

1 Introduction

The PoliMi Space Agency wants to launch a Planetary Explorer Mission, to perform Earth Observation. This section carries out relevant orbital analysis and groundtrack estimation while also considering two perturbation models. A modified groundtrack was proposed for a repeating groundtrack, and two propagation methods are used to perform the analysis which are then compared. A comparison between the real data of a satellite and its analytical results obtained with the code model is also performed for model validity.

1.1 Nominal Orbit

From the provided orbital parameters this satellite heavily resembles a geosynchronous characteristics. Hence, the altitude at perigee is chosen as 35786 km - where it is possible to see the moon and J2 perturbation effect. Ω , ω , and f_0 are chosen arbitrarily.

a [km]	e [-]	i [°]	Ω [°]	ω [°]	altitude at perigee [km]
42159	0.0007	32.5934	0	85	35786

Table 1: Keplerian elements of the orbit.

The unperturbed nominal orbit is propagated as below in the Earth-centered reference frame:

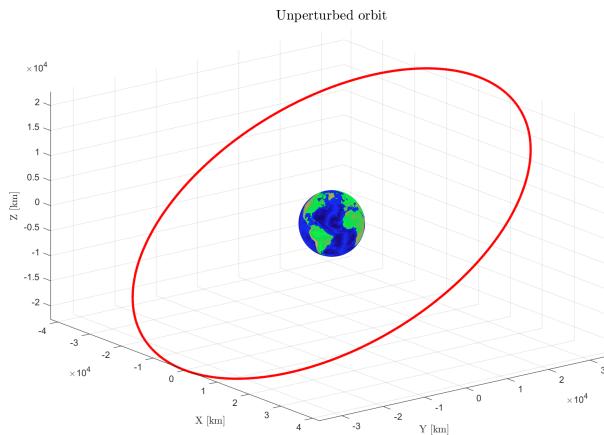


Figure 1: Assigned orbit.

2 Groundtrack

The satellite's orbit is propagated to compute its groundtrack. The motion of the spacecraft is assumed to be a perturbed two body problem in Cartesian coordinates, described by the equation:

$$\dot{\mathbf{r}} = -\frac{\mu}{r^3} \mathbf{r} + \mathbf{a}_{\text{perturbation}}$$

This is solved using Matlab's `ode113` function, with a relative tolerance of 1×10^{-12} and absolute tolerance of 1×10^{-12} .

2.1 Unperturbed Nominal Orbit

The first required analysis of the ground track is for the nominal orbit considering an unperturbed case, where the $\mathbf{a}_{\text{perturbation}}$ in equation is null. The ground track was propagated for a period of 1 orbit of the satellite, 1 day and 10 days, as shown below.

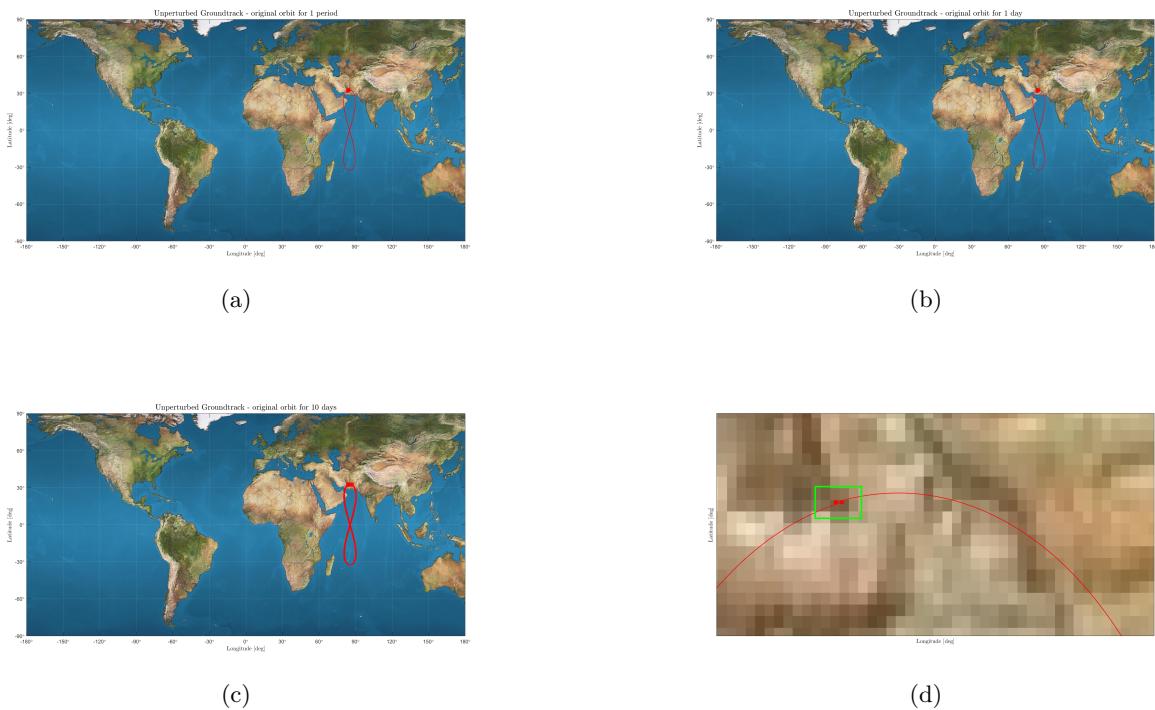


Figure 2: Ground track of the unperturbed nominal orbit during: (a) 1 orbit; (b) 1 day; (c) 10 days. Ground track path (—), Starting point (●), Ending point (■)