Adaptive Sensor Tasking and Control

Walter S. Kuklinski

781-271-5778 • wskuklin@mitre.org

Air Force MOIE

MITRE Technology Program

Problem

- **An unresolved issue with multi-sensor and multi-platform surveillance systems, including both standoff sensors and in situ micro-sensor networks, is a robust method of adaptively controlling the sensors to yield optimal performance in target detection, tracking, classification, and identification.**

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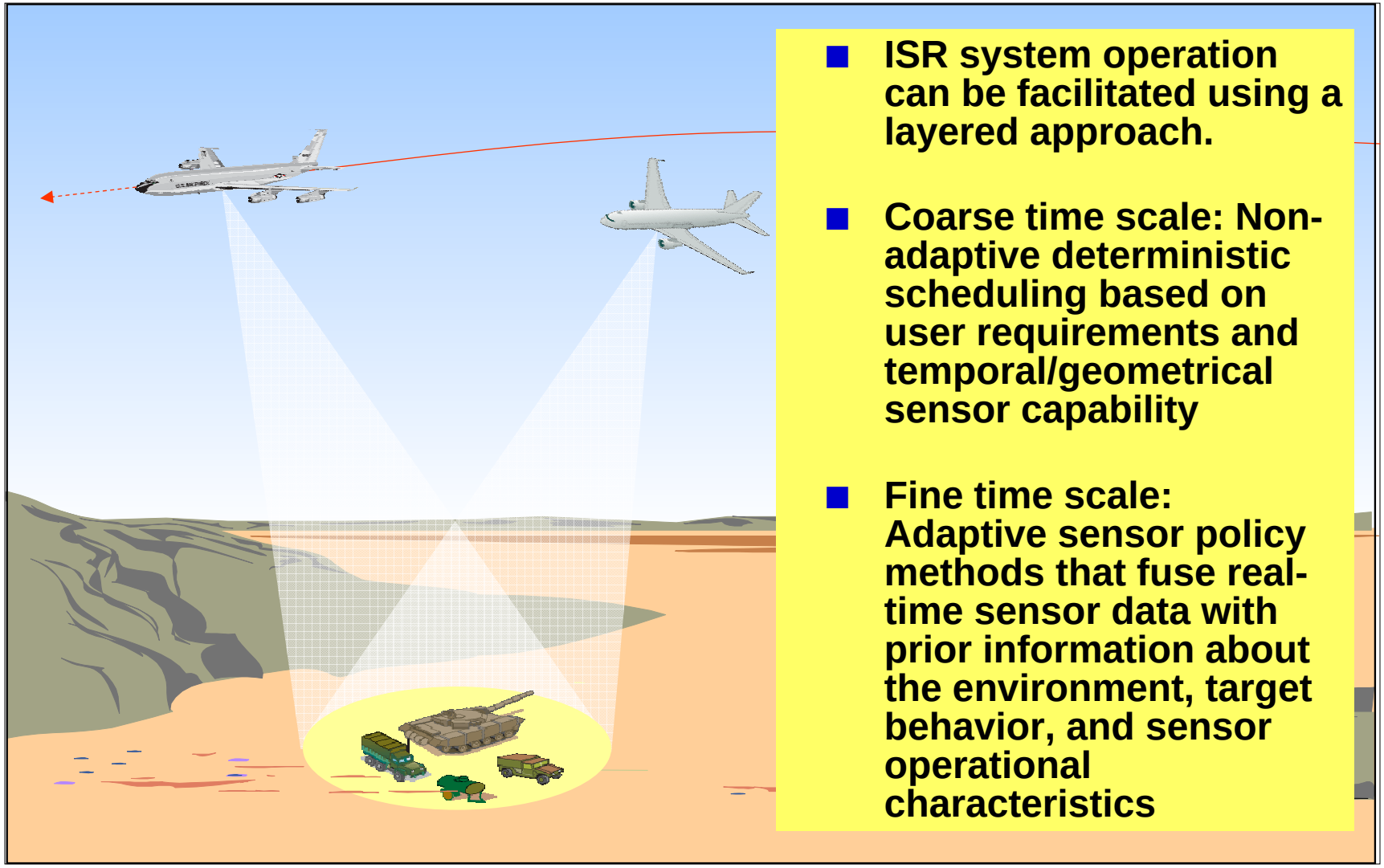
Background



