RF Simulators Emerge to Test Next Generation Phased Array Radar Systems

The next generation of phased array radar systems currently being developed by military research laboratories and major defense contractors is expected to eliminate shortcomings in older systems for faster target detection, higher detection sensitivity, and clutter mitigation.

As a result, this research and development is concurrently driving demand for commercial testing and quality assurance products designed to simulate RF signals as they would appear in the field at varying distances and in more crowded urban environments.

Phased Array in the Military

For many decades, the military has utilized phase array radar systems to determine the range, altitude, direction, or speed of objects such as aircraft, ships, guided missiles, vehicles, weather formations and terrain. Today, most modern military radar systems are based on phased arrays.

Phase arrays are composed of evenly spaced antenna elements, each of which emits a signal that incorporates a phase shift to produce a phase gradient across the array. The amplitudes of the signals radiated by the individual antennas and the constructive and destructive interference caused by objects determine the effective radiation pattern of the array.

By digitally varying the signal phases and amplitude of the elements in an array – a process known as digital beamforming – the main beam can be “steered” to determine the direction of the signal source, even though the antenna does not physically move.

However, despite the growth of ever more sophisticated digital signal processing techniques and increasing bandwidth comes the need to improve the sensitivity and accuracy of the receiver element, which is usually located in the antenna along with the transmitter.

By improving the performance of the receiver, next generation products expect to improve the radar results in more complex, real world scenarios such as tracking a suspicious vehicle moving among many in a densely populated urban environment. This is due to signal attenuation that exists as the signal reflects and/or is absorbed by building materials such as wood, concrete, steel and glass. Rain, sleet, snow, fog, smog, and smoke also complicate radar results.

Multipath signals – radar results that reach the receiving antenna by more than one path – are another issue that next generation systems expect to address. These signals can cause ghost targets to appear that behave like the actual target, leaving the receiver and digital signal processing techniques to decipher the difference. New software encoded into the emitter and receiver is expected to help in this regard.

RF Signal Simulators

With more sophisticated receivers comes the need to test them during the research and development phase. Although custom one-off testing units are a possibility, the market is beginning to respond with commercial testing devices that simulate an RF signal as it travels and bounces off objects.

Renaissance Electronics & Communications, a manufacturer of RF and Microwave Sub-Systems and Components, is now offering a 6 x 6 (REC part number 18A6NAD) and 12 x 12 (REC part number 18A6NAC) Matrix with Programmable Delay Lines (PDL) and Attenuators designed to simulate RF signals for next generation systems.

The units synthesize both amplitude and phase to replicates a variety of phase array RF signals at different distances. Each of the available inputs can be programmed to synthesize a 30-2500 MHz RF signal that is electronically attenuated up to 91dB in 1 dB steps and to simulate signal propagation and absorption loss, along with delays up to 5 ns to simulate the natural effects of distance.

Armed with such RF signal simulators, military research laboratories and defense contractors will be able to move pass the “proof of concept” phase and verify the sensitivity and accuracy of the next generation of receivers.

For more information, contact Renaissance Electronics at phone (978) 772-7774 or on the web at www.rec-usa.com. They are located at 12 Lancaster County Road, Harvard MA 01451.