

AGI USER EXCHANGE

WASHINGTON, D.C. 2007

Using STK in Support of ISR Missions

Ray Miraflor, Steven Carrillo, Dale Bardin

BAE SYSTEMS

San Diego, CA

Outline

- Organization Overview
- Introduction
- UAV Mission Analysis
 - Communications Availability
 - Target Detection
- Radar Cross Section (RCS) Modeling and Analysis
- Middle Eastern Scenario
- Integration with Google Earth
- Summary

Organization Overview

- BAE Systems is a global company engaged in the development, delivery and support of advanced defense and aerospace systems in the air, on land and at sea
- 88,000 employees worldwide
- Sales exceeded \$25.4 billion in 2006
- Performance Engineering, Modeling & Simulation, Visualization & Analysis (PMVA) Team in San Diego, California

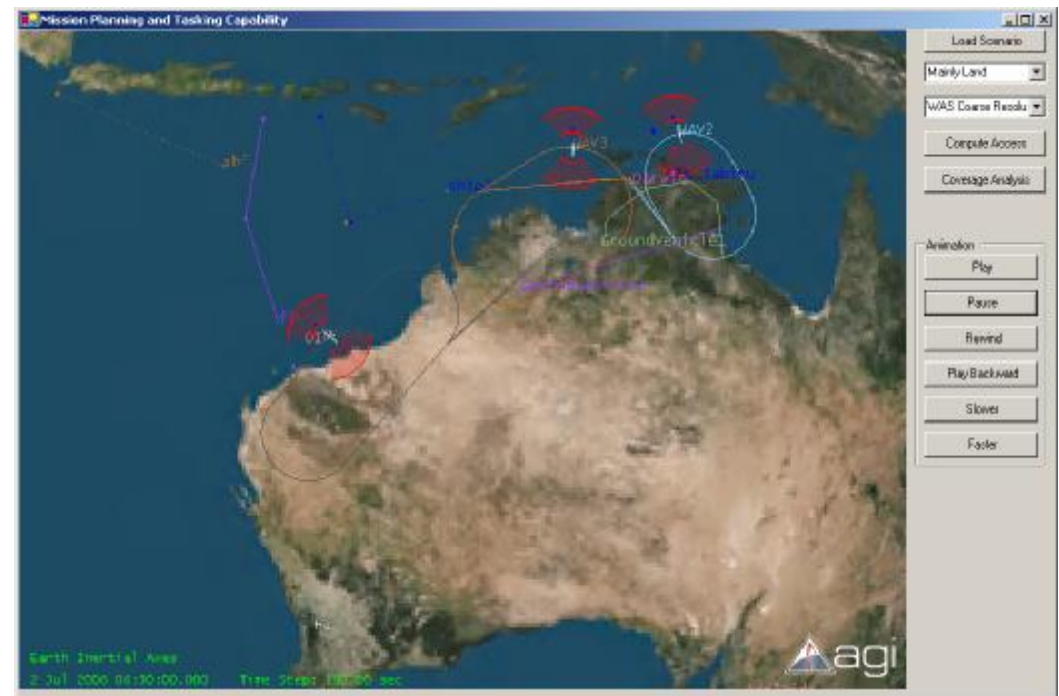
Introduction

- Intelligence, Surveillance, and Reconnaissance (ISR) synchronizes and integrates the planning and operation of sensors, assets, processing, exploitation, and dissemination systems in direct support of mission operations.
- STK provides an optimal framework to model and analyze ISR missions rapidly with components in space, air, on land, and on the sea.
- BAE Systems has applied STK to perform several visualization and analysis studies including communications availability, target detection, RCS modeling and others.

UAV Mission Analysis: Target Detection and Communications

Problem: Given potential coastal terrorist operations, how to determine optimal UAV plans?

Approach: Model UAV operations in two or more path configurations. Analyze access between UAVs and ground station and between UAVs and surface targets. Create a 4DX application for multiple analyses.



Please note, this is a contrived scenario to illustrate some of STK's capabilities. All scenario and vehicle attribute data are obtained using STK defaults.

Results – Communications Availability

Description: Using STK’s ability to perform access calculations and chains analysis, the amount of time (in seconds) the ground station can communicate with the UAVs was examined. The first path covered more land than sea area. The second covered more sea than land area.

Mainly Land				
	UAV1	UAV2	UAV3	UAV4
Ground Station	11,826*	96,260	109,512	11,297
Total Communication Time =				217,069
Mainly Sea				
	UAV1	UAV2	UAV3	UAV4
Ground Station	11,826*	93,852	132,424	11,283
Total Communication Time =				237,558
Difference =				9%

* UAV1 communication through Relay Satellite

Conclusions: There is only a small difference in available communication times between the two flight paths enabling a commander to choose either path without significant penalty.

