НАВІГАЦІЯ

УДК 656.7

O.N. Dmitriev

Kirovograd Flight Academy, National Aviation University, Kirovograd

ANALYSIS OF THE COMMON CALCULATION OF AIR NAVIGATION SYSTEM CASE SC WITH A SPECIFIED RIP OBSERVATIONS

The article analyzes the general case calculation of air navigation system SC with a specified rip observations.

Keywords: *zonal harmonic, draconian period, spacecraft, circular orbits, the period of revolution.*

Introduction

We pose the problem of determining the necessary number of satellites in the system and their relative positioning at the set break of service.

Main part

Calculation of the spacecraft with a predetermined gap in the service can be done if you know the following inputs:

- time gap in service- t_g ;

- the minimum allowable elevation satellites above the horizon– δ_{min} or the amount of angle-board equipment- γ ;

- service time- t_{ser} ;

- height range in which the system can operate satellites, - $r_{c\,min}$, $r_{c\,max}$.

These raw data due to the restrictions imposed on the work as a board and ground equipment, as well as associated with the purpose of the system. Then the order of calculation of the SC with a predetermined gap in the service will be reduced to the following. Assuming the values of the radius vector of circular orbits r_c in the range $r_{c\,min} \le r_c \le r_{c\,max}$, define the quantity

$$\varphi_w = \varphi_s - \varphi_{det} \quad (1)$$

By φ_w It is the inclination of the orbital plane to the plane of the equator:

- systems for Global Service

$$i_{max} = 90^0 - \varphi_w \; ; \quad (2)$$

- systems for zonal service

$$i_{max} = \varphi_в - \varphi_w \quad (3)$$

Given the inclination i of latitude starting point φ_n and Approximate length of the ejection phase can determine the value of the argument of latitude μ_0 in terms of output spacecraft into orbit with this pad. With i, μ_0, r_c, we define Draconian period of the spacecraft by the formula:

$$T_\Omega = T\left\{1 - \frac{3}{4} C_{20} (\frac{a_e}{r_c})^2 \times \right.$$
$$\left. \times \left[1 + 5\cos^2 i - 6\sin^2 \mu_0 \sin^2 i_0 \right]\right\}, \quad (4)$$

where $T = 2\pi\sqrt{r^3{}_c / k}$ – Star treatment period;

C_{20} = - 0,109808 10^{-2} - the coefficient of the second zonal expansion of the capacity of the earth in a series of spherical harmonics;

a_e = 6378 km - the equatorial radius of the Earth.

Define the process node spacecraft orbits per day, taking into account 2nd zonal harmonic:

$$\Delta\Omega_{day} = \frac{3\pi\pi_2 \cos i}{k r_c^2 (1 - e_0^2)^2} n, \quad (5)$$

where $\pi_2 = -1,77 \cdot 10^{25}$ m^5/sec^2; $n = T_{st} / T_\Omega$ - the number of revolutions of the spacecraft in the sidereal day.

Knowing the daily care of the nodes of the orbits of satellites, determine the time required for the rotation of the Earth from orbit ascending node system to the ascending node of the orbit (the effective period of the Earth T_{ef}):

$$T_{ef} = T_{st} \left(1 - \Delta\Omega_{day} / (2\pi)\right). \quad (6)$$

From the known values of the effective period of Draconian period T_{ef} and T_Ω forward interturn distance

$$\lambda_{id} = \frac{2\pi}{T_{ef}} T_\Omega \quad (7)$$

For selected r_c is determined by the width of the swath $\Delta\lambda_\phi$ in the lower latitude service area. There are two possible cases:

a) there is a mountain of a circular orbit r_c in a predetermined range where the condition

$$\Delta\lambda_\phi = \lambda_{id} \quad (8)$$

b) in a predetermined range of altitudes Conditions $\Delta\lambda_\psi \ge \lambda_{id}$ not performed.

Figure 1 shows the value λ_{id} and $\Delta\lambda_\phi$ for circular polar orbit at different values of angle-board equipment γ .

