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Exploration of Other Destinations (5)
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ACCESSIBLE LANDING AREAS ON THE SURFACE OF GANYMEDE: DEFINING AND ASSESSING THE OPPORTUNITY TO REACH THEM

Abstract

Ganymede is the largest moon of Jupiter and in the Solar System. Furthermore, it has a unique feature that is its magnetic field. According to theoretical calculations, there may be an ocean of liquid water underneath its surface, suggesting possible extraterrestrial life. To date, Ganymede has been studied by spacecraft only from a distance. So, researching this moon directly from the surface is immensely interesting for science. This paper studies the possibility of achieving the desirable landing areas on Ganymede's surface to explore it. Many factors can determine the most promising landing site for scientific research, but the technical feasibility of landing in the desired area of the surface remains open to discussion. One particular feature of the problem to be solved is the lack of a dense atmosphere on the moon, i.e., braking for landing will be done by propulsion. Another feature is the synchronicity of the Ganymede orbital period and its orbit period around its axis. This circumstance could be a severe constraint to achieving the most favorable regions on the satellite's surface for research. Several approaches can be considered as a strategy for determining acceptable areas for landing. In one case, a landing on the surface would take place after the spacecraft has entered a circular or elliptical orbit around Ganymede. That gives an additional degree of freedom in the choice of the landing site. Alternatively, a landing on the surface without an intermediate orbit of Ganymede might be considered. In this case, an additional degree of freedom is obtained by applying gravity assist maneuver near the moon. This maneuver allows an additional flyby of Ganymede with entry into orbit with a period of a given multiplicity to the moon's orbital period. That allows landing at the desirable point on the surface. The use of orbits of different multiplicity also expands the allowed regions. In this case, the flight duration increases only slightly. To refine the results obtained, it is also necessary to estimate the flight section's length from the beginning of engine braking to direct landing on the surface. In this analysis, the flight scenario's influence from the first braking impulse to landing on the required characteristic velocity value is estimated.