NEARBY DYNAMICS AND SURFACE CHARACTERISTICS OF APOPHIS. O.C. Winter[1,3], G. Valvano[1,4], G. Borderes-Motta[2,5], R. Sfair[1,6], R. Machado[1,7], and T. Moura[1,8]. [1]Grupo de Dinâmica Orbital & Planetologia, São Paulo State University - UNESP, Guaratinguetá, Brazil. [2]Bioengineering and Aerospace Engineering Department, Universidad Carlos III de Madrid, Leganés, 28911, Madrid, Spain. [3]othon.winter@unesp.br, [4]giulia.valvano@unesp.br, [5]gbordere@ing.uc3m.es, [6]rafael.sfair@unesp.br, [7]rai.machado@unesp.br, [8]t.moura@unesp.br.

Introduction: Since the Potentially Hazardous Asteroid Apophis will have a close approach to the Earth in 2029, it will be an extraordinary opportunity to acquire deeper knowledge on such kind of minor body. Beyond ground based observations, space missions could greatly benefit from this close passage. Naturally, all previous knowledge about Apophis might help in the planning of such observations and missions. In the current work we explore two major aspects of this problem: one concerns the surface characteristics of Apophis taking into account its known shape model, while the other is focused on the dynamical environment nearby it.

Surface Characteristics: Apophis is a highly irregular shaped body with an equivalent radius of about 340 metres (Figure 1).

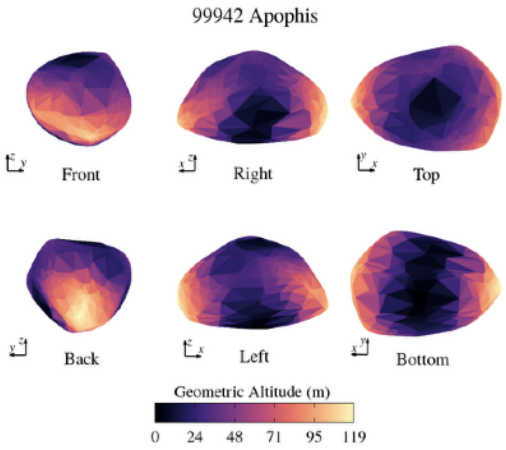

Figure 1. Geometric altitude of Apophis. The color code indicates the altitude value from the "sea level" (black), which is the smallest distance from the surface to the geometric centre of the body.

We considered the irregular shape model as a uniform density polyhedra [1], with a bulk density that might have the significantly different values of 1.29 g cm^{-3}, 2.2 g cm^{-3}, 3.2 g cm^{-3}, and 3.5 g cm^{-3} [1,2,3], and a rotational period of 27.38 h [4,5].

We analysed geometric quantities such as the geometric altitude, and the tilt angle, as well as the physics related to the geopotential as the geopotential, the accelerations, the slope angle and others.

Nearby Dynamics: To explore the dynamical nearby environment, we computed the zero-velocity curves, the equilibrium points, and also their topological classification. Table 1 gives the location and linear stability classification for density value of 2.2 g.cm^{-3}. In both cases four equilibrium points were found, being two stable (S:centre-centre-centre) and two unstable (U:saddle-centre-centre).

Table 1. Location and linear stability of the equilibrium points around Apophis. The results are for density 2.2 g.cm^{-3}.

Point	x (m)	y (m)	z (m)	Linear Stability
E1	910.3	-13.5	-1.0	U
E2	-38.7	-900.8	0.4	S
E3	-911.0	-7.9	-1.1	U
E4	-41.5	900.7	0.5	S

Additionally, we performed several sets of numerical simulations of particles around Apophis taking into account the solar radiation pressure with the goal of identifying stable regions that might have small debris.

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