

# DEVELOPMENT, SOFTWARE IMPLEMENTATION, AND RESEARCH OF MULTILINK MANIPULATOR CONTROL SYSTEM FOR UUV IN DYNAMIC POSITIONING MODE ABOVE UNDERWATER OBJECTS

**A.Yu. Konoplin, A.P. Yurmanov, N.A. Krasavin, P.A. Pyatavin**

The paper considers the task of synthesis of the multi-level control system for multilink manipulator of unmanned underwater vehicles (UUV) for autonomous operation execution in the dynamic positioning mode above underwater objects. The system is based on the improved method capable of precisely determining the object's form and location relative to the vehicle/robot using points cloud provided by the machine vision system. The given parameters of the working tool are overlaid on the identified surface of the object with respect to its possible silting, fouling, or deformation. To guide the manipulator's working tool along synthesized trajectories, the UUV implements methods of stabilization when hovering nearby the object, high-precision control of the working tool movement, and correction of its trajectory with regard to UUV displacement of the relative to the object. C++-based numerical modeling was conducted in the software packets V-REP and Matlab/Simulink using UUV dynamic model with manipulator and models of surroundings and investigated object. The results proved the system's high efficiency in sensor information processing and dynamic control of the UUV equipped with the multilink manipulator.

**Keywords:** autonomous underwater vehicle, multilink manipulator, control system, machine vision, object identification, trajectory planning, underwater operations.

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### About the authors

**KONOPLIN Alexander Jurevich**, Ph.D, head of laboratory  
Institute of Marine Technology Problems Far Eastern Branch of  
RAS;  
Institute of Automation and Control Processes Far Eastern Branch of  
RAS  
**Research interests:** automatic control of underwater robots and  
manipulators, adaptive control, information and control systems  
**Address:** 690091, Vladivostok, Suhanova str., 5a  
**Phone:** +7(924)429-83-96  
**E-mail:** kayur-prim@mail.ru  
**ORCID ID:** 0000-0001-7554-1002

**YURMANOV Aleksandr Pavlovich**, engineer  
Institute of Marine Technology Problems Far Eastern Branch of  
RAS;  
Far Eastern Federal University  
**Address:** 690091, Vladivostok, Suhanova str., 5a  
**Phone:** +7(914)678-60-60  
**E-mail:** yurmanov\_a@mail.ru  
**ORCID ID:** 0000-0001-6849-3700

**KRASAVIN Nikita Andreevich**, engineer  
Institute of Marine Technology Problems Far Eastern Branch of  
RAS;  
**Address:** 690091, Vladivostok, Suhanova str., 5a  
**Phone:** 89025063014  
**E-mail:** krasavin.na@students.dvfu.ru  
**ORCID ID:** 0000-0003-1102-5409

**PIATAVIN Pavel Alexeyevich**, engineer  
Institute of Marine Technology Problems Far Eastern Branch of RAS  
**Address:** 690091, Vladivostok, Suhanova str., 5a  
**Phone:** 89098882900  
**E-mail:** mcmaster988@gmail.com  
**ORCID ID:** 0000-0002-0812-808X



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