Hybrid Localization Scheme for Wireless Ad Hoc and Sensor Networks

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ABSTRACT

Wireless ad hoc and sensor network positioning has gained much research attentions for several years. In this paper, a hybrid localization scheme has been proposed which applies the benefits of low cost Received Signal Strength (RSS)-based ranging approach to Self Organizing Map (SOM)-based range free localization to get higher localization accuracy while reducing cost, power, anchor utilization and supporting dynamic node placements. Distance information as a function of RSS has been utilized in the learning steps of SOM-based algorithm to get more accurate location estimates in a few steps. Each SOM winning node exploits the difference between estimated distance and RSS-based distance to each neighbor node to calculate the revising vector for that neighboring node. Then, neighboring nodes' location are updated using associated vectors. To smooth out the RSS instability, a mean filter has been utilized and the RSS output from that filter has been used as a function for certainty of distance estimation. Impacts of obstacles and irregular network shape have also been considered in the proposed solution. Simulations on various network topologies, node density and anchor utilization have been carried out and results show that our proposed scheme outperforms several existing algorithms in both isotropic and anisotropic environments. While hop count based approaches show acceptable accuracy only on regular node density due to the hop distance estimation error, high location accuracy can be achieved for networks with mere to dense node density by using our proposed scheme. As well, problem of larger number of anchor utilization requirement in RSS-only based approaches has already been solved in proposed solution. Especially, proposed hybrid scheme has reduced the SOM learning steps into just tens of steps compared to thousands of steps in classical SOM based approaches. Achieving tradeoff between cost, power and accuracy is the main critical outcome of our research.

KEYWORDS: RSS, SOM, localization;