ADVANCED REACTOR SAFEGUARDS & SECURITY

Advanced Sensor Fusion Using Low-Cost Sensors for Dramatic Physical Security Cost Reduction

Deliberate Motion Analytics
SBIR Phase I

PRESENTED BY

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Sandia National Laboratories | U.S. DEPARTMENT OF ENERGY

Project Information

- Project Type: DoE SBIR Phase I

- Principal Investigator: Carl Stern, PhD

- Project Title: Advanced Sensor Fusion Using Low-Cost Sensors for Dramatic Physical Security Cost Reduction

- SBIR Topic Number: C56-40.l

- Topic Title: Advanced Technologies for Nuclear Energy Advanced and Small Reactor Physical Security Cost Reduction

- **Company Name:** Management Sciences, Inc.
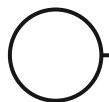6022 Constitution Ave NE
Albuquerque, NM 87110

SBIR Problem Statement

- AR and SMR (ASMR) offer benefits over alternatives due to compact designs
  - Emissions – Can be pivotal in efforts to reach net zero by 2050
  - Cost – Can be competitive with renewables and carbon alternatives
  - Utility – Build in factory and ship to customer site for electricity and process heat
- Today's regulatory requirements increase ASMR's levelized cost of electricity (LCOE)
  - Including physical protection requirements that increase costs & LCOE
- Impacting ASMR's potential competitiveness in energy markets
  - Making alternatives cheaper
- Proposed and draft regulatory changes are in the works to help lower LCOE
- **Make innovative DMA enhancements that support regulatory changes**
  - **Enabling new performance-based security designs**
  - **Lowering ASMR's LCOE and increasing competitiveness against alternatives**

Background

Site/sector PPS layout and sensor choices for nuclear power plants (NPPs) are driven by strict regulations, requirements, and approval

- Defense in depth and design basis threat meet requirements but increase costs

- Engineered detection area separated by two fences

- Motion sensors, infrared and electro-optical, radars, cameras, etc.

- Alarm station software (e.g., Vindicator, AIM, PICARD) notified via dry contact switch

PPS Cost Drivers and DMA Advantage

- Defense in depth and design basis threat meet requirements but increase costs
  - Multiple layers of detection, delay, and response increase complexity
  - Expensive site preparation (digging, power, comms, fencing)
  - Expensive sensors
  - Expensive monitoring
- All sensors suffer from high nuisance and false alarm rates (NAR/FAR)
  - Reducing confidence in the security system
  - Leading to complacency of staff monitoring alarms
  - Driving up operational costs (additional responders, time to evaluate alarms)
  - Excessive NAR/FAR leads to possible regulatory compliance issues, fines, or worse
- Just adding more sensors alone results in more cost and increased NAR/FAR
- **DMA high detection and low NAR/FAR will make AR/SMR competitive**
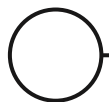
What is DMA?

