comparison with long hauls. The diversity of relative masses for the same type of aircrafts is in limits of 11–12 %, it is very essential and hard to explain.

Judging by data of the table 1 and fig. 3 it is clear that, for examined Tu-204 aircraft, the decreasing destruction probability from meaning of $5.78 \cdot 10^{-7}$ up to $1 \cdot 10^{-9}$ for 1 hour demands to increase the mass of construction payload from 40 to 50 t, that in practice will guide to decreasing payload mass from 35.2 to 25.2 t. The reliability of airplane within destruction probability meanings of $1 \cdot 10^{-9}$ for 1 hour is hard to predict and prove, and its increasing is connected with valuable decreasing payload mass and commercial outcome – the competitive ability. The reliability increasing and decreasing the catastrophe damage, in this case, is connected with increasing the transport cost.

According to this 11–12 % of one class airplane construction diversity, under the same level of machine building production may be reckoned among various risk levels of the developers of airplanes, because decreasing the airplane's construction mass by 10 % increases the destruction risk from $1 \cdot 10^{-9}$ up to $5 \cdot 10^{-8}$.

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Table 2

Calculations of correlation of masses for short range and long haul airplanes

Class	Close-rout					Far-rout					
Parameter type	Tu-134A	Jak-42	MD-81	B-737	A-320-100	IL-62M	B-707-320B	B-767-200ER	IL-96-300	A-340-200	MD-11
Start year	1967	1980	1981	1990	1988	1974	1962	1984	1992	1992	1990
M_{max}	47	57	63.5	52.4	66	167	151.5	175.5	216	251	273.3
M_k	29	33.5	35.5	31	38	73.4	67.1	83.8	117	118.6	126.7
M_k/M_{max}	0.617	0.588	0.56	0.59	0.576	0.439	0.443	0.477	0.54	0.472	0.463

Table 3

Calculation of masses for medium range airplanes

Class	Medium-rout						
Parameter type	TU-154M	B-727-200	B-757-200	A-320-200	IL-86	L-1011	A-330-300
Start year	1986	1971	1984	1988	1980	1972	1993
M_{max}	100	95	108.8	73.5	210	195	208
M_k	55	46.7	58.2	39.8	117.4	108.5	117.7
M_k/M_{max}	0.55	0.49	0.535	0.54	0.56	0.556	0.566

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THE INFLUENCE OF CONDITIONS FOR PASSING GLONASS AND GPS SATELLITE RADIO NAVIGATION SIGNALS ON THE ERRORS OF DEFINING RELATIVE COORDINATES

The influence of the conditions for passing GLONASS and GPS satellite radio navigation signals on the errors of defining relative coordinates is studied.

Keywords: signal delay, multipath propagation, error, frequency, navigation spacecraft.

The retransmission of navigation spacecraft signals of the GLONASS and GPS systems is known as repeated radiation after reception and processing in relaying equipment (further a repeater). Signal processing in a repeater can include intensification, frequency conversion, filtration and additional coding of a navigation spacecraft signal. The relayed signal passes the radio channel and goes on to the retransmitted signal receipt and processing equipment (RSRPE).

The RSRPE processes signals. The signals are transferred by a repeater according to the algorithm provided for the task. It is here that the measurement of radio navigation parameters (parameters of delay, Doppler frequency shift etc.) of navigation spacecraft signals are received by the object and the completion of navigation time task for the object is finished. The repetition of navigation spacecraft signals from a board of an object can be used for different purposes.

1. Remote determination of the coordinates and speed of an object (mobile or fixed) at a basic station (mobile or fixed).

2. Determination of objective coordinates that do not receive navigation spacecraft signals (or receive signals insufficiently to decide navigation-time task) on repeated signal of navigation spacecraft (NSC) radiated by the repeaters that are in favorable conditions for reception of NSC signals.

Navigation parameters of an object (coordinates, speed and direction of movement, parameters of time-and-frequency scale, spatial orientation) are possible to determine on the basis of measurement results of radio navigation parameters (delay, Doppler frequency shift etc.) of NSC repeated signals.

Such an approach can be used as an alternative to the system of remote navigation parameters definition of an object based on the set placed on the object from traditional radio navigation equipment completing the navigation time task and equipment transmitting information about the results of the navigation-time task completion. When using retransmission, the information transmission equipment is replaced by repeating equipment; this permits considerable decrease in navigation equipment weight, size, energy input, and cost by eliminating the block of digital processing of signals (BDPS) and the computing block (CB) from its structure.

An additional advantage the of navigation-time task on the relayed signals completion is the possibility to realize through the RSRPE a special condition for determining objective navigation parameters in real time. To organize conditions for transmission of such a sort from one object to another, no additional information is required.

It should be noted that as the navigation time task is performed with the RSRPE with the given object there is no information about its navigational parameters. This situation is normal for the object monitoring problems. If the object is required both to complete navigation tasks and/or to solve problems of control (guidance), there is a need in an additional channel for transmitting information to the object.

When a signal of NSC is transmitted to the relaying channel, the additional signal delay and Doppler frequency shift take place. The additional signal delay is measured by the distance between the repeater and the RSRPE. The additional Doppler frequency shift is caused by relative displacement of the repeater and the ERPRS. These factors distort the measurement results of NSC radio navigation parameters.

