

SYSTEM OF POSITION/FORCE CONTROL OF UNDERWATER VEHICLES WITH MULTI-LINK MANIPULATORS FOR PERFORMING CONTACT MANIPULATION OPERATIONS

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The article proposes a new method for the synthesis of a system of position/force control of underwater vehicles (UV) equipped with multi-link manipulators, which provides automatic execution of contact manipulation operations in the hovering mode near or above objects of work. To achieve the desired magnitude of the force effect of the working tool on the object, the magnitude and direction of the force vector provided by this tool on the object are calculated. After that, control signals are applied to the drives of all degrees of mobility of the manipulator, providing additional movements of its working tool in the direction of the desired force vector. At the same time, compensation of the calculated in real time force and torque effects on the UV from the manipulator performing the force operation is provided with the help of the thrust created by the propellers of the UV. Herewith, the necessary thrust force is created at the attachment point of the manipulator to the UV. This thrust allows the manipulator's working tool to carry out the desired force effects on the surface of the object of work. In addition, to compensate for inevitable errors of the UV stabilization system, which lead to deviations of the working tool from desired trajectories, these trajectories are automatically corrected taking into account actual displacements of the UV relative to the initial position. As a result, contact manipulation operations are carried out even under conditions of inevitable (albeit insignificant) displacements of the UV from the stabilization point under force effects of the working tool on the surface of the object. The operability and efficiency of the system synthesized on the basis of the proposed method are confirmed by results of numerical simulation in Matlab/Simulink with visualization in the CoppeliaSim simulator.

Keywords: underwater vehicle, multi-link manipulator, position/force control, contact operations, stabilization system.

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