Presented at the DLSU Research Congress 2014
De La Salle University, Manila, Philippines
March 6-8, 2014

# Accuracy Enhancement Performance of Least Mean-Squares Filter on Root-MUSIC-Extracted Direction-of-Arrival Estimates for Passive RFID Application

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**Abstract:** The study aimed to enhance the accuracy of Root-MUSIC direction-of-arrival (DoA) estimates of a passive radio frequency identification (RFID) tag system with a reader that utilizes a two-element uniform linear array (ULA). The enhancement of accuracy was made by using an adaptive filter called least mean squares algorithm (LMS) to reduce the effect of noise and carrier leakage before extracting the DoA estimates through root-multiple signal classification (root-MUSIC) algorithm. Initially, through the use of a simulation in MatLab®, random complex signals from angle bearings negative 90 through positive 90 degrees are established, including noise and carrier leakage added and characterized as additive, white, Gaussian-distributed random variable. An LMS filter, with step sizes of 0.005, 0.002 and 0.001, was designed to reduce the inaccuracy of the estimates by filtering the distortion-afflicted complex signal obtained at the front end of the receiver of the model established. Results of the estimates were compared to the actual DoA of the tag by measuring the discrepancy in degrees as root-mean-square error. Observations have also been done in the case when signal-to-noise ratio (SNR) of the received signal was changed, or when the number of iterations of the filter was varied to show how the convergence of the estimates to the true bearing of the passive RFID tag behaved in accordance to the said variations. The LMS filter has been very helpful in reducing the error in extracting the estimates and the DoA estimates converged to its real value when the step size of LMS is 0.001.

**Key Words:** Direction-of-arrival, root-MUSIC, adaptive filtering, least mean-squares, passive RFID