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*Editorial*

# Underwater Wireless Sensor Networks

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More than 70% of the earth surface is covered with water. To explore and make use of this vast unexplored aquatic environment, new technologies provide us with a number of applications such as pollution monitoring, disasters prevention, and tactical surveillance for scientific, environmental, and military purposes. However, due to unique characteristics such as large propagation delay, low communication bandwidth, node mobility, and high error rate, novel solutions considering the unique features of underwater environment are greatly demanded.

This special issue presents recent schemes for underwater networks, especially featuring current and future research waypoints in the field of underwater wireless sensor networks.

In the paper titled "Orthogonal Regression Based Multihop Localization Algorithm for Large-Scale Underwater Wireless Sensor Networks," proposed by Y. Ren et al., a 3D multihop localization scheme for underwater wireless sensor networks is introduced. The authors construct a 3D multihop localization model and propose an orthogonal regression method to determine the optimum value of regression vector. This value can be used to improve the accuracy of localization.

S. Tsuyoshi et al. present a developed wireless sensor network system in their paper titled "Development of Underwater Monitoring Wireless Sensor Network to Support Coral Reef Observation." The authors define required functions of a wireless sensor node for gathering information on a coral reef environment. Their experimental results in the coral reef are described, using a prototyped hardware.

In the paper titled "UA-MAC: An Underwater Acoustic Channel Access Method for Dense Mobile Underwater Sensor Networks," proposed by C. Lv et al., a TDMA based underwater acoustic channel access method for dense mobile underwater wireless sensor networks is presented. A new MAC scheme defines a preverified template and improves the channel utilization and eliminates the hidden terminal problem.

A forwarding protocol for underwater wireless networks is introduced in "Relative Distance Based Forwarding Protocol for Underwater Wireless Networks" proposed by Z. Li et al. The proposed protocol uses a relative distance to utilize a fitness factor. Based on the factor, the protocol can confine the scope of candidate forwarders and find beneficial relay nodes to forward packets.

S. Lee and D. Kim present fast retransmit techniques over flooding-based routing protocols in their manuscript "Two Fast Retransmit Techniques in UWSNs with ACK Indiscretion Problem." The authors newly define an ACK indiscretion problem and propose two fast retransmission techniques to address the problem. Based on a new sequence number or a number of duplicate ACKs expected to be received, the source nodes can perform fast retransmissions correctly.

The paper titled "SLSMP: Time Synchronization and Localization Using Seawater Movement Pattern in Underwater Wireless Networks," proposed by S. Kim and Y. Yoo, describes characteristics of seawater movement and error factors of existing time synchronization schemes. New

time synchronization and localization schemes contribute to improving accuracy based on Kalman and Averaging filter.

An energy-efficient routing protocol for under harsh underwater is proposed by M. Xu et al. in "An Energy-Efficient Routing Algorithm for Underwater Wireless Sensor Networks Inspired by Ultrasonic Frogs." The authors define a gravity function to represent attractiveness from one sensor node to another node. According to the gravity function, sensor nodes adopt different transmission radii for the purpose of energy saving.

The paper titled "Optimizing of Iterative Turbo Equalizer for Underwater Sensor Communication," proposed by J. W. Jung and K. M. Kim, provides an interactive turbo equalizer algorithm consisting of inner code and outer code to address reflection of sea level and sea bottom. Based on these codes, the algorithm reduces intersymbol interference and multipath error.

The paper titled "Passive Acoustic Source Tracking Using Underwater Distributed Sensors," proposed by S.-Y. Chun and K.-M. Kim, presents an acoustic source tracking algorithm for underwater channel to estimate location of the source correctly. A new algorithm matches interference patterns at each of sensor nodes and calculates a distance ratio between the source and nodes. Based on the distance and hyperbola equation, location of the source can be estimated.

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