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CREATION OF A UNIFIED SELENOCENTRIC SYSTEM USING QUANTUM OPTICAL SYSTEMS

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Fig.1 Light laser beacon

Introduction

The work is devoted to the development of a method for creating a unified selenocentric system for a space satellite in a circumlunar orbit (SSCLO) and reference objects on the lunar surface using quantum optical devices. It is planned to use light laser beacons (LLBs) as such devices [1]. LLBs will be able to provide continuous control over orbit of SSCLO, as the beam distance to the LLB from the trajectory of the subsatellite point will be measured at each orbit. The studies carried out in our work showed that this parameter for the beam allows one to determine the inclination of the SSCLO's orbit with an accuracy of several meters relative to the physical pole of the Moon and to establish a selenocentric dynamic coordinate system (SDSC) relative to the pole of the Moon with an accuracy of 1 m (or even more accurately) for the measurement period of 1 lunar month [2]. At the same time, the SSCLO's orbital period is measured at each orbital revolution with an accuracy of up to 0.03 sec, which can be used to analyze the behavior of the gravity field on the trajectory of a subsatellite, in particular [3], for cartography of mascons [4]. An LLB on the lunar surface will be the first fixed reference point on the Moon with the correct size of a few fractions of a centimeter [5].

Methods

For the purpose of binding and orienting the LLB, the SDSC grid is set, which is oriented relative to the Moon's equator and the direction of the Earth-Moon center line with an accuracy of about a hundred meters [6]. In our work, it is also shown that the installation of a similar LLB in the region of the Moon's equator will make it possible to fully determine the SDSC system with an accuracy equal to the one using the existing technical capabilities with the possible achievement of submillimeter accuracy when using LLB [7].

Results

At the same time, optical systems using LLB and a satellite laser interferometer will be able to provide more accurate positioning of SSCLO than radar facilities [8].
As a result of this work: 1) The possibility of taking into account the negative impact of technical conditions and natural planetary processes was considered [9]; 2) The observing regime at the unlit lunar disk and the regime of an illuminated lunar disk were analyzed [10]; 3) The observational characteristics and accuracy of the results obtained using LLB were investigated [11]; 4) The dependence of the accuracy of measuring the position of the LLB on the height of the orbit of the lunar satellite was found [12].
The validity of the use of LLB is characterized by three aspects: 1) Technical characteristics; 2) The ability to take into account the negative impact of technical conditions and natural planetary processes; 3) Observational characteristics and accuracy of the results obtained [13]

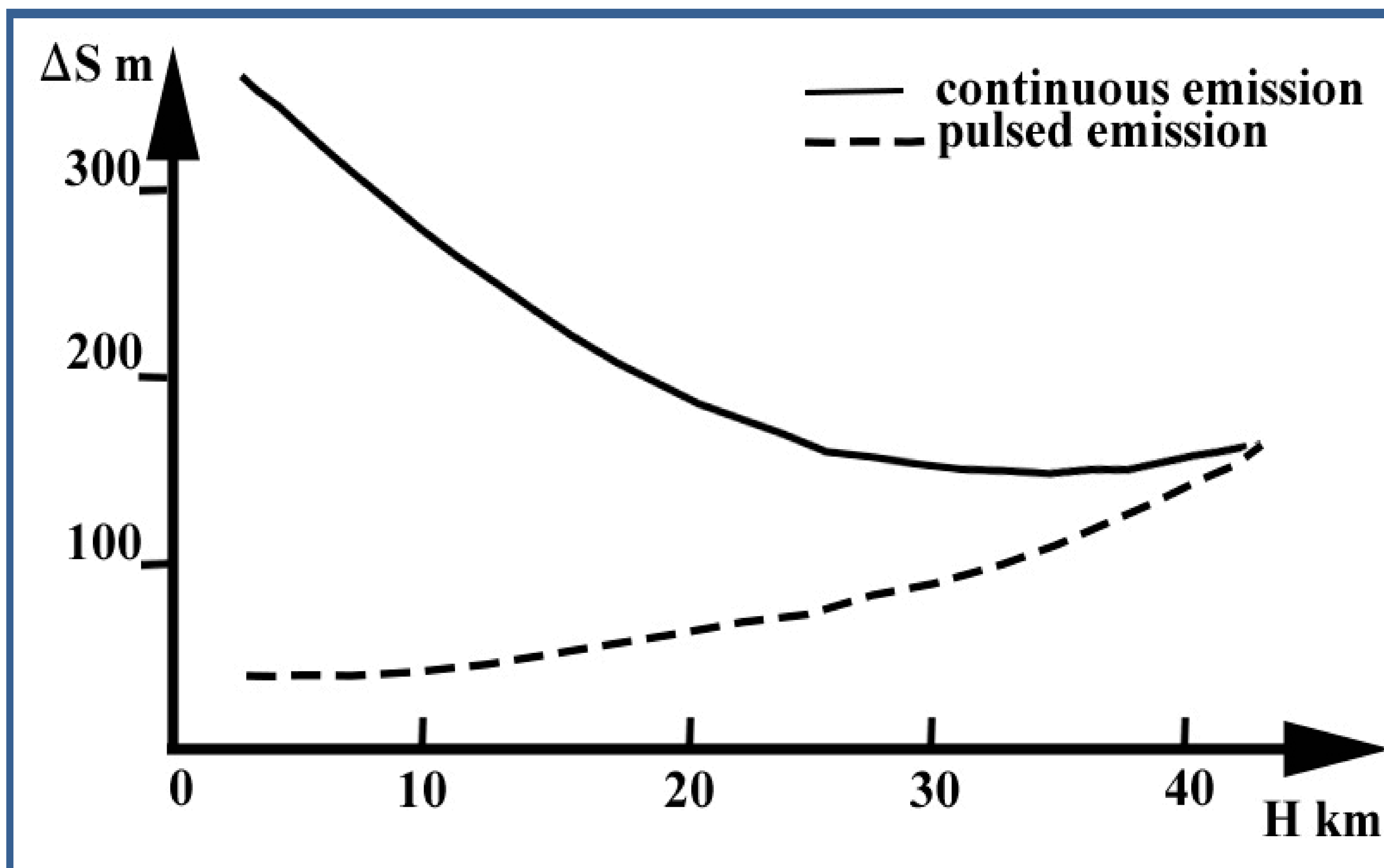

Fig.2 Dependence of the laser beacon position measurement accuracy ΔS on the spacecraft orbit altitude H (km)

Conclusion

As a result of this work, we developed the method for referencing the images of the lunar surface to the stellar field using LLB as benchmarks for connecting the two systems. For the first time, an experiment with the use of quantum optical systems is planned to be carried out for precise landing at a given point on the lunar surface during the Luna-25 mission (Luna-Resource) [14, 15].

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