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APOSTERIORY ANALYSIS OF THE CRAFT'S ORBITAL MOTION IN THE CIRCUMLUNAR SPACE

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Abstract

Tracking the behavior of a spacecraft in lunar space, unlike observations of near-Earth vehicles, is complicated by the fact that the Moon is much further from Earth than its satellites (almost half million km!) Another important factor is that almost half of the time, while in lunar orbit, the device is not accessible to direct observations from Earth. As you know, determining the position of the spacecraft on the far side of the Moon is not an easy task. However, there is already experience in solving it. So in the Japanese SELENE mission of 2007, the position of the Kaguya satellite was determined with the participation of satellite-assistants and ground-based radio telescopes. The Chinese "Chang'e" missions solved this problem by launching relay satellites to the Lagrange point area in 2018 and 2024. These satellites made it possible to establish reliable communication and data transmission to Earth. However, it is not known whether they allow you to determine the position of an object flying over the far hemisphere. In connection with the above, the task of tracking an object on the far side of the Moon seems relevant.

The report discusses the photogrammetric tracking method. Earlier, we applied the mentioned method in the construction of coordinate networks of reference craters. Thus, for the first time, a coordinate network was built in the marginal zone of the Moon in the area of the Orientale Mare (1983). Then photogrammetric measurements of satellite images were used to determine the elements of the circumlunar orbit of the Zond-8 spacecraft.

The exact selenocentric coordinates of the spacecraft found from the space resection solution, in contrast to its calculated positions based on the motion forecast, give the actual positions of the spacecraft in the circumlunar space. This serves as the basis for tracking the behavior of the spacecraft when sequential images are taken during the flight over the territory of interest to us. This method of tracking, unlike trajectory measurements carried out in real time, can be called "aposteriory", since the measurements and calculations themselves are performed after the completion of the flight.

We carried out the first test measurements of this kind on the section of the Apollo-17 spacecraft orbit passing over the Tsiolkovsky crater. In this paper, the orbits passing over the

Aitken crater are considered.
Unlike the first trial calculations, the authors set themselves the task of investigating a number of factors that affect the accuracy of the space resection solution. Such as the number, location and diameters of the selected reference craters, and others. As a result, the authors expect to gain a deeper understanding of the role played by photogrammetry of the lunar surface in the task of independently determining the parameters of the orbit. In addition, an analysis of the accuracy of determining the actual positions of the spacecraft will help to assess the possibilities of the described tracking method in terms of detecting deviations in motion associated with anomalies of the gravitational field of the Moon.

Key words: orbital motion , circumlunar space , trajectory measurements , photogrammetry , lunar craters , reference craters , space resection , space resection solution , far side of Moon , circumlunar orbit , photogrammetric measurements , images , orbit , orbit revolution , relay satellites , Lagrange point , spacecraft , Zond-8 , Apollo-17 , Tsiolkovsky and Aitken craters