An additional factor that distorts the results of HTT completion for the object retransmitted NSC signal is a shift of the RSRPE frequency time scale from a repeater frequency time scale. To accept the propagation path impact of NSV retransmitted signal on NTT completion results in the RSRPE and impact on parameters of the RSRPE frequency time scale, a special pilot signal can be used. The special pilot signal is formed in the repeater and transmitted from the object along with the NSC retransmission signal. Principally, such parameters as signal delays and Doppler frequency shifts (DFS) of the pilot signal to the RSRPE frequency time scale are measured. The results of this measurement allow us to determine an additional NSC signal delay resulting from propagation path and the RSRPE time scale shift from retransmitter time scale and an additional Doppler frequency shift of NSC signals caused by relative motion of the retransmitter and the RSRPE and a frequency deviation of RSRPE reference generator from a frequency of retransmitter reference generator.

It is possible to suggest some methods of pilot signal use.

The first method is pilot-signal synchronization of the RSRPE reference generator. In this variant, the locking of the RSRPE reference generator (analog or digital) is regulated on the same level as a frequency of received pilot signal. The advantages of this method are the lack of additional complication of the RSRPE software in the primary processing and NTT completion. A disadvantage of this method is the limitation of the RSRPE carrying capacity. This way, the RSRPE is capable of simultaneous signal processing of only one retransmitter.

Another variant of the pilot signal use is a measurement of pilot signal frequency relating to the RSRPE reference generator. According to this method synchronization of the RSRPE processes is performed on the base of its own reference generator. Here the RG frequency does not fit the pilot signal frequency. In the RSRPE frequency deviation of a receipted pilot signal is compared with the nominal value and use of this information additional component is excluded from the frequency estimation of NSC retransmitted signal. An additional component results from propagation path and parameters of the RSRPE frequency time scale.

The aforementioned variant is more difficult to implement. Considering this fact the implementation requires processing software for the primary processing of the RSRPE information. The advantage of this technique is the absence of principal restrictions to the RSRPE carrying capacity. The RSRPE is capable to operate several retransmitters simultaneously.

Also it is possible for the RSRPE to operate a similar object. In these conditions the navigation time task is completed with the RSRPE the same way as if it was accomplished immediately on the object. Here the RSRPE represents an extension of the object navigational receiver, for example the block of digital processing of signals (BDPS) or the computing block (CB). Retransmitter equipment, retransmittion path and RSRPE receiving block are inserted into the gap between the receiving antenna, radio path (or its part) and other traditional radio navigation equipment blocks.

The RSRPE operation in the conditions of relative coordinate determination will be the following. In these conditions the RSRPE along with the reception of retransmitted signals from a retransmitter in the frequency range of NSC signal relaying receives in the standard frequency range. Cooperative processing of the measurement results of NSC signal received on the object and retransmitted through the repeater makes it possible to realize high-precision determination of the relative coordinates of the object relating to the RSRPE. In such conditions realization is possible for mobile objects both code and phase mode to determine relative coordinates. Phase mode realization is possible, due to the fact that in the RSRPE there is complete information about the frequency-timeline of an object by using a pilot signal.

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PROBLEMS OF SUPPORT OF MODERN SPACE CRAFT RELIABLE FUNCTIONING UNDER THE CONDITIONS OF THE DESTABILIZING INFLUENCE OF SPACE AND ANTHROPOGENIC FACTORS

The statistic analysis results of cases correlation of abnormal functioning of SC with increased levels of geomagnetic activity are represented in the article. The main results of completing work package in JSC "ISS" to research negative influence of space environment on SC, and the main results of the development of the protective means and methods are described in the article.

Keywords: space craft, SC (space craft) operation, space factors, anthropogenic factors and protective means.

The main operating characteristic of any satellite system is durability that is the ability to perform the specific tasks by all included space craft (SC) during the required life time.

The modern SC includes hundreds of radio-electronic blocks, optical devices and operating surfaces, thousands of structure elements and cable assemblies. This technical complex must operate during all life time (up to 15 years) under the conditions of negative space environment influence.

In the process of full – scale operation the SC is subjected to the influence of the wide spectrum of space factors (SF) and anthropogenic factors (AF). The results analysis of domestic and foreign SC operation indicates the presence of SC abnormal operation correlation of significant degree with variations of solar activity, space geomagnetic disturbance and anthropogenic conditions of SC operation.

According to the conclusion of the Federal Space Agency and Space Forces "…One of the main factors affecting on the characteristics stability and reliability of on-board radio – electronic equipment is space ionizing radiation.

Reportedly, there is 30–50 % of on – board radio – electronic equipment failures per the part of these effects" [1], and "the support of required stability is the most important task of SC manufacture with the long life time (10–15 years), contemplated by the Federal space program of Russia" [2].

Researches conducted by NASA and USAF also indicated, that up to 1/3 of failures at foreign SC operation have operational character and stipulated by the geophysical factors.

During researches the readable dependence between the level of geomagnetic activity and the rate of SC failure of different missions was detected.

It is determined the number of failures of SC on – board equipment rises several times due to solar activity increase [3].

The data analysis on anomalies in the operation of the domestic SC conducted by the specialists of 4 RF CSRI of Ministry of Defense, indicated that general number of failures of on – board SC systems, exchange dysfunction of the control and target information during high heliogeophysical activity increases 2–2,5 times, that, in its turn, sharply shortens the mean time of their active functioning. More than 50 % (on some systems up to 90 %) of them occur because of environment external action on SC on – board equipment. More than 80 % of such failure influences somehow on the performance of specific tasks [3].

At present all these problems are becoming more actual due to transition to the non-pressurized SC performance. The transition to such SC structure is caused by necessity of Life time increase up to 15 years and also by the increase of power supply capacity of newly developed SC. But at the same time the new mechanisms of the space environment influence on-board SC systems appear. All these influences without special analysis and necessary protective means can lead to the serious failures of on-board systems of the modern domestic SC.

Considerable effect on SC operability can also be produced by anthropogenic factors. So during the