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Editorial

Deployment and Tracking in Distributed Sensor Networks

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Distributed sensor networks have the potential to provide unique capabilities for health surveillance, robot navigation, and environmental monitoring. The sensor nodes should be efficiently deployed in a predetermined region since the accuracy of the information depends on the quality of coverage within the sensing region. So deployment is fundamental issue in distributed sensor networks. The deployment strategies are quite different in different situations, such as obstacle-resistant deployment, deployment in heterogeneous/homogeneous sensor network, relay node deployment, and robust deployment of dynamic sensor networks. So the deployment is a challenging research direction in distributed sensor networks.

One of the most widely envisaged applications of distributed sensor networks is surveillance. The surveillance applications must be able to detect and track a target. So the tracking is an important issue in distributed sensor networks. Since the distributed sensor networks have distinctive features such as limited resources, collaborative tracking, and low energy consumption, the traditional tracking algorithms cannot be used in the distributed sensor networks. The tracking has comprehensive research foreground in distributed sensor network.

The main objective of this special issue is to explore innovative, exciting, and fresh ideas for tracking and deployment algorithms and tracking systems. Out of 40 submissions, 17 exceptional contributions were finally selected after several rounds of review by the invited reviewers and the guest editors.

The paper by O. E. Segou and S. C. A. Thomopoulos presents an extensive study of indoor tracking based on the chirp spread spectrum (CSS) specification and an associated analytical framework that allows comparisons to be made between different deployments. A novel topology-based smoothing algorithm that takes into account the dilution of precision in each axis and the extracted error models is proposed. This algorithm managed to alleviate the effects of DoP and greatly improved tracking performance in the highest percentiles of error.

In the paper "*Variational inference of Kalman filter and its application in wireless sensor networks,*" the authors propose an improved Kalman filter algorithm by using variational inference. Simulation results show that the variational approximation is effective and reliable for the linear state space, especially for the case with time-varying non-Gaussian noise.

M. Rebai et al. develop a branch and bound (B&B) algorithm to solve the 2-dimensional critical coverage problem optimally. This algorithm attempts to determine the optimal placement of networked sensors allowing total sensing area coverage such that each sensor device can find a connection path (i.e., a set of connected sensors) which reaches the sink.

In the paper "*Level set based coverage holes detection and holes healing scheme in hybrid sensor network,*" the authors firstly propose a level set based coverage holes detection algorithm for hybrid sensor network. Then genetic algorithms based coverage holes healing algorithm is proposed. Simulation results show that the proposed method could detect the holes efficiently.

X. Jiang et al. propose an energy-efficient node selection algorithm for bearings-only sensors in decentralized sensor networks. The residual energy of a node is incorporated into the objective function of node selection. A new criterion of node selection is also made to coordinate with the objective function.

In the paper "*Energy-efficient target tracking in wireless sensor networks: a quantized measurement fusion framework,*" the quantized measurement fusion via both augmented approach and weighted approach is investigated. For both approaches, the closed-form solution to the optimization problem of bandwidth scheduling is given, where the total energy consumption is minimized subject to a constraint on the fusion performance.

G. Han et al. compare the localization algorithms (distance vector-hop, a new localization algorithm for underwater acoustic sensor networks, large-scale hierarchical localization, and localization scheme for large-scale underwater networks) in terms of localization coverage, localization error, and average energy consumption. Besides, they analyze the impacts of the ranging error and the number of anchor nodes on the performance of the localization algorithms.

In the paper "*Distributed movement control for building a ring in mobile wireless sensor networks,*" the authors try to research the problem of moving sensors to achieve a ring-based shape with minimum moving distance. The optimal sensor layout with random deployment is firstly presented. Then, they propose a fully distributed sensor redistribution algorithm in mobile sensor networks.

H. Woo and C. Lee propose a geometric range-free localization algorithm which estimates the unknown positions geometrically by topological information without considering the distance estimation. To achieve this, they propose an optimal anchor node selection algorithm which selects the anchor nodes connected topologically well for the geometrical location estimation.

In the paper "*Grid-based improved maximum likelihood estimation for dynamic localization of mobile robots,*" an autonomous-dynamic localization system which dynamically chooses beacon node and establishes grids is proposed. This method applies received signal strength indication (RSSI) for distance measurement. Furthermore, the proposed grid-based improved maximum likelihood estimation (GIMLE) fulfills the localization. Finally, the localization error correction is implemented by Kalman filter.

J.-I. Kong et al. propose an energy-efficient clustering algorithm that can respond rapidly to unexpected events with increased energy efficiency, because each sensor node detects events individually and creates clusters using a regional competition scheme. Simulation results show improved performance when the proposed algorithm is used.

R. Marcelín-Jiménez et al. present a GPS-free localization method consisting of four stages that are executed only once during the network initialization process. These stages are aimed at increasing the overall system lifetime by reducing the signaling overhead commonly involved in distributed localization procedures. The proposed localization method turns the initial and complex node deployment to several smaller instances by dividing the network into clusters.

In the paper "*An enhanced tracking algorithm for distributed encoding fiber Bragg grating sensor network,*" enhanced tracking algorithm for distributed encoding FBG sensor network is presented. This algorithm uses three classes of progressive intelligent processing approaches, including the improved cycle matching method, the secondary filter intelligent disposal method, and the assistant decision processes method, to conquer the limitations of the traditional tracking algorithm in which the chaos and error results would be caused as the sensor information variations are overlapped.

In the paper "*A novel robust tracking algorithm in cluttered environments for distributed sensor network,*" a novel robust tracking algorithm to mitigate the measurement noise and NLOS error is proposed. The robust localization method is firstly employed to estimate the positions of the mobile node. Then the residual test method is used to remove the larger localization error. Finally, the modified Kalman filter is introduced to improve the tracking accuracy. Simulation results show that the proposed filter can track the mobile node accurately.

Z. Zhang et al. propose a windowed time reversal (WTR) method for distance measurement between the wireless sensor network (WSN) nodes. In the WTR, the main lobe of the channel response is captured by a window. WTR not only takes advantage of the spatiotemporal focus features of TR but also compensates the multipath effect to eliminate various factors from the environment. WTR method can realize the spatiotemporal focusing which can effectively collect the multipath interference energy, improve the signal-to-noise ratio, and reduce intersymbol interference in arbitrarily complex and inhomogeneous environments.

The paper "*A novel mobile localization method for distributed sensor network with non-line-of-sight error mitigation*" presents a novel mobile localization method for distributed sensor network in NLOS propagation scenarios. The transition between the LOS and NLOS is described by two state Markov models. The interacting multiple model frames are employed to estimate the position of unknown node. Finally the probability data association algorithm is used to filter the estimated location.

X. Hu et al. propose energy balanced scheduling method for distributed target tracking with distance-dependent multiplicative observation noise. This algorithm uses the energy balanced criterion to select cluster head and the subset of sleep nodes to extend WSN network life span. This subset selection problem is formulated as a nonlinear multiobjective constrained optimization problem and an effective heuristic polynomial time algorithm is proposed.

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