Artificial Neural Network Based Target Localization Method for Multi-Static Passive Radar Systems

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The rise in terrorism has increased concerns regarding aerial security. Major geographical areas are currently safeguarded by specialized active radar systems that detect, locate, and track both foreign and domestic aircraft. However, coverage is limited due to the high-cost and low-covertness of the said system. With current approaches, passive radar systems reduce the cost and increase covertness by utilizing available broadcast signals. However, passive systems fail to accurately locate and track targets, so an artificial neural network based target localization method is proposed for a multi-static passive radar system consisting of multiple illuminators, a radar receiver, and a single target. Assuming a multi-frequency network, the time-difference-of-arrival (TDOA) of signals coming from each illuminator via the target path and the direct path was estimated from the cross-ambiguity function. The training data consisted of estimated TDOAs corresponding to each illuminator and each assumed target location. These estimated TDOAs were then used to train a feedforward neural network. The network's performance was evaluated with the test data, wherein 10% of the total data was randomly chosen as test data. Simulation results showed that the machine learning method achieved a low mean squared error value even at low signal-to-noise ratios. This success at target detection and localization indicates potential applications in aerial surveillance and security upon large-scale deployment.