**"Gyroscopy and Navigation" №2, 2001**

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| When a gyro changes over from operating condition to non-operating condition, a rotor performs landing on supports. If the support was de-energized without preliminary deceleration of rotor rotation, the landing process is accompanied with intensive shock interactions between the rotor and its supports. The possibility of fail-safe rotor landing is discussed, assuming that rotor landing falls into emergency type if linear velocity of rotor center displacement exceeded an experimental value. It is supposed that interaction of the rotor and its supports can only result in one of two alternative events: either the gyroscope retains its performance capabilities or its reuse is impossible. The problem of probability determination is divided into two parts: simulation of a single landing process with random parameters; obtaining of a stochastic criterion. A model of shock interaction between the rotor and the support is used, basing on hypotheses of Routh and Newton. Formulas are derived for calculation of the proposed criterion value by the method of statistic tests. An illustrative example is shown for comparing a number of options of four supports position with equiprobable orientation of angular momentum vectors, initial linear velocity of rotor displacement and inertial load. However laws of the indicated vector distribution, amount of supports and their possible positional relationship, as well as shock-frictional properties of supports do not restrict application of a stochastic criterion for other types of gyro devices. The result verifies possibility to use fail-safe landing probability as a criterion of selecting a support disposition variant. |  |
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| The following tendencies are among the main tendencies of Strapdown Inertial Navigation Systems (SINS) development:the miniaturization of all the components of SINS from sensors to board computer;the use of a redundant number of sensors and development of fault-tolerant SINS;the increase of the frequency of data processing in SINS.If these tendencies are taken into consideration many widely used approaches to the development of various components of SINS are to be revised. For special purpose SINS processors it means first of all the development of technique for rational architectures construction.The analysis of SINS algorithms has been resulted in selection of calculating operation like (1). On one hand this operation is a base one for most of known SINS algorithms. On the other hand it determines a set of possible architecture solutions. Operation (1) concerns directly the architecture of Processor Elements (PE) that are the base of developed Function-Oriented Processors (FOP) SINS. PE architecture consists of sum unit (SUM), multiplier (MULT) and memory (MEM). To compare different PE architectures between each other parameters of time complexity LT and data processing frequency F are introduced. The form of LT and F estimates shows that architecture of PE5 (fig. 6) is the most rational. The quantitative estimates presented in the table 3 allow selecting PE5 as a base calculation unit of SINS FOP.The next stage of development is constructing of rational FOP architecture. It begins with transforming of initial algorithms.The approach to transforming the algorithms is illustrated with the Savage algorithm (fig. 7) as an example. The initial graph contains a set of tops related to each other and tops (operators) do not contain practically base relations. The resulting graph is weakly related and its tops are maximally oriented to base operation (fig. 8, 10). Then the problem of "covering" the transformed algorithm graph by FOP architecture is to be solved. Efficiency of data processing on the architecture of multi-processor vector FOP for Savage algorithm depends essentially on a number of PE. On the class of vector architectures the FOP architecture containing three PE like PE5 (table 3) is maximally efficient.The results of the theoretical study and simulating of FOP architectures are applied to two practical systems. One of them is vector FOP based on 9 PE. The type of architecture is SIMD. Mass is 1.5 kg. Equivalent performance on the class of SINS algorithms is 8x106 operations per second. It was developed in 1992.The second of them is PE with RISC architecture. Mass is 0.5 kg. Equivalent performance is 107 operations per second. It was developed in 1995.The results of the study may be used in implementation FOP as a fragment of VLSI. |  |
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