Quasi-Satellite Orbits around Phobos for the Sample Return Mission

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Phobos Sample Return (PhSR) is an ESA-Roscomos mission that aims to characterize Phobos and to collect a sample of its soil to bring it back to Earth. The main science goal of the mission is to understand the formation of the Martian moons Phobos and Deimos and to put constraints on the evolution of the solar system. To do this, samples from Phobos (the moon with the older expected surface) have to be returned to Earth and thus potential landing sites have to be studied in depth beforehand to establish sampling usefulness.

A relevant aspect of the PhSR mission is represented by the use of QSO in the proximity of Deimos and Phobos: these are particular solutions to the three-body problem that can be exploited to remain in close proximity (< 100 km) to the Martian moons for periods in the order of weeks without requiring control burns. Due to its reduced mass and to its extreme proximity to Mars [1], Phobos presents a weak gravitational field with a Hill sphere that is located below its surface [2]; the strongly-perturbed environment rules out the usage of classical Keplerian orbits for its observation and so different trajectories have to be considered for the full target characterization that will allow the careful selection of the landing site [3][4].

This paper illustrates the full process of the QSO generation (through a parametric optimization of the initial conditions and control burns) and selection in the context of the PhSR mission, fulfilling then both scientific [5] and mission [6] requirements.

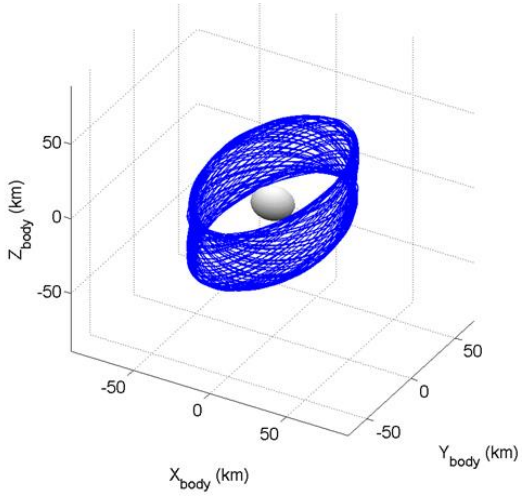

Fig. 1. Example of QSO of 30 degrees of pseudo inclination around Phobos

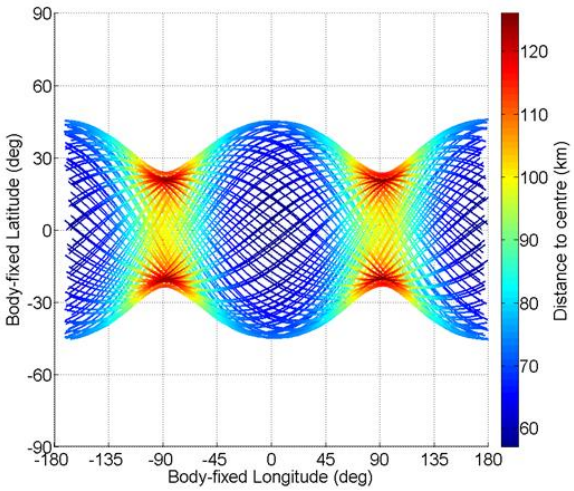

Fig. 2. Phobos QSO ground track with indication of the orbit distance from the surface

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