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PROBLEMS OF MODELLING IN DYNAMICS OF STABILIZATION AND ORIENTATION SYSTEMS

Abstract

This work is devoted to the specific problems of avia-, aerospace systems, with reference to problems of the mathematical modelling, analysis and synthesis for the systems of stabilization, orientation and control with gyroscopic controlling elements, including applications for decomposition problems at system level and sub-system level, for complex navigation systems. Nonlinearity, high dimensionality, multi-connectivity are causing the impediments in obtaining exact solution by analytical and analytic-computer methods in designing and control. It leads to the necessity of the shortening original model, with the subsequent transition to the decomposed systems, to reduced submodels, with designing of separated subsystems. Interesting approach is worked out with reference to the complex system problems for small objects. Here new theoretical and applied problems are revealed that are investigated in this research with using A.M.Lyapunov theory methods. In regard to the stabilization and orientation systems with the gyroscopic controlling elements, it leads to the singularly perturbed problems with the different singularities types, with critical cases, with the nonlinear singular generating systems. For systems of the gyrostabilization the principal questions are discussed: - the general methodology of the reduction-decomposition problems; - the manners, methods for both physical and mathematical decomposition; - the substantiation of decomposed models legitimacy in dynamics and control problems; - the determination of the qualitative equivalence conditions and correctness; Here above formulated problems are solved by method, following to the ideology of stability theory. Generalized approach, developing A.M.Lyapunov methodology, N.G.Chetayev ideas, is extended here. Exactly the understanding these problems via singularly perturbed systems approach gives the perspective results both for theory and for applications, with revealing a constructiveness of Lyapunov stability methods as effective unified mathematical tool. Here it is considered the family of the stabilization and orientation systems models with gyroscopic controlling elements (with division of the models for small satellites, for big stabilized objects, ...). The cases of full mathematical decomposition for original model are examined.