SAND2018-4870 C

Sandia National Laboratories

Physical Security Center of Excellence
Model-based Situational Awareness & the Digital Twin

PRESENTED BY   Ray Trechter, Manager
Interactive Systems Simulation & Analysis
Department
Sandia National Laboratories
ratrech@sandia.gov

U.S. DEPARTMENT OF ENERGY   N S A

2

Model-based Situational Awareness & the Digital Twin

- In this talk we will explore how modeling and simulation (M&S) and augmented reality (AR) can be used to create a Digital Twin that...

  - Supports blue force operations at a high security installation
  - Improves situational awareness, analysis, and exercises
  - Offers new training opportunities.

Sandia National Laboratories

Sandia develops advanced technologies to ensure global peace

- US Government owned, contractor operated Federally Funded Research and Development Center (FFRDC)
- Workforce: 12,001 employees (10,715 NM, 1,286 CA)
- Strong research foundation supports mission delivery

Ray's Background

4

Ray currently leads Sandia's Interactive Systems Simulation & Analysis (ISSA) Department which develops flexible and powerful tools for analyzing security in operational spaces, particularly facilities and their surrounding terrain.

He also expanded Sandia Laboratories' force-protection research and methodologies by focusing on critical infrastructure assessment of U.S. bases/facilities and modeling military missions and their dependencies.

Terms of Reference — A Few Definitions

5

Virtual reality (VR) immerses users in a fully artificial digital environment.

Augmented reality (AR) overlays virtual objects on the real-world environment.

Mixed reality (MR) not just overlays but anchors virtual objects to the real world.

Source: Forbes, *The Difference Between Virtual Reality, Augmented Reality And Mixed Reality,* Feb 2018

Digital Twins are digital models that form mirror images of their physical counterparts

Source: Colin Parris, GE Research

Digital Twins ≈ Mixed Reality

Can a Digital Twin Give an Installation Security Force an Advantage?

6

7 Installations – a Great Candidate for a Digital Twin

- Three elements of a digital twin
  - Asset Model
  - Analytics
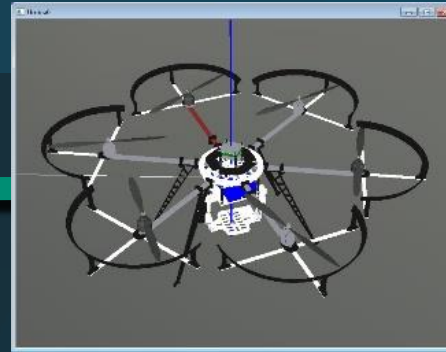   - (predict, describe, and prescribe the behavior of the asset)
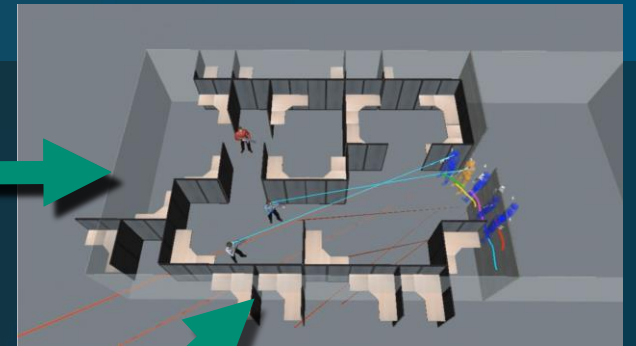 - Knowledge base

Source: GE https://www.ge.com/digital/predix/digital-twin

A Digital Twin An Be Used to Improve Command and Control

8

Real Operation

Autonomy

Simulation
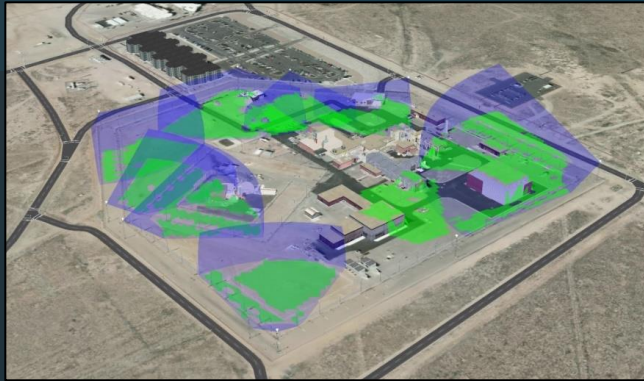

Digital Twin with AR

An digital twin can be used to

- Lower response time

- Improve defender awareness

- Serve as a battle aid

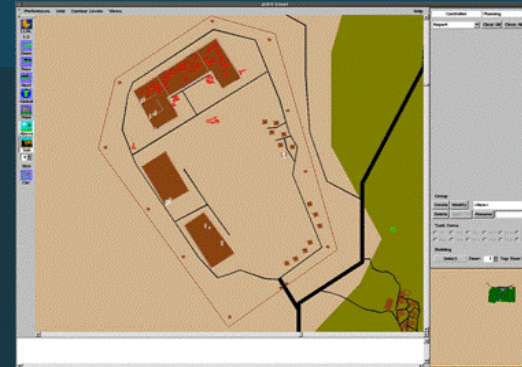- Predicted OPFOR and suggested blue force moves

Digital Twins Enable Different Types of Physical Security Analyses

9

Planning and Design (OpShed)

Human-In-The-Loop Exercises (JCATS)

System Effectiveness Modeling (Dante)

Training (VBS3)

10 Security Force Advantage Through M&S

Simulation features include:
◦ OPFOR vs Defender AIs
◦ Knowledge and use of terrain
◦ Tactics (e.g., OPFOR anticipates Defender Patrols)
◦ Sensing View Sheds
◦ Faster than real-time, predicts outcomes

