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ANALYSIS OF THE METHODS FOR CALCULATING THE NATURAL FREQUENCIES AND VIBRATION AMPLITUDES, APPLICABLE TO THE MECHANISMS OF ANTENNA DEVICES

АНАЛИЗ МЕТОДИК РАСЧЕТА СОБСТВЕННЫХ ЧАСТОТ И АМПЛИТУД КОЛЕБАНИЙ, ПРИМЕНИМЫХ К МЕХАНИЗМАМ АНТЕННЫХ УСТРОЙСТВ

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Antenna is a radio device, designed to emit or receive electromagnetic waves. It is one of the most important elements of any radio system. These systems are: communication systems, information retrieval systems, destruction of information, radio system.

The main task of antenna device is to ensure signal quality at the required distance. Therefore, the direction AU is one of its most important characteristics.

Accuracy requirement is the one of the main requirements. The accuracy of the movement of working antenna systems (antenna reflector, horn scanner probe in the measuring device, etc.) depends on the accuracy of the radio parameters. The use of various radio waves to increase the accuracy of the results is often more complicated and costly compared to the use of high-precision gears.

The problem, which occurs when you create the satellite dish is the need to initial implementation and subsequent maintenance of geometry structures with deviations of no more than 1/16 of the wavelength. Exceeding the distortions of the form elements for the specified limit leads to a sharp decrease in efficiency of the antenna.

Vibrations and the vibration amplitudes, which are too high, can affect the accuracy of guidance.

The Lagrange equations of type II, is using to obtain the equations of motion for the study of cross-torsional vibrations, including uncertain factors. It makes the calculation very big and complicated. Recently, the most common approach in the task of analyzing multi-dimensional dynamical systems is the using of finite element method (FEM). The drive system can be studied just as the study of the stress-strain state of elastic bodies by breaking their solid models into finite elements (grids of different types). According to allowance of Limarenko G. N. "The dynamics, vibration diagnostics and vibroprotection machines", for the calculation and analysis of the dynamic characteristics of the drive design model is creates. It is a dynamic model, in which inertial mass and damped elastic elements interacts in a certain way. In "DYNAR" for the calculation and analysis of torsional vibration actuators uses modal analysis method, i.e. the method of expansion in the natural vibration modes. To do this, a mathematical model is represented in a frequency. Also a method of presenting dynamic mechanical drive system composed of interacting finite elements is used. These are modules, in which torsional and transverse vibrations are modeled. Modules is used here as functional elements. Dynamic model of the drive produced by assembling of finite element modules.

The dependence of the radiation pattern of the vibrations is considered in Taliban N.A., A. Yakimov, Smogunov V. V. "The influence of vibration on the pattern of the waveguide slot antenna."

In mechanical harmonic actions with an initial phase of zero, throught one space discretization in time Δt, which is equal to the time of passage of mechanical wave distance from the edge of the antenna to its center, the resulting deformation of the profile antenna leads to the following changes in the radiation pattern (see Fig. 1, curve 2): width of RP varies slightly, but zero levels of side lobes are disappears and side-lobe level is changed. In the study of the deformation results for each subsequent time interval Δt effects of transverse mechanical vibrations evaluated for the new profile of the spatial position of the receiving antenna slots in the previous moment.

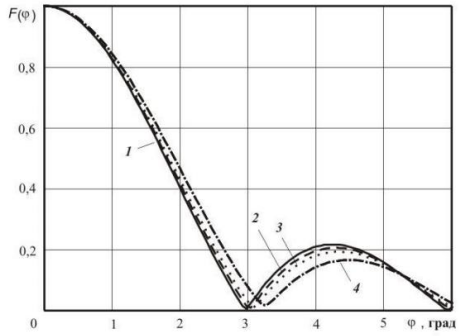

Figure 1 – the change of the antenna RP due to the deformation produced by vibrations.

Calculations of the strain profile antenna for times t, corresponding to its further increment interval Δt gave the following results: At t = 2Δt (see Fig. 1, curve 3) and t = 3Δt (see Fig. 1, curve 4), i.e. with increasing t, is observed an increasing in the strain profile antenna and changing RP.

Consequently, calculating and minimizing the vibrational characteristics are very important for aerial devices.

In the manual Basinyuk V.L.,"The calculation of the dynamic characteristics of machine tools' development of a mathematical model of main drive consists of the following stages:

1. Analysis of the developed design main drive and determination of its parameters by assembly drawings, building design scheme of dynamic drive system.
2. Description of the design scheme of the drive system of differential equations.
3. Determination of the transfer functions of the dynamical system main drive.
4. Construction of frequency and transition frequency characteristics of the drive.
5. Analysis of the dynamic quality of main drive for its dynamic characteristics.

Next the drive elements compliances are calculated.

The resulting calculation of the moments of inertia of the concentrated mass of the drivers of the elastic compliances and areas between the design scheme is a chain system is very cumbersome, since shafts rotate at different speeds and are interconnected through transmission.

Features of this method:

- Using of bulky Lagrange equations of the second kind.
- This procedure does not mention the use of automation, engineering programs.
- Focuses on the torsional vibrations.

It examines in detail the calculation of the dynamic characteristics of the spindle work Basinyuk VL, Alexander Kuleshov "The calculation of performance and multi-criteria selection of parameters spindles", developing a methodical approach to multicriteria choice of the most efficient design and operating parameters. Considering the design of spindles dual console as a beam on elastic supports, loaded lumped and distributed masses. This approach is

not sufficient for the problem of determining the dynamic characteristics of the drive antenna devices.

Modal analysis is also used in article of Abuthakeer S.S., «Dynamic characteristics analysis of high speed motorized spindle". Calculations are made in the software package Ansys, resulting in a certain characteristics of spindle rotation at the critical velocity. As a result, the natural frequencies are obtained for different situations. However, this paper is not calculated vibration amplitudes spindle.

In Limarenko G.N. “Design methodology with automated rack and pinion drive” is a method of calculating the amplitudes of forced vibrations of mechanical components of the drive system of heavy machine. This method is based on the frequency of the transfer functions of the drive and modal analysis.

Having examined the above studies, it can be concluded, that the most detailed calculation of dynamic characteristics of mechanical systems considered in the methods Basinyuk VL, Alexander Kuleshov "The calculation of the dynamic characteristics of machine tools" and Limarenko G. N. "Dynamics, vibrodiagnostics vibroprotection and machines." However, the method presented in the textbook of Limarenko G. N. is more effective for several reasons:

- The use of finite element and modal analysis
- modularization.
- calculation as torsional and transverse vibrations.
- using of different software products.