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Definition of the moments of inertia of details and knots of devices by means of the computer environment LabView

Today the given subject is actual because production of details and knots of devices is accelerated as robots can quicker work for receiving any enterprise of the income. But the highest precision can't be provided. Therefore, people work. Calculation of the moments of inertia is made long, and thus the purpose of this article is to simplify these calculations.

Tasks of article are:

1) introduction of calculations to the LabView program;
2) revealing algorithm of work of the considered algorithm.

First of all it is necessary to clarify what the inertia moment is. Moment of inertia *J (*kg·m2*)* – parameter, which characterizes the measure of inertia of the bodies rotating rather rotation axis fixed.

The moment of inertia of a body is the sum of the moments of inertia of the material points making this body. It can be expressed through the body weight and its sizes [1].

Methods of calculation of the moments of inertia [2]:

- Analytical method:

Analytically to calculate the moment of inertia of any body, it is necessary to know the extent of the measured object and material density.

- Use of CAD systems:

The majority of CAD-systems (such as KOMPAS-3D, T-Flex) consider the moments of inertia of flat profiles.

7. Experimental methods of definition of the moment of inertia

- Method of the Atwood's car:

The solid body is fixed on a motionless axis and brought into rotation by means of the falling freight attached to the thread which is reeled up on the cylinder rotating together with a body.

- Method of a physical pendulum:

The moment of inertia is determined by the period of small fluctuations of a physical pendulum or by its carried-out length.

- Method of swing of a double pendulum:

The heavy material point is connected by an inextensible thread to a motionless point and a thread with a heavy material point. Such system is brought out of an equilibrium state and makes fluctuations in the vertical plane under the influence of the weight of points.

- Method of tortional fluctuations [3]:

This method is used for definition of the moments of inertia of more difficult details.

Before measurement the detail is suspended on one or several elastic threads, so that the center of mass of a detail lay on a subweight axis, and an axis round which it is required to measure the inertia moment, coincided with a thread. Further measure the period of tortional fluctuations.

The moment of inertia of a body is defined by a ratio: J = Jэ*T2Tэ2,

where T – the period of fluctuations of a body

Jэ – the moment of inertia of the used standard (which it was earlier defined) *Tэ* – the period of fluctuations of a standard

This method of calculation was chosen for determination of experimental values of the moment of inertia because it is simple and convenient, and also allows to define the inertia moment with high precision.

Experimental definition of the moment of inertia of J details and knots.

The installation was originally collected for definition of the moments of inertia by method of tortional fluctuations represented in fig. 1 [3]:

Fig. 1. Installation for definition of the moments of inertia

All necessary measurements of the sizes of a standard were taken by an electronic caliper. Standards 1–4 are presented in fig. 2:

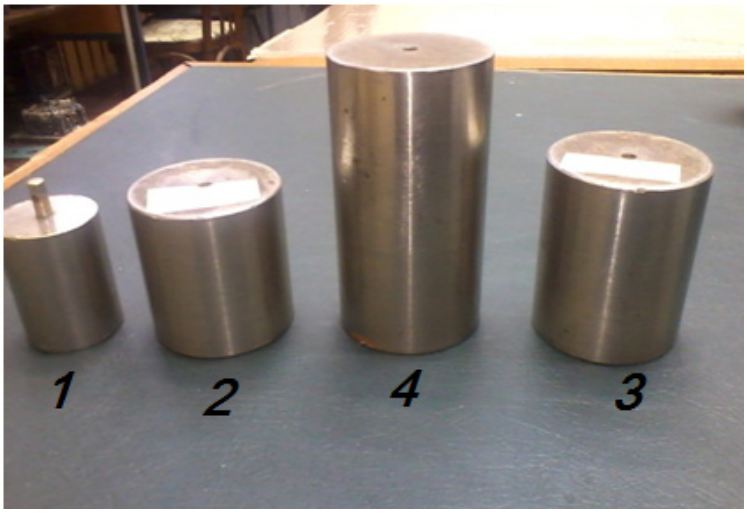

Fig. 2. 4 samples of standards

Further defined the periods of fluctuations of standards, data are presented in table 1:

Table 1

Characteristics of each standard

	Standards			
	first	second	third	fourth
Height, m	0,042	0,0496	0,059	0,09
Radius, m	0,016	0,0239	0,024	0,0242
Time of fluctuations, sec	10	10	10	10
Number of fluctuations	12	11	9	10
Body weight, kg	0,263	0,697	0,835	1,298
Frequency of fluctuations	1,2	1,1	1,2	1,2

Moment of inertia for standard:
Standard 1: $33.5*10^{-6}$ kg·m2
Standard 2: $19.5*10^{-5}$ kg·m2
Standard 3: $38*10^{-5}$ kg·m2
Standard 4: $24*10^{-5}$ kg·m2
During the done work defined the inertia moment for 4 samples:

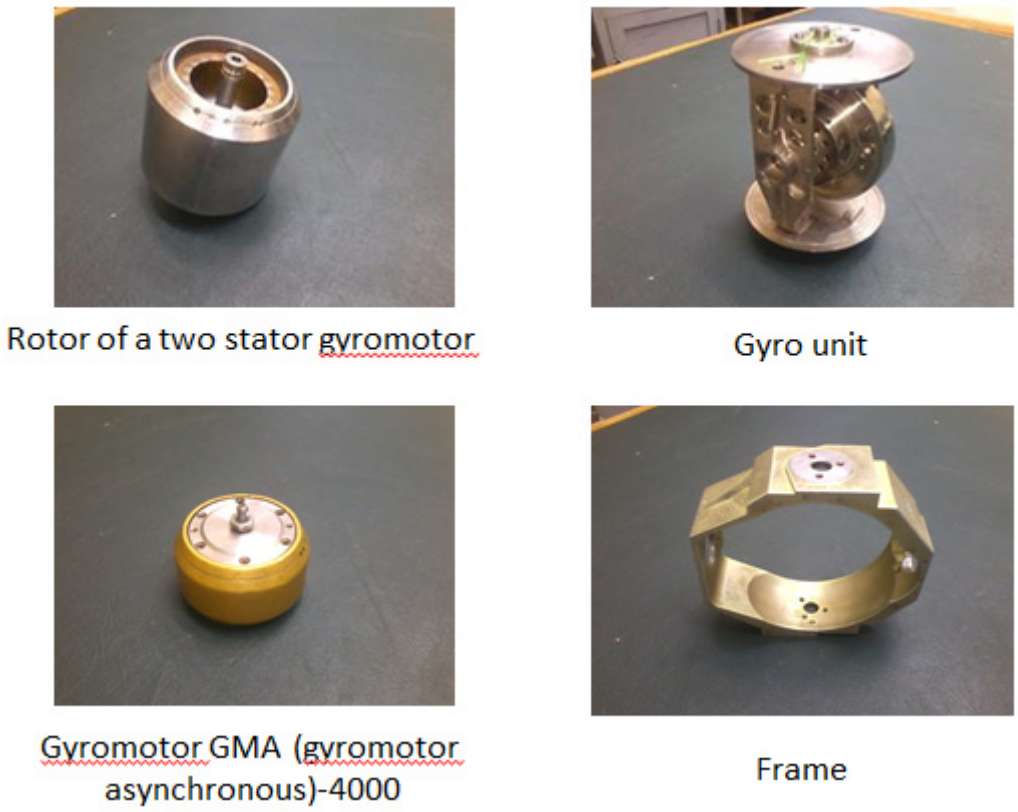

Fig. 3. sample for definition of the moments of inertia

For these samples defined the periods of fluctuations.

For gyromotor 4000 there are chosen standards № 1 and № 2, and on a formula J = Jэ*T2Tэ2, the inertia moments are calculated.

J = 3,93*10^{-5} kg·m2 at a standard № 1 and J = 1,95*10^{-4} kg·m2 at a standard № 2.

Table 2

The periods of fluctuations each samples

	Frame	Gyromotor GMA-4000	Gyro unit	Rotor of two stator gyromotor
Number of fluctuation	9	11	11	8
Time of fluctuation	10	10	10	10
Frequency	0,9	1,1	1,1	0,8
Period	1,1	0,9	0,9	1,25

Considering that the present moment of inertia gyromotor 4000 is equal $1{,}78*10^{-4}$ kg·m2, that it is possible to draw a conclusion that it is necessary to take a sample for a standard № 2.

The error of the moment of inertia made: 8.3 %.

The inertia moment for a rotor gyromotor was defined (standard № 3):

$$J = 8{,}6*10^{-4} \text{ kg·m2}$$

The inertia moment for gyro unit was defined (standard № 4):

$$J = 2{,}8*10^{-} \text{ kg·m2}$$

The inertia moment for gyro unit was defined (standard № 2):

$$J = 2{,}9*10^{-4} \text{ kg·m2}$$

All above-mentioned calculations it is possible to avoid if in advance to load the necessary standards into the computer. For this purpose it is necessary to realize data processing on the computer in the environment of graphic programming of LabView. In this program standards will be initially put, and all intermediate calculations and calculation of the moments of inertia will be made by the computer. The algorithm of work of the program consists in the following:

- The logical signal from an optopara arrives on the computer;
- The logical signal is processed by the computer and from its parameters, such as the period, calculation of the moment of inertia;
- In the developed program in the environment of LabView the front panel of the virtual device is created;
- On this panel results of measurements will be displayed.

References

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