- ISR system operation can be facilitated using a layered approach.
- Coarse time scale: Non-adaptive deterministic scheduling based on user requirements and temporal/geometrical sensor capability
- Fine time scale: Adaptive sensor policy methods that fuse real-time sensor data with prior information about the environment, target behavior, and sensor operational characteristics

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Objectives

- Develop and implement adaptive sensor tasking and control methods to provide enhanced detection, tracking, classification and ID performance using Markov Decision Process (MDP) methods as an analytical framework
- Evaluate these approaches using both simulated and field data

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Activities

- Deterministic scheduling for tasks with temporal and/or geometrical varying value
  - Appropriate for standoff sensor scheduling applications
  - We use a multiple dimension matrix (data-cube) representation of task value and sensor capability.
  - Multiple sensor cooperation, sensor energy budget, and frequency of task execution are represented as constraints in linear integer programming problems.
- Agent-Based Adaptive Sensor Management
  - Explicit energy considerations included in Markov Decision Process (MDP) state space
  - Can be readily extended to cases where the configuration of the sensor network varies with time
  - Will be evaluated using “live” data during the MITRE Netted Sensors MSR Concept Demo
  - Analytic determination of MDP task reward structure as a function of higher order system performance will be a critical need.

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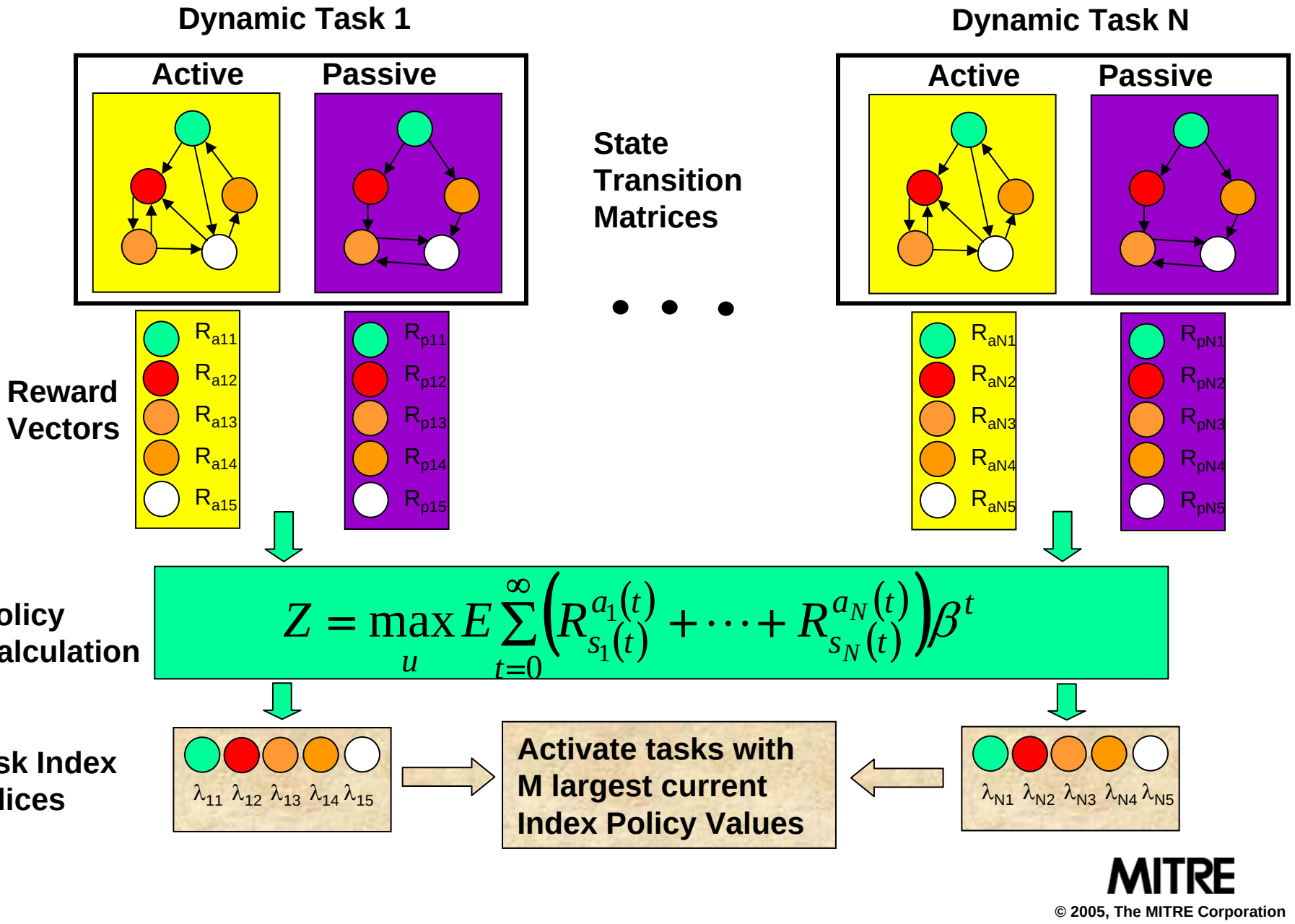
Highlight: MDP Restless Bandit Methods



