RESEARCH PROJECT FOR JOINT IMPLEMENTATION
"Software for Determining the Statistical Characteristics of Complex Dynamic Systems Based on Multi- Differential Transformations"

The proposed method of determining the statistical characteristics of dynamic systems based on multi-differential transformations can be used while developing software for complex high-dynamic systems (spacecraft, aircrafts missiles) that operate in real time.

Additionally, the aforementioned method can be used to create complex software systems (or their components) of mathematical modeling (for example Maple, Matlab, etc.).

The project object of the proposed method while developing software for targeted use of complex dynamic systems described by conventional nonlinear stochastic differential equations for the solution of which is taken their mean value (mathematical expectation of phase coordinates) and dispersion (correlative error matrix for determining phase coordinates), provided the original differential equation allows linearization.

The well-known methods for determining the statistical characteristics (method of interpolation polynomials, Dostupov method, Monte Carlo method) have a significant drawback: the computational complexity of resulting algorithms (software) is too high, making it difficult (and often impossible) to use by dynamic systems that operate in real time.

A prototype (known statistical method for determining characteristics) is represented in the method of linearization relative to the average value characteristics of dynamic systems with further transformation using the method of correlation.This prototype cannot be used for building the software that works in real time, as it has either significant methodological difficulty in carrying out analytical linearization (definition of the matrices of partial derivatives) or low accuracy in carrying out the linearization using numerical methods (method of finite differences).

The advantage of the proposed method of determining the statistical characteristics of dynamic systems based on multi-differential transformations is the reduction of computational complexity of software for complex high-dynamic systems (spacecraft, aircraft, rockets), which work in real time and have the onboard computers, where such mathematical software is established.

The proposed method resolves itself to the creation of a formalized algorithm (systematically implemented on a computer) for determining the statistical characteristics of complex dynamic systems, that greatly simplifies the process of developing software and simultaneously increases the efficiency of its operation (to reduce its computational complexity). The implementation of the software with reduced computing costs requires reduced capacity of onboard computers, and therefore their lower cost that has a significant economic impact for complex dynamic systems (spacecraft, aircraft, missile).

When describing the dynamics of spacecraft flying near space (600-700 km high), and using the sophisticated models of spacecraft motion the proposed project reduces computational complexity of the resulting algorithm to 1-order.

So, the proposed method allows developing formal mathematical algorithm of software building for targeted use of complex dynamic systems described by ordinary nonlinear stochastic differential equations for the solution of which is taken their mean value (mathematical expectation of phase coordinates) and dispersion (correlative matrix of errors definition of phase coordinates), provided the original differential equation allows linearization.

Scientific superfisor: Doctor of Engineering Science, Full Professor Yurii Kravchenko (+38095-068-86-25; yl143@rambler.ru)