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Three-dimensional wireless ad hoc and sensor networks 2016

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Distinct difference between two- and three-dimensional spaces has led to new research challenges to provide self-organizing communications for wireless ad hoc and sensor networks. Therefore, conventional approaches to extend or modify the existing schemes in two-dimensional space cannot meet the specific requirements for three-dimensional networks. Instead, a new design and its implementation are usually demanded to accelerate deployment in real world.

Based on research motivation, our previous Special Issue in 2014, "Three-dimensional wireless ad hoc and sensor networks," seems successful in points of presenting the existing research efforts and attracting the interests from the community. In accordance with achievement, we intend to organize the second Special Issue for the same research area. While previous Special Issue was supposed to address the fundamental design issue, more practical approaches which contribute to advances in three-dimensional wireless ad hoc and sensor networks are our major objective.

While considering our objective, editors believe that this Special Issue provides collection of articles on networking technique in three-dimensional ad hoc and sensor networks. We have selected 7 valuable papers out of 12 submissions in several aspects such as relevance to Special Issue and novelty of solution. The topic of these papers is roughly categorized into following areas: error detecting, localization, routing protocol, application, and simulation tool.

In the first paper titled "A hybrid decoding of Reed–Muller codes," Shuang Li et al. proposed hybrid decoding algorithm for Reed–Muller (RM) codes to decrease the number of floating-point multiplications significantly. The proposed algorithm reduced computational complexity for decoding of RM codes by terminating recursion procedure in earlier stage. A simplified maximum-likelihood (ML) decision based on fast Hadamard transform (FHT) is another source of low complexity. Simulation results were given to prove the improved performance of error correction as compared to conventional algorithms.

Next two papers are related to localization problem. One is for Bluetooth and the other for wireless sensor networks. In the second paper titled "Three-dimensional positioning system using Bluetooth low-energy beacons," Hyunwook Park et al. introduced three-dimensional positioning scheme for Bluetooth. The proposed scheme used Bluetooth low-energy (BLE) beacons to estimate the distance and calculated three-dimensional coordinates based on three-dimensional triangulation. A proposed scheme measures three-dimensional location of moving nodes by employing four fixed position beacon nodes to form random sphere to collect position of each node. Simulation results reveal that the proposed method can reduce distance error rate rather than the existing two-dimensional triangulation method. In the third paper titled "A distance-based maximum likelihood estimation method for sensor localization in wireless sensor networks," Jing Xu et al. studied node localization in wireless sensor networks since conventional maximum-likelihood estimation (MLE) scheme based on received signal strength indicator (RSSI) failed to reflect the physical characteristics properly. To address this issue, in this paper, distance-based MLE (DB-MLE) to consider measurement errors was formulated as a complicated nonlinear optimization problem. Furthermore, two solutions based on first-order optimal condition and two-dimensional search method were presented. Simulation results showed that DB-MLE provided higher localization accuracy than the other methods.

In the fourth paper titled "Autonomous drone for delay-tolerant networks in indoor applications," Radosław O. Schoeneich et al. introduced interesting idea and application of autonomous drones as mobile message ferries in delay-tolerant networks. In order to prove applicability, universal software architecture of drone based on Android devices and its detail prototype were presented. This implementation was tested with the autonomous movement and observed to pass all relevant tests.

In the fifth paper titled "Cooperative downloading in mobile ad hoc networks: a cost-energy perspective," He Li et al. presented another interesting application, cooperative downloading. To improve file downloading, contents are distributed by the help of mobile

terminals which form mobile ad hoc networks during download process. Since content distribution is affected by the efficiency, cost, and energy consumption of cooperative downloading, optimizer of cost distribution (OCD) algorithm and optimizer of the content distribution based on auction (OCDA) for mobile ad hoc networks were proposed. This algorithm is based on relative location of nodes and local optimization theory. The simulation experiment showed that the cost distribution was fair as well as content distribution had higher downloading efficiency and lower energy consumption.

In the sixth paper titled "Randomized geographic-based routing with nearly guaranteed delivery for three-dimensional ad hoc network," Alaa E. Abdallah et al. proposed four different randomized geographic-based routing algorithms. The new protocols, 3DRanDom, 3DRanDomProb, G_3DRanDomProb, and G_3DRanDomProb_G, improve performance in the aspects of guaranteeing delivery ratio, low overhead, and low path dilation in three-dimensional environments. These protocols are correlated and switched to one of them adaptively according to network conditions. Experimental results revealed that these hybrid randomized routing algorithms on three-dimensional mobile ad hoc networks can achieve nearly guaranteed delivery while discovering routes significantly closer in length to the shortest path and with low overhead.

In the last paper titled "A survey on network simulators in three-dimensional wireless ad hoc and sensor networks," SeokYoon Kang et al. overviewed the existing network simulators which are used to evaluate performance of protocols for airborne ad hoc networks and underwater sensor networks. The major features of existing simulators are described and compared. In addition, outstanding mobility models for each network are described.

Finally, we appreciate all authors, reviewers, and editorial members for their invaluable contribution. Without their hard work and dedication, it would have not been possible to select these high-quality papers within the give time limits of this Special Issue.

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