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Advantages of Propagation Path Replication for Radar Range Testing

by Joe Mazzochette, Eastern OptX

As radar systems become increasingly complicated, with improved range and resolution, performance verification testing is a costly challenge. The test capability must provide accurate and rapid results that match real-world situations. This capability must also provide test solutions for radar system development, verification, qualification, and production and calibration situations. The three common approaches to radar testing are:

- Range Testing
- Simulation
- Channel Replication

The strengths and weaknesses of these alternatives are well known, but some detail will help in determining the best method for a particular application.

Range testing is probably the most comprehensive approach since it duplicates the real-world environment. Frequently used for final or system acceptance test, the range test can be conducted with actual targets or strategically located corner reflectors. This method is not well suited for development work, which requires many tests over extended periods. The variable nature of the range environment also creates uncertainties in the test results. This uncertainty makes it difficult to be certain that a change in a test result is due to a design change or a change in the test environment.

Other drawbacks associated with range testing include cost, weather related problems, health hazards, environmental restrictions, radiation regulations (FAA, FCC, etc.), and program delays.

Simulation is a great alternative to range testing. Simulations eliminate the cost and environmental issues associated with range testing. They aid in system development. The measurements are repeatable and consistent. One difficulty with simulations is that they require some knowledge of the radar system architecture to function correctly. It is difficult to create a universal simulator, or one with wide frequency bandwidth and dynamic range.

Propagation Path Replication (PPR) is a variation on the simulation approach. Like simulation,

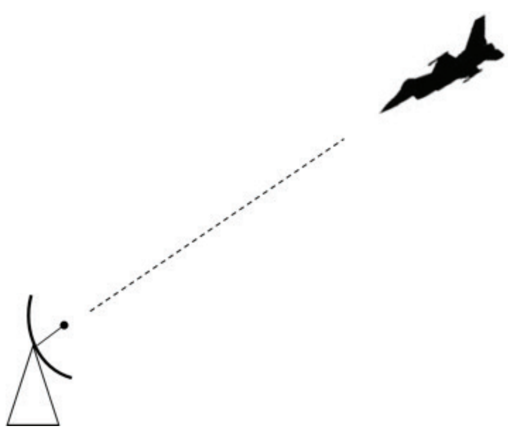

Figure 1: Radar range testing

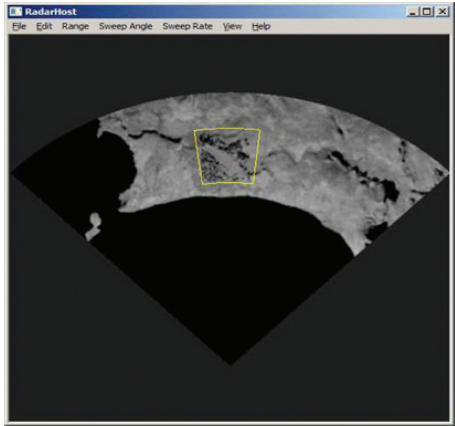

Figure 2: Radar simulation (METaVR real-time 3D visual simulation tool)

PPR testing can be done in a controlled laboratory environment without signal radiation, logistical problems, and delays associated with range testing. PPR reproduces the normal environment associated with the real-world radar application, including multipath (clutter), moving targets (Doppler), multiple targets, path loss, variable attenuation, and delay.

The PPR approach is broad-band (up to > 20 GHz instantaneous BW), has minimal latent delay, requires no information about the radar system modes of operation, is expandable to include intentional and unintentional interferers, and provides more than 120 dB of dynamic range.

Eastern OptX's broadband construction for the PPR is based on optical fiber spools to build the target propagation path and multipath delays. Optical fiber is lightweight, low cost, rugged, and low loss. A typical 1U, 19-inch chassis can provide target distances up to 35 km. Moving target Doppler generation, vector modulator, propagation loss, radar cross section, and system antenna gain are all incorporated into the loss model.

The typical PPR system GUI (graphical user interface) includes target distance and speed control, system gain settings, propagation loss factors, longitude/latitude target position input, and multipath selection.

This PPR approach can create moving target scenarios by coupling the variable delay with the Doppler generation. Scenarios begin with an initial target longitude, latitude, and altitude, a transit target speed, and a destination longitude, latitude, and altitude. Multiple scenarios may be stitched together to create a complete moving target test pattern.

In conclusion, the PPR provides a compelling alternative to radar range and simulation testing. Versatile features make the PPR useful for many radar system types. They operate at any radar transmit frequency, pulsed or CW, with any modulation scheme, with any encryption, and with frequency agile systems. A versatile laboratory tool, the PPR accommodates system optimization, troubleshooting, production testing, and calibration.

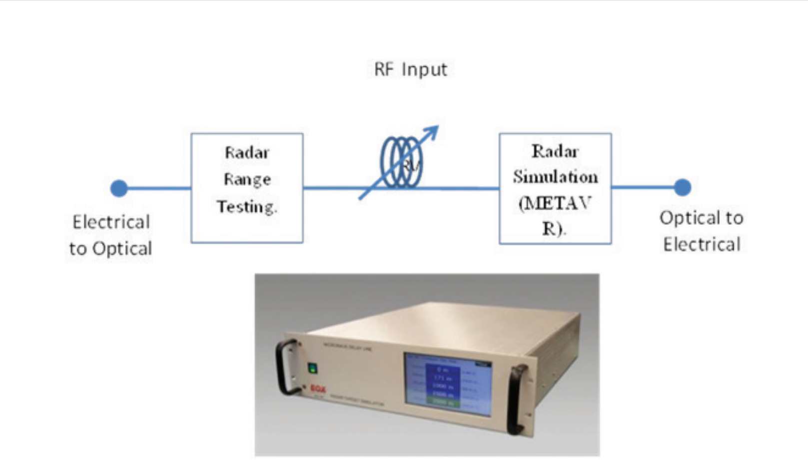

Figure 3: Typical fiber optic Propagation Path Replication (PPR)

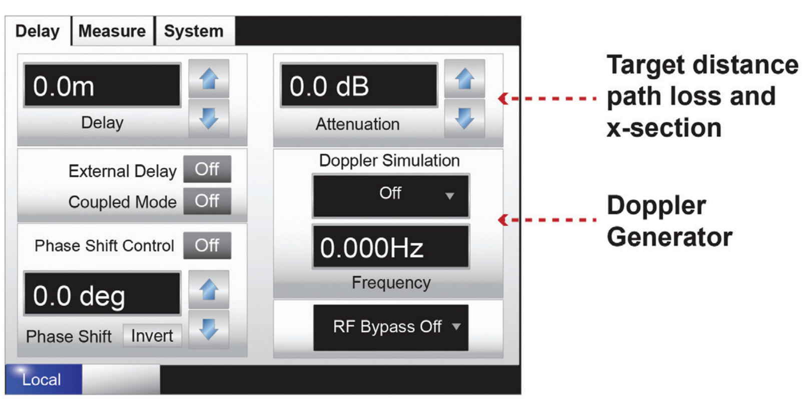

Figure 4: Typical fiber optic PPR GUI

For more information about radar range testing, contact Eastern OptX at (856) 231-0668 or www.eastern-optx.com

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