

AN IMPROVED GbLN-PSO ALGORITHM
FOR INDOOR LOCALIZATION PROBLEM
IN WIRELESS SENSOR NETWORK

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ABSTRAK

Jaringan Sensor Tanpa Wayar (WSN) menjadi bidang penelitian yang penting. WSN terdiri daripada sekumpulan nod pengesan yang berhubung antara jangkar (nod yang mempunyai maklumat kedudukan) dan nod yang tidak diketahui kedudukannya. Nod pengesan ini, memiliki kemampuan untuk meninjau keadaan lingkungannya, melakukan komputasi yang terhad dan berkomunikasi secara tanpa wayar dengan nod yang lain. Cabaran dalam WSN adalah untuk menganggarkan kedudukan nod yang tidak diketahui kedudukannya, di mana terdapat masalah ralat dalam pengiraan jarak antara nod. Kewujudan masalah ralat dalam fasa anggaran jarak yang disebabkan oleh gangguan dalam ukuran julat, memberi kesan kepada proses penentuan lokasi nod. Oleh kerana itu, teknik lokalisasi yang terbaik diperlukan untuk mengira posisi nod yang tidak diketahui secara tepat. Lalu, tujuan kajian ini adalah untuk meningkatkan ketepatan dalam menentukan kedudukan nod dan meminimalkan waktu yang diperlukan dalam proses lokalisasi nod. Untuk mencapai tujuan tersebut, algoritma Improved Global Best Local Neighborhood Particle Swarm Optimization (IGbLN-PSO) diterapkan. IGbLN-PSO berasal dari algoritma Global best Local Neighborhood Particle Swarm Optimization (GbLN-PSO) yang telah diimplimentasi pada masalah penentuan objek gambar. Algoritma GbLN-PSO telah membuktikan dapat meningkatkan ketepatan dan mengurangkan masa yang diambil untuk proses pengiraan selesai. Namun, mekanisme pencarian oleh GbLN-PSO perlu ditambah baik karena kaedah partikel jiran yang digunakan dalam algoritma GbLN-PSO hanya mencari nilai sepanjang perjalanan partikel dalam proses pencarian tanpa menghitung nilai optimal di sekitar partikel utama. Ini menyebabkan partikel akan mengira nilai yang sama dan boleh terperangkap sedangkan terdapat juga kebarangkalian nilai optimal wujud disekeliling partikel utama. Jadi, dengan membuat penambahbaikan kaedah algoritma GbLN-PSO yang dipanggil sebagai IGbLN-PSO, dapat meningkatkan potensi partikel jiran mencari kedudukan terbaik disekitar partikel utama. Hasil eksperimen akurasi dan komputasi lokalisasi dibandingkan dengan algoritma Particle Swarm Optimization (PSO), Differential Evolution Particle Swarm Optimization (DEPSO), Health Particle Swarm Optimization (HPSO) dan GbLN-PSO. Eksprimen dijalankan dengan meletakkan empat puluh (40) nod tidak dikenal lokasi di dalam 100×100 meter area. Tiga jangkar diimplementasi dan hasil eksperimen akurasi menunjukkan persaingan antara algoritma dimana IGbLN-PSO dapat meningkat 0.3% dibandingkan dengan GbLN-PSO dan 1.5% peningkatan dibandingkan dengan algorithm lain. Selain itu, eksperimen waktu komputasi lokalisasi pula meningkat sebanyak 88.88%, 90.99%, 89.75% dan 20.49% dibandingkan dengan PSO, DEPSO, HPSO dan GbLN-PSO.

ABSTRACT

Wireless Sensor Network (WSN) has become an important field of research. WSN consists of a group of wireless nodes connected between an anchor and unknown nodes. These wireless nodes have the capability to sense the surroundings, process the information and communicate with other nodes wirelessly. The challenging matter in WSN is to estimate the position of the unknown nodes, where there is the error in the distance calculation between nodes. The error in distance estimation phase, caused by noise in range measurement, effects the process of node location. Therefore, the best technique of localization to measure the position of unknown node is required. This study aims to increase the accuracy of node estimation and to minimize time taken for the node localization process. To achieve the stated aims, we implemented an Improved Global best Local Neighborhood Particle Swarm Optimization (IGbLN-PSO) algorithm. IGbLN-PSO algorithm, which is originally from GbLN-PSO algorithm, was applied in previous research into the object tracking problem and it was proved can gain high accuracy and lower the computational time. However, GbLN-PSO searching mechanism must be enhanced when applied into localization problem. This is because the neighbor particles keep searching in the same search space along the main particle's journey without calculating the optimum value around main particles. This makes the particle calculate the same value, and it may become trapped, while there is the possibility of optimum value around the main particle. Thus, we improved GbLN-PSO, known as IGbLN-PSO algorithm, where the neighbor particles are distributed around the main particle in every iteration to localize unknown node positions. Then, we compared the result with Particle Swarm Optimization (PSO), Differential Evolution Particle Swarm Optimization (DEPSO), Health Particle Swarm Optimization (HPSO) and Global best Local Neighborhood Particle Swarm Optimization (GbLN-PSO) algorithm. The experiment is set to localize forty (40) unknown nodes in 100×100 meter area. Three anchors were implemented and the experiments have shown that the accuracy result is competitive where IGbLN-PSO increased 0.3% and 1.5% compared to GbLN-PSO and others, respectively. For result computational time, IGbLN-PSO recorded an increased of 88.88%, 90.99%, 89.75% and 20.49% compared to PSO, DEPSO, HPSO and GbLN-PSO, respectively.

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