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ROBOTIC OBJECTS' GROUP CONTROL WITH THE PRESENCE OF PARAMETRIC UNCERTAINTIES

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This paper shows the way of synthesising a group control algorithm based on a robust control algorithm for a single object with high gain observer.

Introduction. Thanks to the active development of scientific and technological progress, the number of different robots in the modern daily life is rapidly increasing. Pursuing the goals of the qualitative improvement of existing technologies, robots are used in many different fields, from everyday life to manufactures, including spheres where human capabilities are limited.
However, it should be mentioned that the probability of successful completion of the task with usage of a single robot, regardless of its abilities, will be relatively lower than with using a group of robotic objects (agents) that make up a multi-agent system (MAS). For example, in the case of working in extreme situations or a hazardous environment, the breakdown of a single robot will lead to an absolute failure of its mission, in contrast to the use of the MAS.

Main part. Thus, it was decided to create a MAS controlled by a stabilization algorithm previously used for a single robot. As a model characterising each of the considered MAS agents, it was decided to use the results achieved by O.I. Borisov, A.A. Pyrkin and A. Isidori. In this way agents are represented by quadcopters, controlled through six parameters, specifically three Cartesian coordinates of the mass center and three Euler angles that characterize the position of the quadcopter. The main feature of the chosen algorithm is that roll and pitch angles of the model are immeasurable.
The task of maintaining the formation was chosen as the main control goal. In other words, agents must keep a certain distance from each other, regardless of external conditions. Taking into account that MAS consists of quadcopters, the synthesis of the control system for each of the agents consisted of two parts: vertical control and control in the horizontal plane along the x and y coordinates. The implementation of vertical control is proposed to be carried out using a standard PD controller with saturation. Horizontal control was carried out using a robust controller used in algorithm mentioned above.
To create a formation consisting of four agents, a graph-analytical method, based on theory of matrixes, was used. Since the system has a cyclic structure, in order to demonstrate it, a closed directed graph without loops was used. This made it possible to form expressions for the interaction of agents of MAS. Which in turn made it possible to establish a connection between the inputs and outputs of the system.
To demonstrate the efficiency of the algorithm, a similar control system based on the classical PID controller was synthesized.

Conclusion. As a result of the study, a group control system was built in two versions, and scientific novelty was provided, in the form of applying a robust controller with extended observers to the group.

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