Return to the Moon (02)
Lunar Surface Outposts and Enabling Technologies (4)

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SOME ISSUES ON DEVELOPMENT OF THE LUNAR PNT SYSTEM TO SUPPORT MOON EXPLORATION

Abstract

The main method of providing PNT both in circumlunar space and on the surface of the Moon should be GNSS-like information and navigation systems. These systems are to support navigation, spacecraft control in circumlunar space, provide PNT of rovers, crew members of sorties and permanent bases, as well as collect, process and deliver additional information to all members of a mission. That information may include surface monitoring information, radiation environment data, data of visual monitoring of surface vehicles, distress alerts and so on. The presentation deals with the issues of stability of lunar orbital constellations, possibility of using intersatellite range measurements and astromeasurements for provision of ephemeris and clock to a navigation and communication spacevehicle. The possibility of Lunar information and navigation system development mostly depends on constellation stability. This especially topical for space vehicles in lunar orbit, for lunar gravitational field, unlike that of earth or Mars, has less regular structure. That structure is preconditioned by large local anomalies while close to the Moon, and by the Earth, planets and the Sun disturbances while at distance. The presentation contains results of research on orbital structures stability in circumlunar environment and in libration points of Earth-Moon system. It also analyses various options for constellation configuration of Lunar Integrated Navigation and Information System (LINIS). The main direction of advanced PNT development is the study of new autonomous methods and techniques for orbit determination and time synchronization to improve performance of the future PNT, to expand the scope of GNSS applications, to provide advanced PNT services for future users. Moreover, it is clear that autonomous techniques provide better performance in future that includes better reliability, safety and cost reduction of system control operations. It is also clear that completely autonomous work of large-scale systems to which LINIS belongs is the matter of the future, even far future. But study should be done well in advance to implement the whole process in steps. Integration of intersatelllite- and astromeasurements will provide relation of an orbital structure

to absolute reference system that is the solution of the large-scale task on the whole bulk of information including intersatelllite- and astromeasurements. In particular it is possible to make some definite conclusions on the future concept of the algorithm for orbit determination and time synchronization on board the modified Glonass space vehicle. At the current stage of study we recommend some certain options for using such algorithms.