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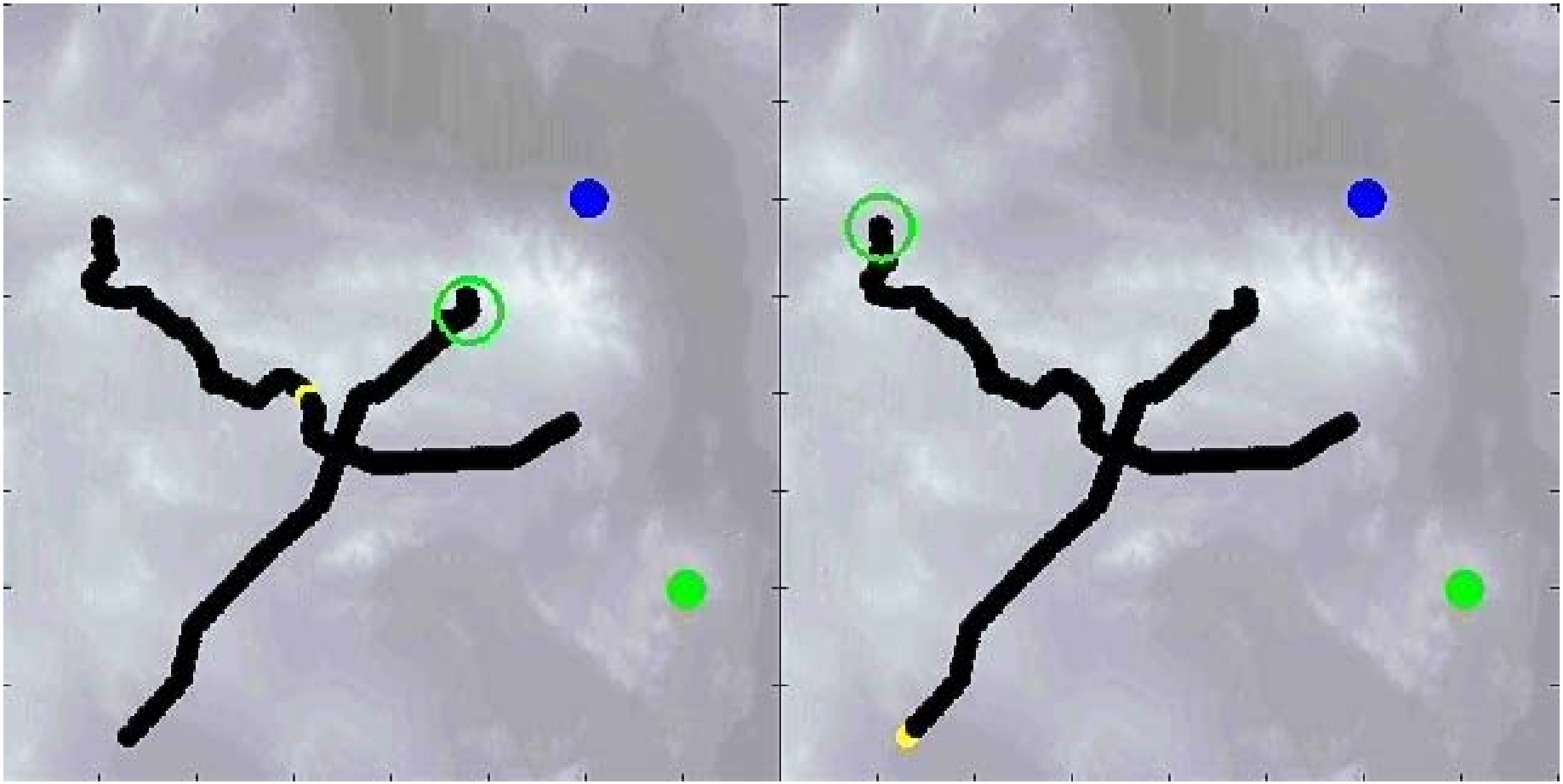
Highlight: NTC (National Test Center) Simulation