- Advanced sensor fusion system
    - First developed as a smart nuisance and false alarm filter extending prior SBIR R&D
    - Grew into high-performance artificial intelligence (AI) technology
    - Tracking intruders & alarm sources
    - Analyzing motion-behavior to identify intruders and filter out nuisance/false alarms
- DMA R&D and AI prototype developed in SBIR R&D
    - Close collaboration with Sandia National Labs (SNL)
    - Funded by DoE Advanced Reactor Safeguards and Light Water Reactor Sustainability areas
- Has demonstrated dramatic nuisance alarm reductions
    - In operational environments during prototype testing at Sandia STEC and NPP sites
- Current status: Patented, high COTS TRL prototype
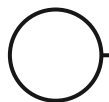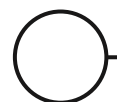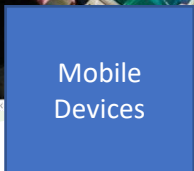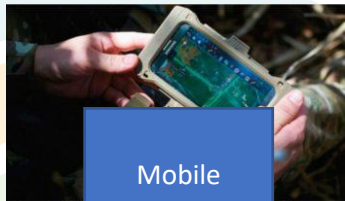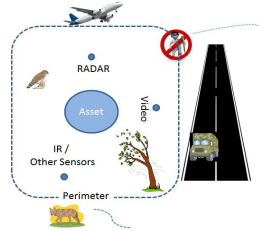
Operational Concept
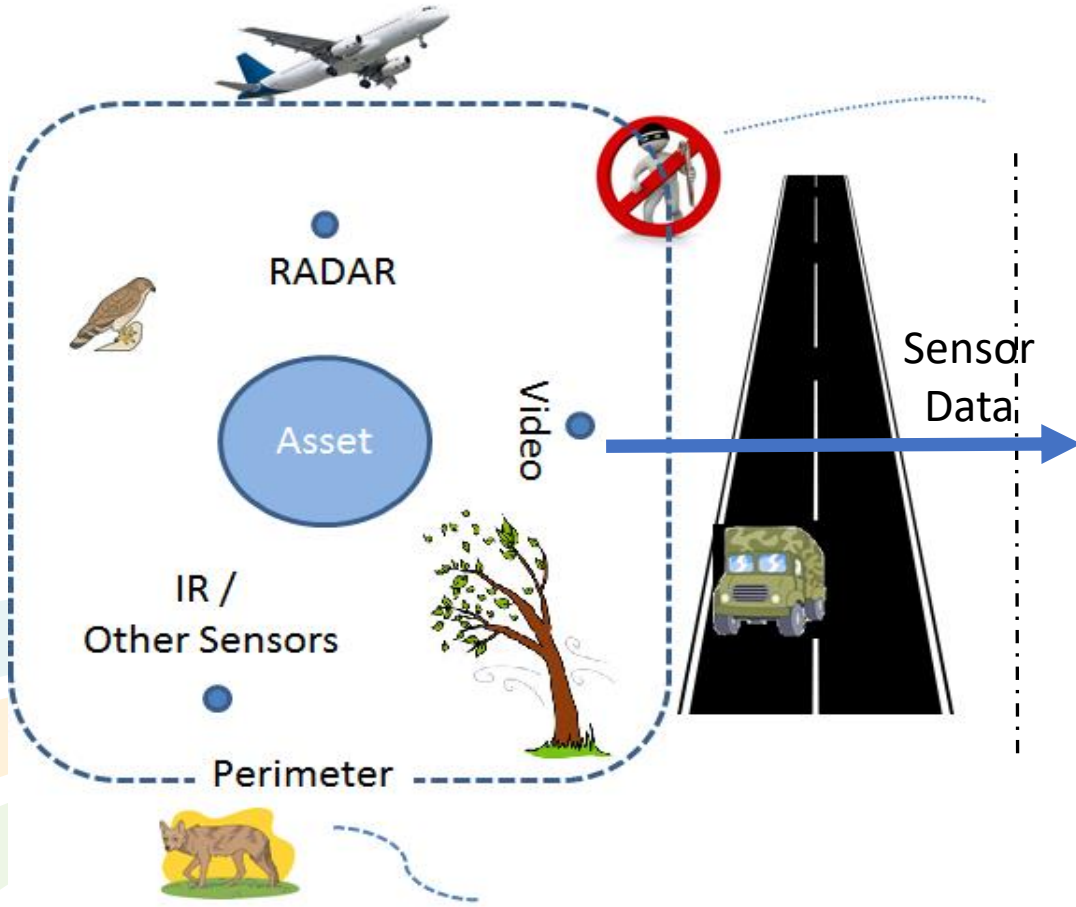
DMA Intrusion Detection Process

- Sensors stream data to DMA in real time
  - Open architecture supports RADAR, LIDAR, video, PIR, & more

- DMA analyzes detections using AI algorithms
  - Filters out events that to do not indicate an intruder
  - Issues real time alerts to responders.
- Alarm outputs
  - Dry contact switch, SEIWG
  - CAS / SAS software integrations
- Real time remote displays
  - Web pages
  - Mobile devices (ATAK/ COVTa
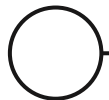
DMA SBIR Approach to Cost Reduction

- Site Design
  - Integration with Modeling and Simulation validates optimal performance-based security designs

- Site preparation
  - Reduced need for rigorous landscape engineering
  - Eliminate digging and trenching for sensor power & comms

- Infrastructure
  - Fewer fences, poles, cameras, cables, FDBs

- Operations
  - Fewer response forces required less often, responding faster, and better informed
  - Enabling remote response forces serving multiple AR/SMRs and other innovative cost-saving concepts
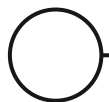
Phase I Highlights

New and improved algorithms
- Prototyped and tested using previously recorded and new test data

Integrate DMA directly into sensors
- Preliminary integration into small form factor RADAR embedded processor
  - Improving performance
  - Enabling mesh of nearby sensors that further improve performance
- Preliminary integration with cybersecure hardware to create secure 'DMA appliance'
  - Can be installed in field distribution boxes, network closets, and mobile
  - Tested with tactical-class cross domain solution from General Dynamics Mission Systems

Modelling & Simulation
- Can replay previous intruder detections against "what if" PPS designs

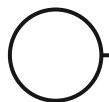## Integrate DMA with mobile geospatial information sharing applications
- Preliminary integration with USAF Android Team Awareness / Tactical Assault Kit (ATAK)
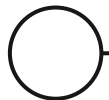
Phase II Development

- Minimum viable product tailored to AR/SMR customer requirements
- Customer-focused DMA maturation and productization
- Tighter integration with video analytics and computer vision
- Smart algorithms for target classification and target-aware tracking
- Third-party hardware and software integrations
  - Sensors with built-in DMA
  - CAS + SAS integration
  - First responder and law enforcement mobile app
  - Modeling and simulation
- Verification and validation at Sandia
  - Paves the way for customer adoption
- Verify that DMA meets customer requirements
  - With interested AR/SMR developers

Questions?

For more information about DMA, contact

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