

PRINCIPLES OF ORBITAL FORMATION OF SATELLITE SYSTEM FOR CARTOGRAPHICAL PURPOSE

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The four-satellite system of cartographical purpose is considered in structure of: the spacecraft (SC) with two the optoelectronic onboard equipments for carrying out of panchromatic routing stereoshooting in a plan of an orbit (SC "Cartograph"); the SC with one or two the optoelectronic onboard equipments for carrying out of panchromatic and multispectral shooting with high resolution (SC "Detailor"); two the SC with the radar onboard equipments, working in tandem for carrying out of interferometric and stereoscopic shooting (SC "Radar-1" and SC "Radar-2").

From requirements to materials of space shooting, suitable for the decision of the cartographical problems, follows, that at ballistic designing considered system it is necessary to take into account follow condition:

1) the geocentric orbits of all the SC entering into system should be near circular with average heights in a range of 450-600 km, sun-synchronous and should not be isorouting;

2) the nodal orbit periods of the SC "Cartograph" and the SC "Detailor" should provide displacement of the tracks on the distance in proportion to width of a stripe of capture of the onboard equipment at shooting without turns of the SC on a roll;

3) with a view of maintenance of identical conditions of shooting for effective receipt interferometric pairs of images the SC "Radar-1" and the SC "Radar-2" should move on the distance about 20 km from each other on orbits with equal periods, but with some differences in ascending nodes and in time of passage of the SC through ascending nodes;

4) the nodal orbit period of the SC "Radar-1" and the SC "Radar-2" should provide displacement of tracks on the distance in proportion to width of a stripe of review of the onboard radars;

5) the working branches of trajectories of all the SC – descending;

6) the local average solar time of flight of the SC "Cartograph" and the SC "Detailor" on a descending branch of trajectories above the Northern hemisphere should lay within the interval of 9-11 hours.

Sever constraints on periodicity of carrying out of shootings in interests of Roskartographia are not imposed. However, in cases of use of the materials of space shooting in interests of other departments, solving problems of monitoring type, there can be a necessity for carrying out of repeated supervision of the fixed ground objects through a time interval, essentially smaller, than the period of a full covering of an interval between two successive ground tracks (an inter-tracks interval) by a stripes of capture. In the present work the compromise variant of ballistic formation of satellite system, which in the certain degree smooth out the contradiction between shooting of areas without restrictions on periodicity and shooting of objects with restriction on periodicity is offered.

Increase of periodicity of shooting without essential damage for the decision cartographical problems can be reached by increase in frequency rate of one of quasigeosynchronous orbits of the SC entering into system as which it is logical to choose an orbit of the SC "Detailor". If to accept, that demanded periodicity of repeated shooting of the fixed ground object makes three day, frequency rate of an orbit should be equal to three and daily displacement, which size is proportional with 1/3 of the inter-tracks interval, should make a stripe of review, formed by a turn of the SC "Detailor" on corresponding the corner of a roll. As a result there is an opportunity of implement if necessary repeated supervision of the fixed ground object in a stripe of review of the SC "Detailor" of times in three day. Thus the period of a covering of inter-tracks interval by a stripe of capture at shooting in nadir

from this SC will be increased by total time of implementing of shootings in a stripe of review.

Below parameters of orbits of the SC entering into system calculated according to stated above condition and with realization of an opportunity of increase of periodicity of shootings from the SC “Detailor” for passing decision of the monitory problems are resulted. As initial data it was accepted, that the stripe of capture of the optoelectronic equipment of the SC “Cartograph” and SC “Detailor” is equal according to 60 km and 15 km from the conditional height of 500 km, the stripe of capture and corners of vision of the onboard radars of the SC “Radar-1” and the SC “Radar-2” make: 10 km, 20° (minimal), 50° (maximal).

The SC “Cartograph”. The average height of an orbit - 570 km, the inclination – $97,62^\circ$, the nodal orbital period – 95,81 min, displacement of a track in one day – $0,71^\circ$ in eastern direction, duration of a covering of the inter-track interval by the stripe of capture – 34 day.

The SC “Detailor”. The average height of an orbit – 480 km, the inclination – $97,23^\circ$, the nodal orbital period – 93,93 min, displacement of a track in three day – $0,18^\circ$ in western direction, the corner of a roll for supervision of the fixed ground objects in the stripe of review – up to 35° , duration of a covering of the inter-track interval by the stripe of capture – 131 day.

The SC “Radar-1”. The average height of an orbit – 530 km, the inclination – $97,43^\circ$, the nodal orbital period – 94,94 min, displacement of a track in one day – $3,97^\circ$ in eastern direction, duration of a covering of the inter-track interval by the stripe of capture – 199 day.

The SC “Radar-2”. The same orbit, as the SC “Radar-1”, but time of flight through the ascending node on $\Delta t = 3s$ later, then of the SC “Radar-1”, and a difference between longitudes of ascending nodes of orbit of the SC “Radar-2” and the SC “Radar-1” makes $\omega\Delta t$, where ω - the angular velocity of rotation of the Earth.

Initial values of longitudes of ascending nodes of the orbits of the all SC will be calculated depending on the corner of a direct ascent of the Sun for date of start of the SC with performance of following conditions: the local average solar time of flight through latitude 40° a descending branch of a trajectory makes for the optoelectronic SC of 9 hours, for the radar SC – in a vicinity of 12 hours.