USE OF LUNAR SWINGBYS TO ENABLE GTO LAUNCHED PLANETARY MISSIONS*

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ABSTRACT

Considerable cost and mass savings are possible by launching small spacecraft into lunar and planetary space as secondary payloads, and opportunities are forthcoming. The Ariane 5, for example, will provide a platform for several such payloads on each of its monthly launches of placing communication satellites into geosynchronous orbits. After launch, these payloads would be spring-ejected into the geosynchronous transfer orbit (GTO), from which they must escape the Earth-Moon system and be on their way to perform their mission. This paper proposes a trajectory scenario which can accomplish this, while tolerating weeks to months of Ariane launch dates, and still meet the stringent requirement of a fixed Earth-escape date and direction. The primary requirements are that the spacecraft be capable of precise navigation and have a propulsion capability of less than half that required to escape from LEO. The major difficulty of this problem is that the GTO orbit lies close to the equator, is highly eccentric, and has a specific major axis orientation.

The method proposed here is to (1) inject from GTO into a high ellipse, with apogee 2-3 times the distance of the Moon, (2) perform a maneuver to encounter the Moon at a specific time on its return leg (3) perform a lunar swingby back to Earth, and (4) perform a 3rd maneuver at Earth perigee to escape **in the required direction and with the necessary energy to encounter its target.** In step 2, 3rd body perturbations of the sun must be taken into account. A computer program which performs the calculations will be described in detail, and results for the upcoming Mars and Venus opportunities will be presented. General mission design charts for other targets will be included in the paper, Finally, limitations of this method will be described and alternate methods, using additional lunar flybys, will be suggested.

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REFERENCES

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