SYMPOSIUM ON SAFETY, QUALITY AND KNOWLEDGE MANAGEMENT IN SPACE ACTIVITIES (D5)
Safety of Vehicules and Ground Segment for Aerospace Missions (1)

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SYNTHESIS OF CRITICAL DISTRIBUTED RANDOM DISTURBANCES FOR SPACE VEHICLES SAFETY ANALYSIS

Abstract

The method of the definition of the critical random factors aggregate for a space vehicle mission is proposed. The critical aggregate has the worst effect on a quality criterion at the given event probability. The criterion is chosen for the risk analysis of the space vehicles flight task performance.

The maximal injected payload mass, admissible atmospheric disturbances level, vibroacoustic loading rate, etc., can be used as the quality criterion. Random factors can include both parameters, characterizing, for example, vehicle characteristics uncertainty, and functions, defining, for example, density variations or/and wind distributions with altitude and latitude. In practice the dimensionality of the vector of random factors runs up to thousands. Distribution laws of random variables can be various.

In view of the mentioned conditions the developed method allows to obtain the analytical synthesis of critical multidimensional profiles of random disturbances for any flight task. The method is based on the game approach and the solution of the auxiliary conjugate equations with transversality conditions of the Pontryagin maximum principle.

Some applications of the objective formation of critical atmospheric disturbances profiles for the space transportation systems are shown. Considerable advantages of the developed method (several orders of the CPU time faster) are demonstrated in comparison with the well-known Monte-Carlo technique.