Modeling of a Retrodirective Channel With Active Antenna Arrays for Cross-Eye Jamming

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Abstract

Cross-Eye (CE) jamming is a technique aimed at inducing false target angles in radar measurements. The potential to deceive monopulse radar, a radar type commonly used due to its angular accuracy and resilience against jamming, has captured the interest of Electronic Warfare (EW) system manufacturers. CE jamming may increase the capability of self-defense against radar guided missiles.

In this thesis, a CE jammer, based on the retrodirective channel design, for use in an EW systems is modeled and analyzed. The focus of the analysis is on the non-reciprocal Active Electronically Scanned Arrays (AESA). An electrical model of the jammer system and the AESA, including variations in the electrical properties, together with three different system correction methods are used. A simulation procedure, using single frequency (CW) signals, is defined and used for estimating total level of reciprocity, which is a primary contributor to jammer performance. Reciprocity error sensitivity for variations in model parameters is simulated to indicate which AESA aspects are essential for performance. Further, the influence of characterization and calibration noise is investigated.

The usability of the model is demonstrated in different types of simulations, which highlights the differences between the system correction methods. Simulations show that a relatively high level of reciprocity can be achieved when using system correction, if measurement noise and model limitations are disregarded. The expected degradation in reciprocity from differences in electrical properties between the reception and transmission branch of the AESA has been confirmed. The effect of characterization and calibration noise, for realistic levels of noise, seems to be a dominating factor in the total reciprocity error. A significant increase in reciprocity error can likely be expected when non-CW signals are used and when realistic levels of noise and non-linear effects are added.

Key Words

electronic warfare, antenna array, antenna system, radar countermeasures, jamming, cross-eye, systems modeling, system performance, systems simulation