Accurate Wireless Sensor Localization Technique Based on Hybrid PSO-ANN Algorithm for Indoor and Outdoor Track Cycling

This paper aims to determine the distance between the mobile sensor node (i.e., bicycle) and the anchor node (i.e., coach) in outdoor and indoor environments. Two approaches were considered to estimate such a distance. The first approach was based on the traditional channel propagation model that used the log-normal shadowing model (LNSM), while the second approach was based on a proposed hybrid particle swarm optimization-artificial neural network (PSO-ANN) algorithm to improve the distance estimation accuracy of the mobile node. The first method estimated the distance according to the LNSM and the measured received signal strength indicator (RSSI) of the anchor node, which in turn used the ZigBee wireless protocol. The LNSM parameters were measured based on the RSSI measurements in both outdoor and indoor environments. A feed-forward neural network type and the Levenberg-Marquardt training algorithm were used to estimate the distance between the mobile node and the coach. The hybrid PSO-ANN algorithm significantly improved the distance estimation accuracy more than the traditional LNSM method without additional components. The hybrid PSO-ANN algorithm achieved a mean absolute error of 0.022 and 0.208 m for outdoor and indoor environments, respectively. The effect of anchor node density on localization accuracy was also investigated in the indoor environment.