FROM SENSING TO MAKING SENSE

Description And Utility Of The Chemical/biological System Of Systems Optimization Tool (cbsosot)

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The JPEO CBRN Defense concept of Integrated Layered Defense is predicated on CBRN sensing to provide early warning to the force and characterize the nature, extent, and duration of potential and actual threats. Situational awareness contributes to the National Defense Strategy pillar of building a more lethal force by collecting and assimilating information from sensors in near-real time to characterize the CBRN hazard to the force commander. CBRN detection involves the overlap of sensing and battlespace management and is integral to CBRN Support to Command and Control (CSC2) and Joint All Domain Command and Control (JADC2).

The challenge in fusing CBRN detection with battlespace management is addressing the inherent tradeoffs in sensor modalities, numbers, and placement to characterize the battlespace and inform actual and potential impacts of CBRN hazards. A system of systems modeling approach provides a methodology and tools to examine the technical and operational trades in performing “detect to warn” and “detect to treat” missions based on high-fidelity threat, sensor, and human performance modeling.

There are many currently available chemical/biological models for evaluating system performance. However, these models focus on hazard prediction and system communications and DO NOT provide high-fidelity representations of detection systems. The lack of fidelity in these representations results in false reporting of system performance and does not consider the adverse effects interferents, weather and terrain have on detection performance. Our proposed tool environment, the Chemical/Biological System of Systems Optimization Tool (CBSoSOT) is designed so that high-fidelity, physics-based detector and human performance models can interface with high-fidelity environmental models in a modular fashion via simulation standards. Our approach leverages past CBDP investments in modeling and simulation and provides a mode-based system engineering approach to sensor development, algorithm development at the sensor, node, and network levels, and ConOps development by placing sensors and personnel in realistic and measurable environments. This will enable optimization of current/proposed systems to increase warning time, minimize logistical and cost burdens of reconnaissance missions and provide a more accurate and relevant Common Relevant Operating Picture.

CBSoSOT includes high-fidelity representations of point chemical detectors, passive standoff detectors, and active standoff detectors. The sensor representations are instantiated within a simulation environment which propagates the various components of the application (sensors, environment, threat clouds, etc.), keeping them synchronized in simulation time. A data fusion engine ingests each sensor report as it arrives from the various sensor models and updates its fusion threat map accordingly. A performance calculator function produces sensor and system performance reports as defined by the user. The modular tool design enables straight forward integration of other threat, sensor, and data fusion models to ensure the most accurate representation of proposed detection systems. Our work demonstrates the utility of a simulated SoS detection system.

CBSoSOT will benefit the chemical/biological test and evaluation community with faster, more efficient testing that will provide more robust understanding of the capabilities and limitations of CB warfare agent detectors than with current methods, resulting in faster, less expensive, and more accurate system development and deployment.