SENSORS FOR DETERMINING THE SPATIAL POSITION OF THE AIRCRAFT

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The aviation community must constantly work to improve safety around the world. The main driving force of its continuous development is the awareness of the importance of safety and efficiency in aviation. It is in aviation that the most modern technologies are introduced in the first place, including information technologies, which require highly qualified personnel serving the aviation industry, equipment and increasing the level of safety.

Piloting an aircraft in blind flight in other words in the absence of visibility of the ground, is possible only in the presence of devices that indicate the pilot position of the vessel in space. The position of the aircraft in space is determined by three main angles: roll, pitch and true course.

A massive flywheel (rotor) driven in rapid rotation around its axis of symmetry has properties different from the properties of a stationary flywheel. The new properties are manifested only if the axis of rotation of the flywheel can rotate in space, i.e. if the flywheel has more than one degree of freedom.

A device in which a rotor that has more than one degree of freedom rotates rapidly around its axis of symmetry is called a gyroscope. The gyroscope can have two or three degrees of freedom, depending on how the rotor suspension is arranged.

Gyroscope - a device capable of responding to changes in the orientation of the base on which it is mounted relative to the inertial space.

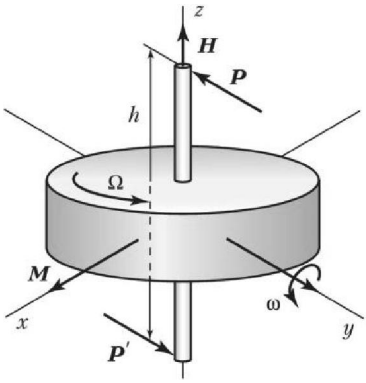

Fig. 1. The principle of operation

The angular velocity of the precession can be calculated by the formula:

$$\omega_p = \frac{L}{H},$$

where L is the moment of external force; H is the kinetic moment of the gyroscope.

The error of the gyroscope is the deviation of its main axis "X" from a given direction relative to the ground. The technical gyroscope has errors due to:

- friction in bearings of axes of a Cardan suspension;
- imbalance of the rotor relative to the axes of rotation;

- diurnal rotation of the Earth around its axis.

An accelerometer is a device that measures the projection of an apparent acceleration onto one or more axes, called the axes of sensitivity. The term seeming acceleration should be understood as acceleration due to the sum of all forces applied to the object, except gravity.

The term is mainly used in navigation systems. If only the force of gravity acts on the accelerometer, it will measure the acceleration of free fall, because, under the action of this force, the sensing element will deviate from the equilibrium position.

There are several types of accelerometers, which differ in the sensitive elements and the principles of conversion of a physical quantity into an electrical signal. To understand better the principle of operation of the accelerometer, it should be presented as a load mounted on springs. The principle will be the same - there is a displacement of the sensitive element under the action of any force. Fig. 2. presents a block diagram of a uniaxial accelerometer.

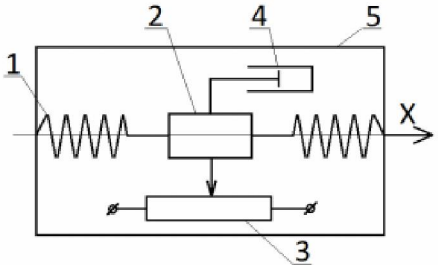

Fig. 2. The internal construction of a uniaxial accelerometer.

The operation of the accelerometer may exceed the readings of its measurement. This can primarily be affected by humidity and ambient temperature. This changes the properties of the materials used in the manufacture of devices. Interference also creates an external magnetic field.

To minimize its impact, the sensor design can have various technical additions. Also, the measurement error results from the vibration of the measurement object.

The work of modern aviation is the need to obtain in real-time the spatial position of aviation systems during the primary and secondary training of operators to operate the above systems.

This will not only obtain the characteristics of each operator and identify the patterns of its activities, but also further predict the occurrence of systematic errors inherent in a particular operator.

And further contribute to their reduction, which will significantly affect the process of training aviation system operators and increase the level of aviation safety in general.

References:

1. Kharchenko V.P., Ostroumov I.V., Avionics. Textbook. - K: NAU, 2013 (in Urkainian)

2. Andrusevich A.O., Kasyan V.S., Stadnik V.V. Information and measuring devices, avionics systems and complexes. Textbook. - Kryvyi Rih, 2011(in Urkainian)