Paper ID: 81483
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IAF ASTRODYNAMICS SYMPOSIUM (C1)
Interactive Presentations - IAF ASTRODYNAMICS SYMPOSIUM (IPB)

Author: Mr. Vladislav Zubko
Space Research Institute (IKI), Russian Academy of Sciences (RAS), Russian Federation

Dr. Natan Eismont
Space Research Institute (IKI), RAS, Russian Federation
Mr. Konstantin Fedyaev
Space Research Institute (IKI), RAS, Russian Federation
Mr. Andrey Belyaev
Space Research Institute (IKI), Russian Academy of Sciences (RAS), Russian Federation
Dr. Vsevolod Koryanov
Bauman Moscow State Technical University, Russian Federation

COMPLEX ANALYSIS OF A MISSION TO VENUS WITH GRAVITY ASSIST AND RESONANT ORBITS UNDER THE LANDER-ORBITER CONSTRAINTS

Abstract

A current research considers an approach to designing a flight scenario to Venus that would allow as many points on the planet's surface as possible to be attainable for landing. An application of the scenario to the prospective Russian Venus exploration mission is discussed. The proposed approach is based on using the Venus gravity assist to place the spacecraft in a so-called 1:1 resonant orbit with the Venus orbit, i.e. these two orbits have the same period. This will allow the spacecraft to return to the planet after 224.7 days and land at the desired destination.

Examples of the application of the proposed approach to practical cases are provided for launches in 2029 and 2031, which are closest to the planned launches of the Venera-D and DAVINCI+ missions. The study also presents results for a mission to Venus consisting of an orbiter and a lander. It is shown that the application of the proposed technique and the transfer of the spacecraft to a 1:1 resonant orbit by means of a gravitational assist allows to fulfil all the constraints imposed on the satellite in orbit around Venus. The results of the study show that the new approach radically extends the attainable landing areas and allows access to any point on the surface of Venus, without increasing flight time.

Other examples of the use of resonant orbits for solving tasks such as asteroid flybys on the way to a spacecraft's desired landing point, and the deployment of small satellites for continuous asteroid flybys while maintaining resonant orbits, are also presented.