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East-West Station Keeping for

Areostationary Relay Satellites

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Abstract

The coming decade of Mars exploration will involve a diverse set of robotic science missions, including in situ and sample return investigations. This future planned exploration will pose new telecommunication challenges due to the requirements on the huge amount of data return. In supporting this mission set, NASA has proposed [1, 2, 3, 4, 5, 6] the use of Mars areostationary satellites for continuous coverage of a specific region of Mars.

Areostationary satellites are intended to be at rest with respect to the rotating Mars with a period of P = 88642.663 seconds This corresponds, in a spherical and homogeneous gravitational Mars field, to an areostationary semi-major axis of 20428 kilometers. Stationary position also requires eccentricity and inclination values equal to zero.

However, an areostationary satellite is perturbed by several forces that make its orbit non areostationary. Station-Keeping manoeuvres will be therefore required and they should be implemented by on-board thrusters [7, 8]. Tangential manoeuvres should control the satellite longitude evolution, which is due to the drift caused by the perturbing terms of the Mars potential [9, 10, 11] and to the non-zero eccentricity because of the Solar Radiation Pressure (SRP) effects.

Mars shadow plays an important role in the model of this perturbation on the areostationary orbit. The SRP

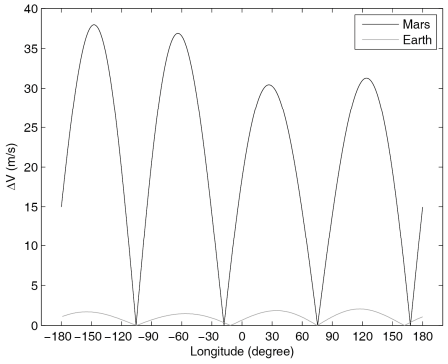

Figure 1: Annual ΔV for the East-West longitude station keeping.

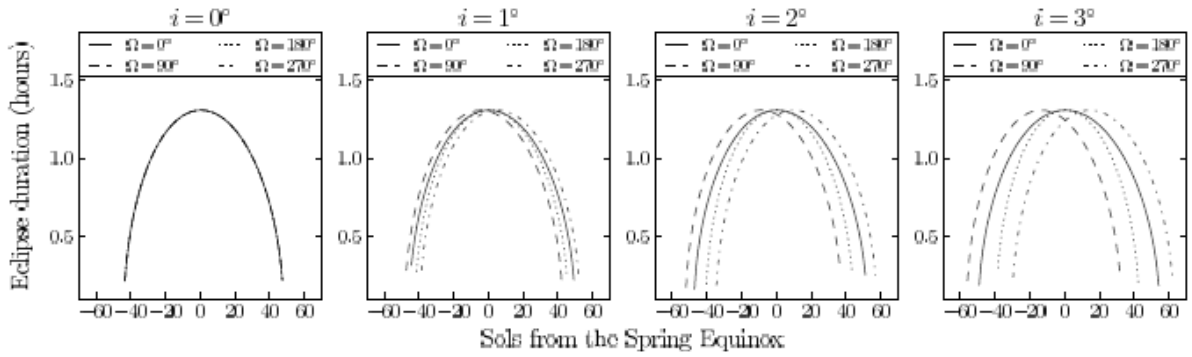

Figure 2: Sols in solar eclipse and eclipse duration in the Martian year from the Martian Spring Equinox 07/31/2013.

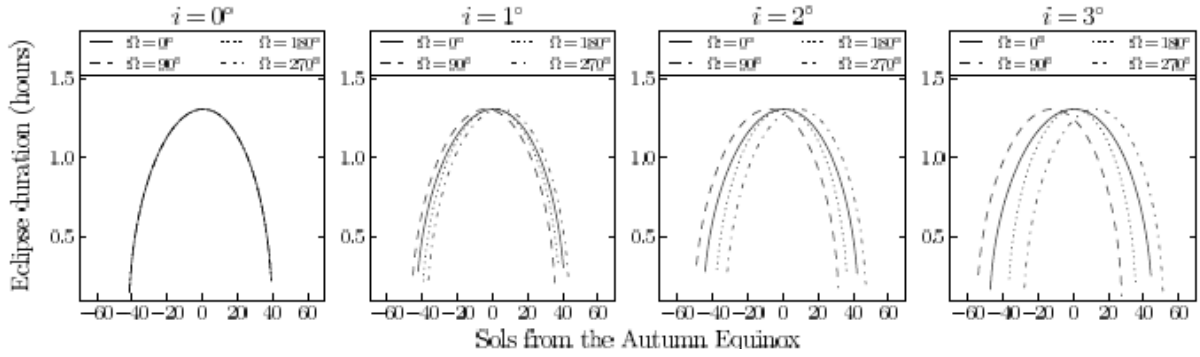

Figure 3: Sols in solar eclipse and eclipse duration in the Martian year from the Martian Autumn Equinox 08/17/2014.

force becomes zero while the spacecraft is in the shadow and the inclusion of a shadow function is necessary to model SRP [11]. Also, eclipses affect the station keeping as manoeuvres are not allowed in this time interval [7, 8].

We present here a description of the East-West tangential manoeuvres [11], as well as an accurate depiction of solar eclipses by Mars on geostationary satellites to analyze the implementation of the impulsive manoeuvres in the East-West station keeping.

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