Yarkov I.S., Yarkova E.A.

Modeling ways to place selenodetic points for launching an orbital lunar block

*Joint-stock company «Academician M.F. Reshetnev «Information satellite system»
(Russia, Krasnoyarsk)*

doi: 10.18411/lj-05-2019-44

idsp: ljjournal-05-2019-44

Аннотация

На основе моделирования компоновки селенодезического спутника (СДС) и селенодезических пунктов (СДП) под головным обтекателем, определены способы размещения СДС и множества СДП, их весовая составляющая и возможность доставки на поверхность Луны.

Ключевые слова: селенодезический спутник, селенодезический пункт, селенодезическая сеть, лунный блок

Abstract

Based on the simulation of the layout of the selenodetic satellite (SDS) and selenodetic points (SDP) under the head fairing, the methods for placing the SDS and the set of SDP, their weight component and the possibility of delivery to the Moon's surface are determined.

Keywords: selenodetic satellite, selenodetic point, selenodetic network, lunar block

In the near future, the space powers prioritize the exploration of the moon. For these purposes it is necessary, first of all, to create a selenodetic coordinate system for the movement of consumers, both on its surface and in the near-moon space.

The task of creating a triangulation selenodetic network of points includes the following stages: the development of a selenodetic satellite (SDS) and equipment of the selenodetic point (SDP); production and delivery to the near-moon orbit of the SDS and several SDP, alternate soft landing of each SDP at a given point on the lunar surface, organization of selenodetic binding of the SDP in the lunar coordinate system [1,2].

The principle of deployment of the selenodetic network of points depends on the means of removal used. The energy capabilities of modern means of removing the middle class are sufficient for the joint delivery (as part of an orbital block) of one selenodetic satellite and several SDPs to the circumlunar orbit [3].

Selenodetic network should contain 9-12 selenodetic points. Consider the option of delivery at the same time using the carrier rocket in the complete set of all SDP and selenodetic satellite.

If the orbital lunar block is to be removed using the “Soyuz-2.1B” with the “Fregat” and head fairing (HF) 14S737, then the maximum mass of the block is no more than 1385 kg.

Table 1.

Analysis of the total cost of the mass of the payload zone for 9 SDP and SDS

№	Name	Quantity	Weight, kg	Total kg
1	Separation device	1	69	69
2	Selenodetic satellite	1	234	234
3	Power Structure (Farm)	1	19	19
4	Selenodetic point	9	103	927
5	Reserve mass		136	1249

Thus, from table 1, the reserve mass of the payload zone: $1385 - 69 - 234 - 19 - 927 = 136$ кг.

Table 2.

Analysis of the total cost of the mass of the payload zone for 12 SDP and SDS

№	Name	Quantity	Weight, kg	Total kg
1	Separation device	1	69	69
2	Selenodetic satellite	1	234	234
3	Power Structure (Farm)	1	19	19
4	Selenodetic point	12	65	780
5	Reserve mass		283	1102

Thus, from table 2, the reserve mass of the payload zone: $1385 - 69 - 234 - 19 - 780 = 283$ кг.

The number of modules SDP (n), simultaneously displayed in the orbital lunar block is determined by the residual principle:

$$m_{CДC} + n \cdot m_{CДП} + \Delta m \leq m_{ОЛБ}$$

where $m_{CДC}$ is the mass of the selenodetic satellite; $m_{CДП}$ – mass of selenodetic point; Δm is the reserve mass; $m_{ОЛБ}$ – mass of the orbital lunar block.

With the help of the Catia software, the SDS and 9 or 12 SDP layouts were modeled on the power structure under the head fairing (HF) 14C737.

Layout Model 9 SDP + SDS under HF 14C737

Layout Model 12 SDP + SDS under HF 14C737

Thus, we have modeled the SDS and SDP layout under the head fairing, determined the optimal placement of the SDS and the set of SDP on the power structure, and calculated their weight components for the possible implementation of the delivery to the lunar surface.

1. Chebotarev V.E., Kudymov V.I., Zvonar' V.D., Vnukov A.A., Vladimirov A.V. Kontseptsiya okololunnoy navigatsii (Circumlunar navigation) // Issledovaniya naukoigrada. 2014. № 4(10). Pp. 14-20. (In Russ.)
2. Chebotarev V. E., Shmakov D. N., Anzhina V.A. Kontseptsiya lunnoy sistemy sputnikovoy svyazi (The concept of lunar satellite communication) // Issledovaniya naukoigrada. 2014. № 1(7). Pp. 26-31. (In Russ.)
3. Chebotarev V.E., Zvonar' V.D., Gritsan O.B., Vnukov A.A. Kontseptsiya postroeniya triangulyatsionnoy selenodezicheskoy seti (Concept of triangulation selenodesy network design) // Issledovaniya naukoigrada. 2014. № 2(8). Pp. 15-21. (In Russ.)
4. Melekhina Yu.N. Osvoenie kosmicheskogo prostranstva (Space exploration) // Molodezh'. Obshchestvo. Sovremennaya nauka, tekhnika i innovatsiya. 2010. Pp. 61-62.