Design and Development of a Remotely Operated Underwater Multi-Robot Manipulator Controller

Dr. P. R. Saseendran Pillai, Ph.D.
Professor, Department of Electronics, CUSAT
prspillai@cusat.ac.in +91 484 2576418

N.P Subramaniam, M.E.
Teaching Research Associate,
Madras Institue of Technology, Anna University
npsubbu@yahoo.com 044-22237276-233

Mr. James Kurian
Lecturer, Department of Electronics, CUSAT
jkurian2000@yahoo.com +91 484 2576418

Abstract: For the scientific and commercial utilization of Ocean resources, the role of intelligent underwater robotic systems are of great importance. Scientific activities like Marine Bio-technology, Hydrographic mapping, and commercial applications like Marine mining, Ocean energy, fishing, aquaculture, cable laying and pipe lining are a few utilization of ocean resources. As most of the deep undersea exploration are beyond the reachability of divers and also as the use of operator controlled and teleoperated Remotely Operated Vehicles (ROVs) and Diver Transport Vehicles (DTVs) turn out to be highly inefficient, it is essential to have a fully automated system capable providing stable control and communication links for the unstructured undersea environment. Moreover, to communicate with submerged vessels, ROVs, DTVs, etc. in sectors, where it is impossible to deploy cables or buoys, it is essential to have a wireless underwater communication set-up. The design and development of a remotely operated and untethered multi-robot manipulator controller capable of tracking and updating all global information on the status of manipulator arms mounted on a single or multiple ROVs are described in this paper.

The automated multi-robot controller proposed in this paper increases the flexibility and offers friendly man machine interfaces at lower operating costs. In addition to this, task planning and sharing of resources are also available in the setup. In most of the multi-robot manipulator system environments the synchronization of the systems are of great importance. The proposed single host controlled system is capable of integrating many available add-on peripherals as well as easy implementation of control and communication algorithms.

The communication controller sets-up a communication link to the ROVs/DTVs by packetizing information such as control parameters, controller identification number, error check bits, headers etc.. All the undesirable problems of common nature encountered in underwater communication due to multipath propagation effects leading to time-spreading can be alleviated by incorporating spread spectrum techniques. The spread spectrum technique adopted in this system will eliminate all multipath and doppler effects encountered in undersea communication scenario by adaptive filtering and receiver tuning.

The front end of the robot controller is capable of establishing a communication link with the host. The robot link controllers are implemented with microcontrollers and actuators. The link controllers are capable of generating the drive signal, sensing the home, power, position, overload and stall conditions of each link. All these link controllers communicate with a coordinating processor which interacts with the communication controller and is responsible for managing the system.

The host system tracks and updates all global information on the status of all the manipulator arms in the network and generates the required commands and controls.