

Identification and mitigation of non-line-of-sight path effect using repeater for hybrid ultra-wideband positioning and networking system

ABSTRACT

At least two decades ago, various applications have been proposed for the implementation of ultra-wideband (UWB) technology, but only a few of them are being realised such as radar detection, home networking, and indoor positioning. Although UWB positioning offers precise locality tracking, the accuracy of the estimation is greatly affected by the non-line-of-sight (NLOS) path effect. In this paper, we propose a hybrid indoor UWB positioning and networking system that utilises the existing repeater of the data network to eliminate the NLOS paths. A switching algorithm is written to identify the existence of NLOS paths based on received signal strength (RSS) and unique channel characteristics such as mean excess delay (MED) and root mean square (RMS). From the simulation results, the NLOS paths have been successfully identified under the NLOS environment. Hence, a higher probability of accuracy across the entire tested area can be achieved for the UWB positioning system by mitigating the NLOS path effect using the proposed algorithm. Besides that, the transmission of the line-of-sight (LOS) signal attains a data rate of around 15 times higher than the NLOS signal at a bit-error-rate (BER) of 10^{-5} in the indoor networking system. In this case, the minimum-bit-errorrate (MBER) receiver is again shown to outperform the minimum-mean-square error (MMSE) and the performance gain drops around 5 dB to 6 dB at a BER of 10^{-5} when the repeaters increase to a maximum number of 10 units. In conclusion, the proposed method is capable of mitigating the NLOS path effect on both indoor positioning and data networking systems.