

Establishing Antenna and Signal Requirements for Mobile Low-RCS Targets using PRN Modulated Pulsed Radar Systems

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Monostatic radar detection systems for low RCS objects have return signals that are expected to be below (or close) the noise floor for distances of 1 km. Using simple analysis, a cross section of 100 cm^2 at 3 km has a returned power level of -111 dBm when using a 1 watt 20 dBi transmitter at 30 GHz; this is already 20 dB below noise level. One possible solution to make these echoes detectable is to modulate the transmitted signals with a pseudo random noise (PRN) code, and consequently to detect the received spread spectrum signal through autocorrelation in a manner similar to the processing done by GPS receivers (P.W. Ward, J. W. Betz, and C. J. Hegarty, Understanding GPS: Principles and Applications, Artech House, 113-122, 2006). This paper, will explore the basic requirements for antennas and signals associated with a PRN modulated pulsed radar system (Fig. 1) through analysis and simulation of this new approach.

The preferred antenna for this application would need to be electronically steerable with high gain and a very narrow beamwidth operating at mm wave frequencies. Analysis has shown that for a specified detection distance, the beam should be narrow enough so that there is only one reflected ray path for each position of the beam, ensuring minimum phase error due to propagation length differences. A design procedure for establishing beamwidths based on the above criteria will be presented.

Signal design requires values for the radar system includes pulse repetition period, transmitter-on time, and receiver-on on time; this is based on several variables including minimum specified target distance, scanning speeds, PRN code chipping time, and estimated signal processing time. Procedure used in establishing signal parameters for this approach will also be presented.

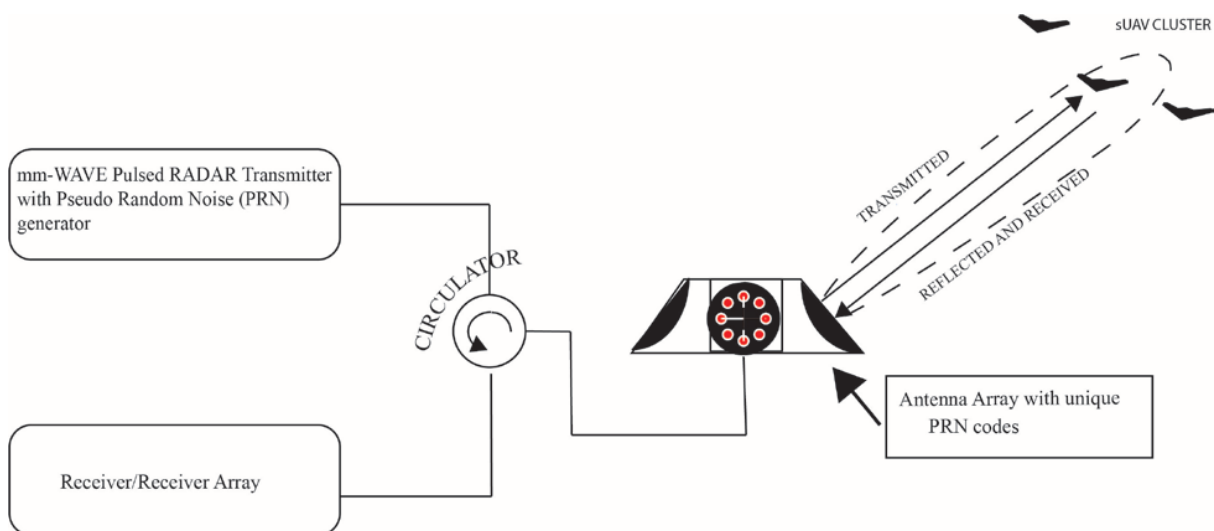


Figure 1. Overview illustration for PRN modulated pulsed radar system.