penalty; development of this version is planned to begin in late FY ’10.

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