MDP Operation

- No Recent Measurement
- Track Initiation
- Inadequate Data
- No Moving Targets
- Adequate Data

Non-Adaptive Operation

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Impacts

- **This MOIE will develop and evaluate sensor tasking and control algorithms that will provide enhanced ISR capability over a wide range of domains.**

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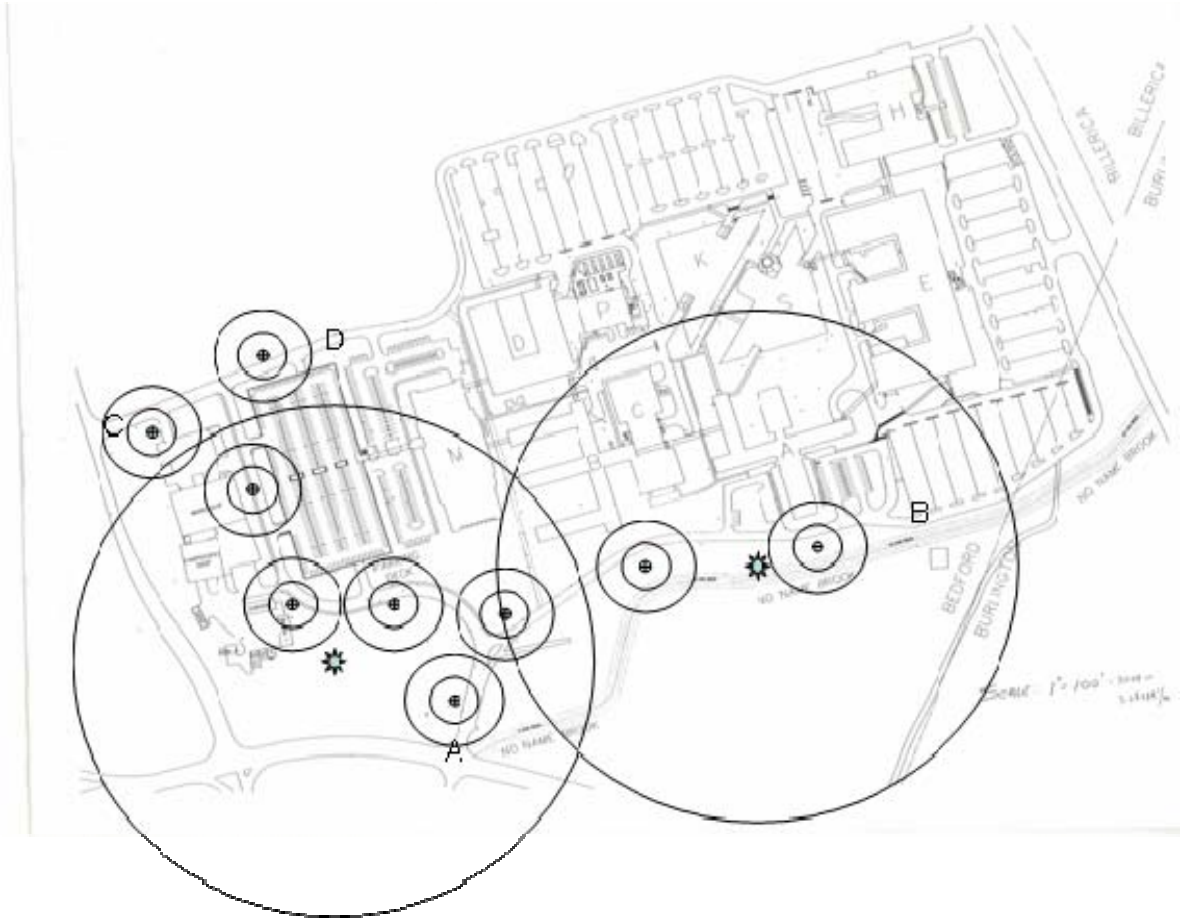
Future Plans

- **Evaluate the performance of MDP adaptive multi-sensor tasking and resource management procedures in real time during the concept demos conducted as part of MITRE's Netted Sensors project**



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