DANTE™

Sandia National Labs

Another Possible Advantage Through AR

11

Visual Communication Channel
- ◦ Could also be auditory or haptic
- ◦ Persistent

Show things that can't be seen in real world
- ◦ Sensor coverage including blind spots
- ◦ Key asset location
- ◦ Recommended fighting positions

Enemy identification
- ◦ Video cues/markers placed on OPFOR
- ◦ Avatars

Rapid Prototyping of Security Layouts through Augmented Reality

And Yet Another Advantage Through Autonomy

12

Source: Time.com

- UAS and other moving sensors can accurately locate themselves and other forces

- Moving sensors can be dynamically repositioned for better views and changing environmental conditions

- Autonomy may be needed to combat autonomy (e.g., swarms)

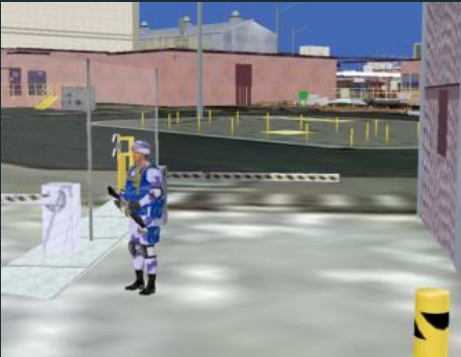# More Awareness to the Edge

13

Cameras
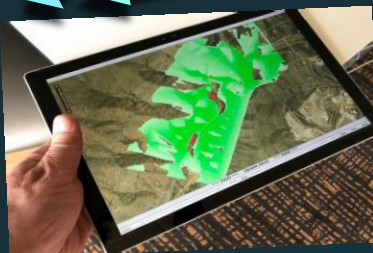

Other Sensors

Streaming Video
Sensor Alarms

Radio

Alarm Station and Commander
Assess and Direct Forces

Digital Twin Maintains the
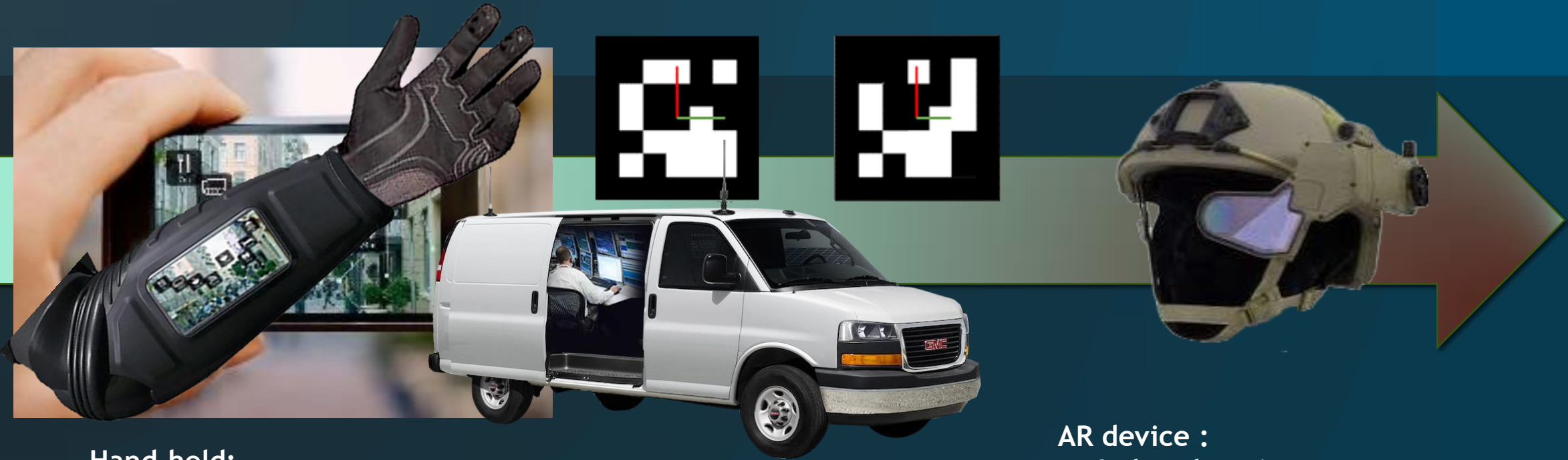Situation and Aids in Decisions

Response Force

Tailored Display

AR Enhancements
Suggested Routes
Other Visual Ques

Sensor Alerts and other information can be displayed immediately allows the response force to anticipate response needed and better coordinated C2

M&S and AR Prospects for Installations Readiness Timeline

14

Hand-held:
- Outdoor locations
- GPS-based blue force tracking
- Real-time sensor information
- Cover, observation points
- C2 marking of objects
- Predictive OPFOR tracking

AR device :
- Indoor locations
- Location libraries
- Object registration and tracking though video analytics
- Pose Information
- Virtual Characters/Equipment
- Smart Objects

Augmented Operations Provide New Training Opportunities

15

- Scenario-based custom configurations
- Personalized views
- Real-time tracking
- Potentially more immersive
- On demand training with job aids (e.g., maintenance manuals)
- Training on prototype systems that may reduce the engineering design lifecycle
- Lowers costs

Some Parting Thoughts

- Does a stepwise approach to AR – crawl, walk, run, make sense in your environment?

- How might instantaneous access to threat information change the operating environment?

- Information filtering?

- Changes to tactics and response?

- What are the training ramifications of an augmented operational environment?