Determination of meteoroid orbits using numerical integration of equation of motion

Vasily Dmitriev[1], Valery Lupovka[1], and Maria Gritsevich[1,2,3]

[1]Moscow State University of Geodesy and Cartography (MIIGAiK)
[2]Finnish Geodetic Institute, Department of Geodesy and Geodynamics, Geodeetinrinne 2, P.O. Box 15, FI-02431 Masala, Finland
[3]Russian Academy of Sciences, Dorodnicyn Computing Centre, Department of Computational Physics, Vavilova 40, 119333 Moscow, Russia

The article describes a technique for determining orbit of meteorites based on strict transformations of coordinate and velocity vectors recommended by the IAU International Earth Rotation and Reference Systems Service (IERS) and integration of differential equations of motion. The obtained results show good correspondence with different implementations of the traditional technique, which are based on zenithal attraction assumptions. The considered technique takes into account the perturbations from the Earth (as point mass), perturbations from the non-central part of the geopotential perturbations of the Moon and other planets in the Solar System and Earth atmosphere. Analysis of perturbations in the motion of meteors in time preceding meteorite collision with the ground was done. (Figure 1). Performed comparison of the proposed technique with classical methods. Software for calculation of meteor orbit and its analyzing was developed Software for calculation of meteor orbit was developed. Using this software is able to analyze orbital motion of meteoroids in time before falling and to calculate location of collision meteorite with ground.
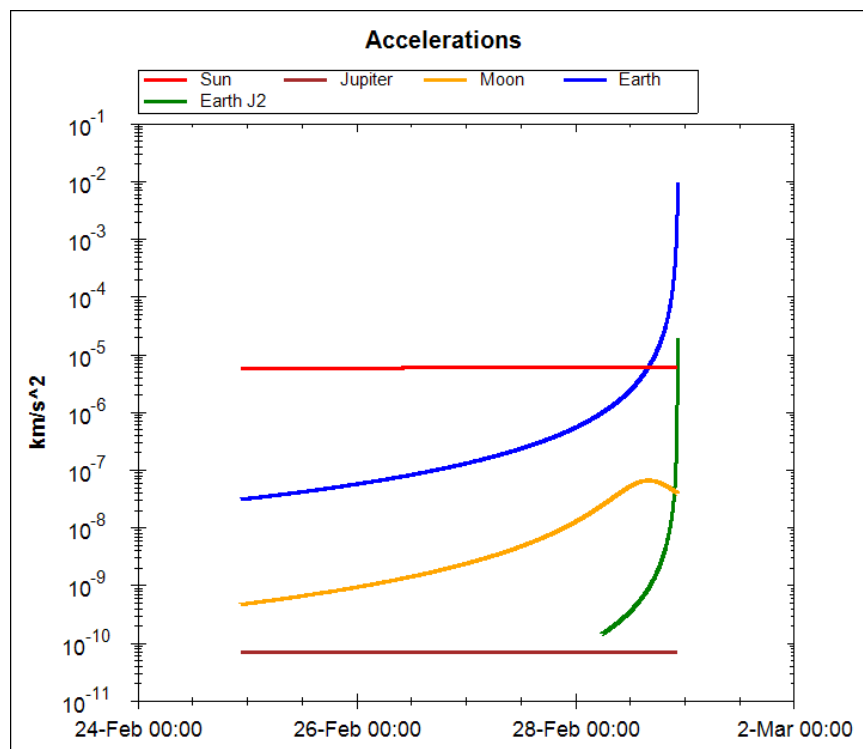

Figure 1. Acceleration in motion of the meteoroid Košice.

Orbit of meteoroid calculated using initial data from [1].

References

[17] J. Borovička, et al., "The Košice meteorite fall: Atmospheric trajectory, fragmentation, and orbit," Meteorit Planet Sci, vol. 48, no. 10, pp. 1757–1779, 2013.