Shot report

FRACTAL MODEL OF MICROACCELERATIONS: RESEARCH OF QUALITATIVE COMMUNICATION{CONNECTION}

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In work qualitative connection between fractal dimension of Weierschtrass-Mandelbrot function and the moment of operating rocket engines spacecraft is researched.

The problem of microaccelerations during more than thirty years is deep a barrier on a way of development revolutionary new technologies [1]. First were confronted by it the American researchers in 1973, 300 various series which have developed and realized more experiments at space station " Skylab " from which not all have come to the end successfully. Later it has been found out that the reason of some unsuccessful experiments became excessively high level quasi-static components of microaccelerations.

The analysis of conditions of flight has shown that the condition of weightlessness inside of a spacecraft in space is not absolute because on it not compensated system of forces and the moments works. Therefore in all internal space spacecraft there is a field of residual small accelerations which can be named microaccelerations. Studying, forecasting and maintenance of a level of microaccelerations necessary for technological processes became one of the major problems of space materiology.

Technologists have started to struggle with quasi-static components microaccelerations trying to improve the design-layout circuit (DLC) of spacecraft. For this purpose tests for orbital complexes «Salut-6,7» and also a number of experiments on an artificial satellite of type the PHOTON were spent. The researches connected with microaccelerations were spent and abroad: the program onboard orbital space stations (OSS) «Freedom». The striking example of successful struggle with quasi-static components became spacecraft «Spot-4»: it included one panel of the solar battery (PSB) which fastened to case spacecraft by means of an elastic bar. «Spot-4» has not been intended for power-intensive processes.

The idea maintenance of the necessary level microaccelerations not in all internal space spacecraft and in a working zone of the process equipment now is considered one of the most perspective. The topical of the this idea increases in connection with planning in RCC "Energy" of the technological project "OKA-T" the level of microaccelerations on which should not exceed 10^{-7} g.

Not less important than experiments the role at the present stage of development of a problem microaccelerations plays mathematical modelling. For achievement of more effective results is reasonable to spend natural tests in a complex with mathematical modelling.

There are great number of the mathematical models estimating a level of microaccelerations onboard spacecraft after its flight, however until flight estimations are far from perfect.

Developed by authors the fractal model of microaccelerations with use of the valid part of Weierschtrass-Mandelbrot function (WMF) [2] allows to estimate a level quasi-static components of microaccelerations onboard spacecraft without obvious modelling its movement. Following statement of a task is used: rotary movement spacecraft around of the center of weights is considered, the level of the microaccelerations arising from fluctuations of elastic elements after individual abrasion of operating rocket engines of system of orientation spacecraft (ORE) is estimated.

During modelling an identification of parameters WMF and characteristics of physical conditions at which the field of microaccelerations inside of a working zone of the process equipment is created at carrying out on spacecraft various experiments is one of the key question.

In the given work the question of an opportunity of an estimation of average value WMF at a qualitative level is considered. For reception of average value of microaccelerations spatial rotation spacecraft of type «NIKA-T» having three elastic elements (model [3]) was considered.

The estimation of correlation was spent by classical factor of correlation [4].

Dependences of average value of microaccelerations on ORE moment for various values of the accelerative-mass characteristics spacecraft received on model [3], are resulted on fig. 1.

It allows to accept confidently a hypothesis about linear correlation between average value of microaccelerations and average value of WMF on 5 %-s' significance value (critical statistics 0,537). However the classical criterion is unstable to displacement from the normal law of distribution therefore to a final conclusion about applicability WMF for an estimation of average value of microaccelerations we shall apply nonparametric rank criterion Cox-Stuart′s [4].

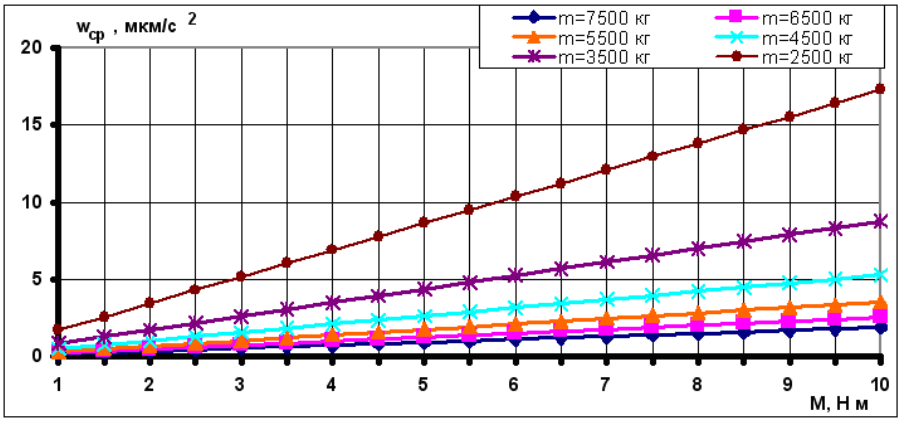

Figure 1. Dependence of average value quasi-static components of microaccelerations from moment ORE for various lump spacecraft

Dependence of average value WMF on its parameters is presented on fig. 2.

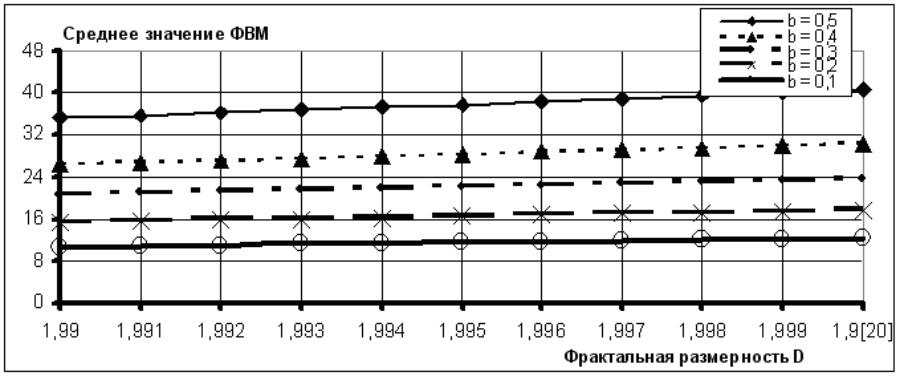

Figure 2. Dependence of average value WMF on it fractal dimensions at various values of scale parameter

The analysis shows that values of correlation coefficient is within the limits of from 0,80 up to 0,90 for various samples (fig. 3).

Figure 3. Values of correlation coefficient for various

For sample in 17 points it has the maximal value +17 at critical statistics for 5 %-s' significance values +9 [4] therefore the hypothesis about linear correlation is accepted. Similar results can be received considering other samples and researching correlation between dependences fig.1 and fig.2.

Thus by correlation coefficient and criterion Cox-Stuart's the opportunity of modelling average value

quasi-static components of microaccelerations by WMF in the statement designated above is proved.

References:

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