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THE SIMULATION SYSTEM FOR DETERMINING THE POSITIONS OF LUNAR OBJECTS ON THE BASIS OF SATELLITE OBSERVATIONS IN THE SELENOCENTRIC SYSTEM

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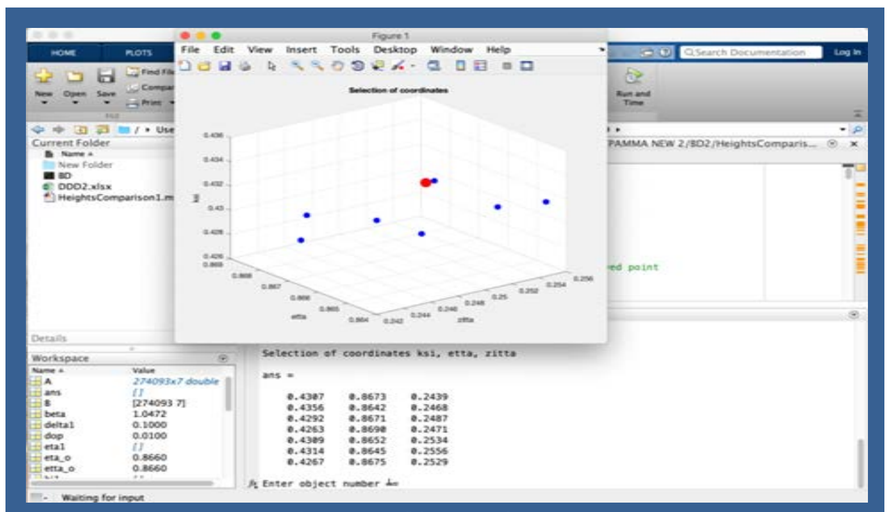

Fig.1 Distribution of lunar object in 3D space

Introduction

The work is focused on the creation of the software simulation system for determining the positions of lunar objects on the basis of satellite observations in the selenocentric system. It was constructed using the data from “Apollo”, “Zond”, “Clementine”, “Kaguya”, “LRO”, and “SMART-1” [1, 2] lunar space missions. Within this research, a complex of the advanced physical models, experimental methods, data analysis methods, and computer software for the solution of the problem on the construction of highly accurate space lunar navigation systems were developed and implemented. It is of significant practical importance, as it allow using the results of the research in the creation of space navigation instruments for the exploration of the Moon [3].

Methods

For the simulation system, a reference catalogue of lunar objects of the visible and far sides of the Moon was created and a simulation model of cartographic support of the lunar navigation selenodetic system (LNSS) was developed based on an expanded and condensed reference selenocentric network covering the visible, marginal (including polar regions) and the far sides of the Moon using topographic data from space missions as well as synthetic robust estimation method and multi-parameter harmonic analysis [4].

Results: As a result of this work: 1) methods for processing and analyzing satellite observations taken over long time intervals allowing to investigate statistical memory effects and describe the dynamics of short- and long-period correlations of long-term observations were developed [5]; 2) the construction of a software simulation system for determining the positions of lunar objects on the basis of modern satellite observations in the selenocentric system was performed [6] (Fig, 1).

Discussion: The software simulation model of the LNSS cartographic support is implemented in the form of the HeightsComparison program (Fig.2), compiled in the MATLAB system, and provides access to an interactive analytical computing mechanism that allows, according to various criteria set by users, to create simulation models of the LNSS cartographic support, to sample digital data, and carry out a comparative analysis of the altitude data of the model with a digital map of the lunar surface [7, 8]. The program allows simulating the determination of the observed selenographic rectangular coordinates of lunar objects from the values of the entered spherical selenographic coordinates characterizing the position of the object on the lunar surface [9, 10]. Here you can select and / or set the required options: values of selenographic latitude and longitude, sample radius in fractions of the mean radius of the Moon [11, 12]. The final information can be obtained as a result of the program's work in the MATLAB system.

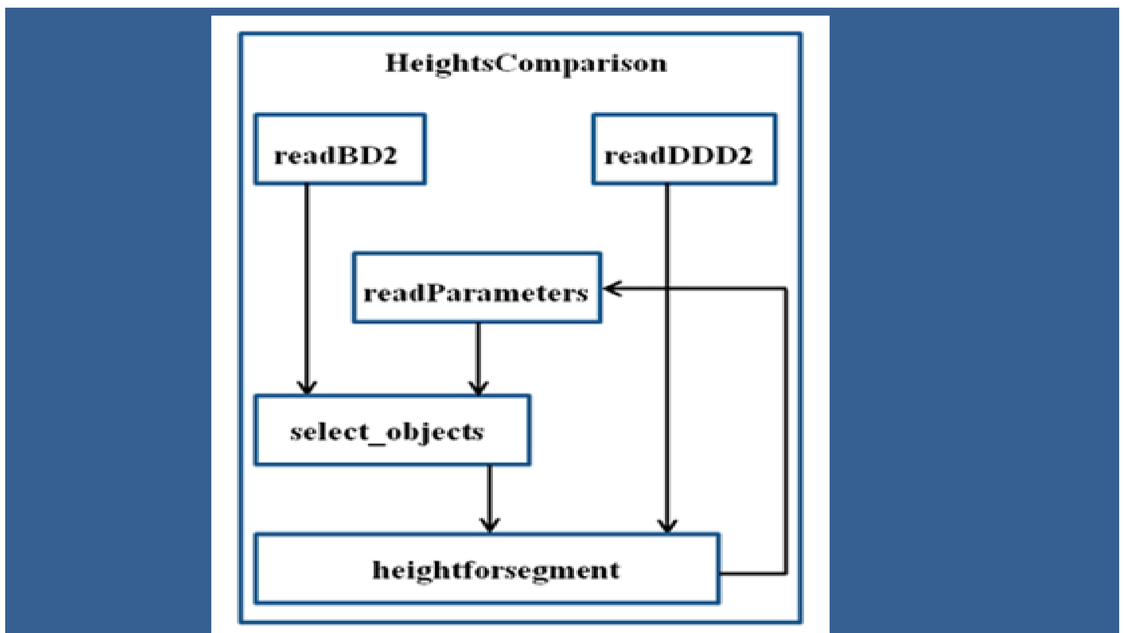

Fig. 2 Modular scheme Heightscomparison program

Conclusion

In this work, the authors’ method superior in accuracy compared to the existing analogues and developed on the basis of multi-parameter statistical analysis is used for the study of satellite observations [13]. The produced simulation system will allow using both satellite star sensors and lunar quantum and optical systems and the lunar objects as reference points for establishing the selenocentric coordinate system [14]. The models and methods of analyzing satellite data developed in this work will allow to create a more accurate coordinate and time support on the Moon compared to the analogues existing in the world [15].

Acknowledgements

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