GAME METHOD OF EVENTS SYNCHRONIZATION IN MULTIAGENT SYSTEMS

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The processes of the events synchronization in the multiagent systems which function in the conditions of uncertainty are the research object. The synchronization is necessary for the coordinated work maintenance of the multiagent systems components, for the message transfer between agents, for the self-organization conditions maintenance when the distributed system behaves as a complete artificially generated organism.

The stochastic game model for the events synchronization in the multiagent systems is the research subject. The game events synchronization in the multiagent systems is the topical scientific and practical problem not studied enough yet. Unlike the synchronization of oscillators networks, which are described by the systems of the differential equations, the stochastic games of the multiagent systems investigate the difficult behavior of the intellectual agents' networks with various models of decision-making in the conditions of uncertainty on the basis of artificial intelligence methods.

The design of the stochastic game method of the spatially-distributed synchronization of systems processes is the purpose of this work. To achieve this purpose, the stochastic game problem formulations are established, the recurrent method is offered and the algorithm is developed for its solution, the results of computer modeling of the stochastic game are analyzed.

The essence of the game method consists in the delays alignment of the approach of an event by each player on the basis of the actions supervision of the next agents. The values of players' pure strategies define time intervals between two adjacent oncoming moments of some approaching event. The pure strategies of players are discrete random variables which are generated with the probabilities which are the part of the players' mixed strategies. The vectors of the mixed strategies dynamically change in time on the recurrent method constructed on the basis of the stochastic approximation method. After the termination of the pure strategies choice, each player receives the current penalty, which is estimated as the current deviation of the approaching events time within the local players' coalition. The game purpose is to minimize the functions of losses averaged in time.

During the stochastic game agents self-learn to choose the optimum pure strategies, reconstructing their own vectors of the dynamic mixed strategies. Under certain conditions, which are defined by the parameters of environment, in the parameters of a game method and the criteria of the decisions variants choice, the self-learning of stochastic game provides the agents' strategies synchronization.

The considered game method, given appropriate adjustment of its parameters, provides the multiagent systems events synchronization. Theoretically, the base conditions of the stochastic approximation should satisfy the value of such parameters. In practice, the value of parameters, which provide convergence of a game method to one of the collective optimality points, can be specified as a result of the computer modeling.

The efficiency of the method is estimated by means of the characteristic functions of the average losses and the average quantity of agents with the synchronized events. The convergence of a game method depends on the quantity of players, the quantity of strategies and the interrelations of the method parameters with the multiagent systems parameters.

The results received in this article made it possible to define the optimum values of the game method parameters for the problem solution of the events synchronization in the multiagent systems within the shortest time.

The reliability of the received results is confirmed by the repeatability of the calculated characteristics values of the game method for different sequences of random variables.

In the offered model of synchronization of systems the intellectual level of agents is limited to the possibilities of the theory of stochastic automatic machines with the variable structure. The increase of intellectuality of agents can be carried out applying methods of the artificial intelligence, for example, the artificial neural networks, the Bayesian networks of decision-making, the fuzzy logic, the reinforcement learning and etc.