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Hardware-In-The-Loop Simulators

Today's threat and National Missile Defense initiative requires strategic radar systems to operate in a myriad of ionospheric and atmospheric conditions heretofore not considered and/or tested. Ionospheric scintillation resulting from spaceweather or from nuclear weapons effects is well recognized. Its affect on radar performance is well documented and modeled with high fidelity. Mission Research Corporation (MRC) has worked with the Defense Threat Reduction Agency (DTRA) developing Hardware-in-the-Loop (HWIL) simulators for strategic radar assets. MRC and DTRA support the use of these directly connected simulators because they test the maximum operational hardware and software and directly evaluate actual radar performance under man-made or naturally occurring environments.

The Radar Nuclear Effects Corruptor Simulator (RNECS) is a HWIL test station used to evaluate BMEWS and PAVE PAWS strategic radar performance in nuclear and naturally scintillated environments. Severe ionospheric scintillation can cause radars to create multiple tracks for the same target, produce range, track and angle errors and potentially overload the radar's processors. Natural scintillation caused by space weather can impact radar performance as well, although less severely. RNECS is phase-locked to the radar operating frequency and precisely synchronized with each radar resource period. Using a simulated missile fly-out scenario developed off-line, a Radio Frequency (RF) scene is simulated and injected into the radar receiver equipment, in real-time. The radar is fully operational as it detects, acquires and tracks the simulated ballistic targets. This test capability is sometimes referred to as "SIM-Over-Live".

DTRA's RF target injection methodology requires no modifications to the radar under test, uses the actual radar hardware and operational software, and thoroughly evaluates the radar's performance in intended operational environments. This methodology also directly involves the radar operators, allowing them to see how the radar performs under realistic ionospheric conditions.

The need for independent, validated and effective operational test capability cannot be underestimated. The DoD-owned RNECS Test Station offers a truly independent and comprehensive test and evaluation capability. Utilizing existing, proven DTRA models and equipment significantly reduces the risk and attendant cost.