

SPACE OPERATIONS SYMPOSIUM (B6)
New Operations Concepts, Advanced Systems and Commercial Space Operations (2)

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THE PROSPECTS OF DEVELOPMENT AND USE OF INTELLIGENT CONTROL SYSTEMS FOR
SPACE VEHICLES

Abstract

At present the intelligent control systems are much wider used in different fields of scientific and technological activities in many countries. The use of intelligent control systems ensures big prospects of quality improvement and reliability of space missions. Thus the use of intelligent systems is a single option variant of space vehicle control in the close to real time-scale for deep space missions. Only the autonomously made decisions and their urgent fulfillment will allow successful performing flight programmes of space vehicle without operative interaction with earth-based stations. At the same time the study of existing materials showed that there's no general approach to the development of high-efficient intelligent control systems. The new structural composition of intelligent control system for prospective space vehicles is elaborated based on the analysis of famous variants of intelligent systems. Along with the traditional elements - the knowledge base and the inference machine it includes additional elements – the unit of identification of flight situations, the unit of simulation and state prediction of space vehicle equipment state. The unit of identification of flight situations is designated for performance sizing of space vehicle present position and on-board equipment state, their comparison with the forecast parameters, feature detection of contingency cases and necessity of control programme adjustment. The knowledge base includes the data base and the set of decision rules. The data base is a software structure which contains event set S in the form of objects, attributes and their values. The unit of simulation and forecasting of space vehicle operation is meant for determination of space vehicle motion paths in the subsequent flight phases, standard characteristics of onboard systems state under “ideal” execution of commands and comparison of predicted results to the real parameters, including the results based on the telemetry and trajectory data. The inference machine provides step-by-step formation of intellectual technological cycles for control decision-making on the basis of selection of decision rules combinations from their total set. The elements of intellectual novelty of the system are as follows: formation of decision rules on the basis of analytical algorithms of accelerated test of quasioptimal control; automated correction of decision rules under the conditions of changing flight situations; updating of the knowledge base by identification of new flight situations.