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Mars Exploration – missions current and future (3A)

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NETWORK OF SMALL SATELLITES FOR THE EXPLORATION OF MARS

Abstract

The framework of this study is called RENSEM (or NETSSEM) and is dedicated to the observation, characterization, and understanding of the relationships between the different regions surrounding Mars, not using one but several spacecraft performing simultaneous measurement in the Mars' magnetosphere. The mission consists of 4 spacecraft: one mothership and 3 "daughters". The 3 daughters are released by the mothership after arrival at Mars on 3 different orbits. Due to the difference in orbital elements, the orbits will drift with respect to each other due mainly to the effect of Mars' oblateness. And because of the instruments and equipment onboard the (spinning) nanosatellites, no station keeping is possible. The always changing configuration (and particularly the orientation with respect to the Sun) will be more or less favorable depending on the mission's objectives. The typical orbit characteristics are: low periaster (altitude around 250 km), and altitudes of apoasters of 0.5 Mars radii for the mothership and 1, 1.5, 2 Mars radii for the daughters. With these values relative drifts of several tenth of degrees per day can be observed. The paper will show the main results of the study which is very dependent on the relative evolution of the orbits which in turn has an impact on the regions that can be explored. The main aspects that will be described and analyzed are related to inter-satellites communication between mothership and daughters (in particular the maximum time without connection is of primary importance), possibility of relative or absolute orbit determination, observation of the 3 main regions of the magnetosphere (delimited by the bow shock and the magnetic pile up boundary) with adequate space and time sampling, radio-occultation and associated coverage, etc... Some aspects will be more thoroughly analyzed and discussed, in particular the effect of the orbital elements on the sampling and if it's possible to find adequate orbits (which partly depend on the conditions of arrival at Mars). A second important aspect is the accuracy of the orbit determination using either Doppler measurements between the mothership and the daughters and/or Earth tracking stations and the contingency cases that may or may not be showstoppers.