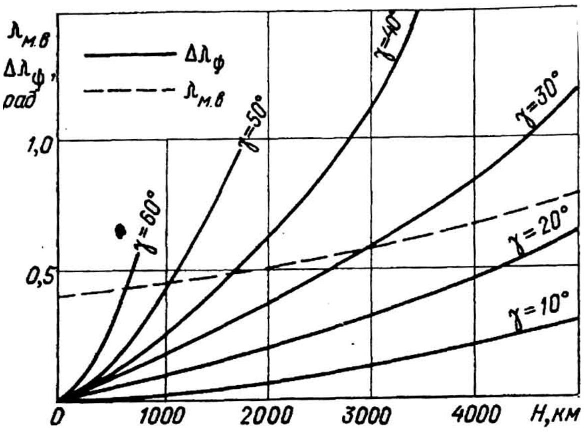

Figure 1. Dependence λ_{id} and $\Delta\lambda_\phi$ circular polar orbit at different angles γ

Consider the case of the first.

If the condition (8) fulfilled, then we can determine the angle of longitudinal break in service

$$\lambda_g = \frac{2\pi}{T_{eff}} t_g \quad (9)$$

and then the required amount of spacecraft system

$$N = \pi/\lambda_g \quad (10)$$

In general, the number of satellites in the system of fractional turns, so it should be rounded up to the next higher integer:

$$N_1 = \left[\pi/\lambda_g\right] + 1 . \quad (11)$$

In view of the whole number of devices in the system determines the final time, the gap in service:

$$\lambda_g^{/} = \pi/N_1 \quad (12)$$

and

$$t_g^{/} = \frac{\lambda_g^{/} T_{ef}}{2\pi} . \quad (13)$$

The physical basis of the proposed method of calculation for spacecraft systems with the specified break in service lie in the fact that the spacecraft systems located in near-Earth space in such a way that the track of the same. Condition (8) shows that the interturn distance should always be covered by the review areas of spacecraft.

If at the given viewing angles onboard equipment $r_{c\,min} \le r_c \le r_{c\,max}$ in the bed elevation (8) is not satisfied (the second case), the interturn distance populated areas review additional spacecraft

$$n^{/} = \frac{\lambda_{id} - \Delta\lambda_\phi}{\Delta\lambda_\phi} \quad (14)$$

Moreover, if the spacecraft in one interturn region arranged so that the argument of latitude μ for the same spacecraft (ie spacecraft spaced relative to each other in longitudinal relation to $\Delta\lambda_\phi$), the breaks in service to be equal to a predetermined gap.

Conclusions

If the spacecraft filling the coverage areas of one interturn spacing, are coplanar and offset relative to each other at an angle $\Delta\omega$, the gap in the observation is different from the calculated value by the amount $\pm\Delta T$ (where $\Delta T = \frac{\Delta\lambda_\phi}{2\pi} T_{st}$). Thus, we identify the needs of the number of satellites in the system with the specified service rupture.

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Received 12.12.2014

Reviewer: Dr. Sc. sciences, professor S.V. Kozelkov, State University of Telecommunications, Kiev.

АНАЛИЗ ОБЩЕГО СЛУЧАЯ РАСЧЕТА АЭРОНАВИГАЦИОННОЙ СИСТЕМЫ КОСМИЧЕСКОГО АППАРАТА С ЗАДАННЫМ РАЗРЫВОМ НАБЛЮДЕНИЯ

О.Н. Дмитриев

В статье рассматривается общий случай расчета аэронавигационной системы КА с заданным разрывом наблюдения.
Ключевые слова: *зональная гармоника, драконический период, космический аппарат, круговые орбиты.*

АНАЛІЗ ЗАГАЛЬНОГО ВИПАДКУ РОЗРАХУНКУ АЕРОНАВІГАЦІЙНОЇ СИСТЕМИ КОСМІЧНОГО АПАРАТА З ЗАДАНИМ РОЗРИВОМ СПОСТЕРЕЖЕННЯ

О.М. Дмітрієв

У статті розглядається загальний випадок розрахунку аеронавігаційної системи КА із заданим розривом спостереження.
Ключові слова: *зональна гармоніка, драконічний період, космічний апарат, кругові орбіти.*