Results – Target Detection Study



Description: Using STK’s ability to perform access calculations, the amount of time (in seconds) the ships were visible to the sensors on-board the UAVs was monitored as a function of flight path. The first path covered more land than sea area. The second covered more sea than land area.

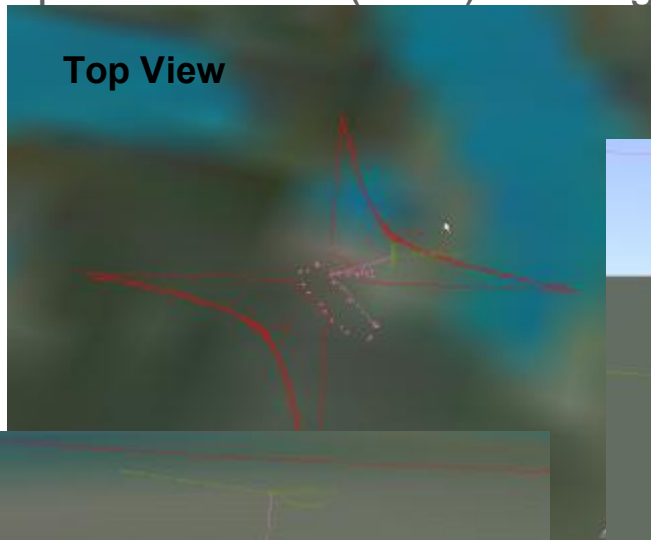
Conclusions: The difference in ship detection between the two paths is minimal (13%), however the difference in ground vehicle detection is significant (-30%). Thus the commander may likely choose to monitor “mainly land” in this case.

Mainly Land	Ship 1	Ship 2	Ship 3	Ship 4	Ship 5
UAV1				38,600	61,329
UAV2			8,450		
UAV3		8,897	32,404		
UAV4	10,868	7,149	4,584		
Total Ship Detection Time =					172,281
Total Ground Vehicle Detection Time =					226,630
Mainly Sea	Ship 1	Ship 2	Ship 3	Ship 4	Ship 5
UAV1				38,600	61,329
UAV2			12,169		
UAV3		9,393	41,459		
UAV4	19,357	8,229	6,844		
Total Ship Detection Time =					197,380
Total Ground Vehicle Detection Time =					174,772
Difference in Ship Detection =					13%
Difference in Ground Vehicle Detection =					-30%

RCS Target Detection Example



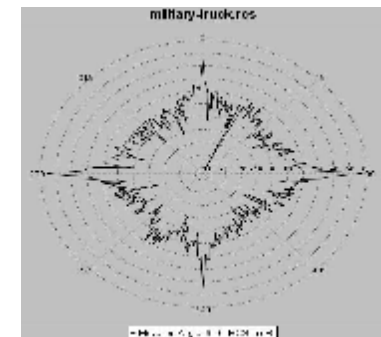
Problem: Extending the previous study on ground vehicle detection, perform higher fidelity target detection using Synthetic Aperture Radar (SAR) sensing via a JSTARS aircraft.



Top View



Target to Aircraft View

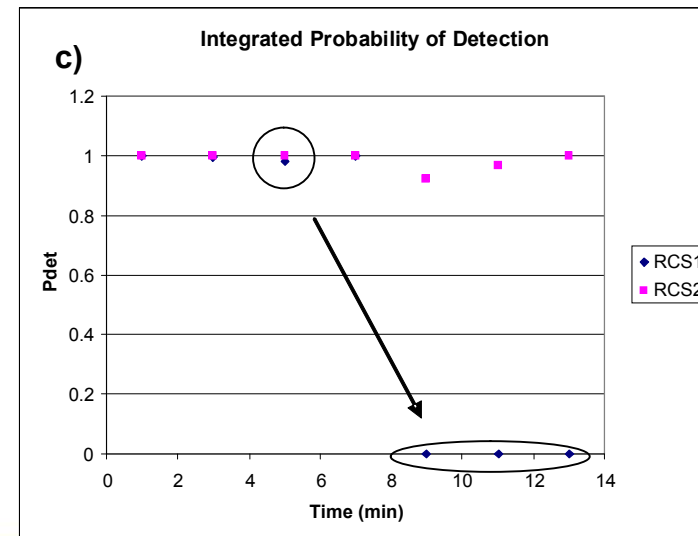
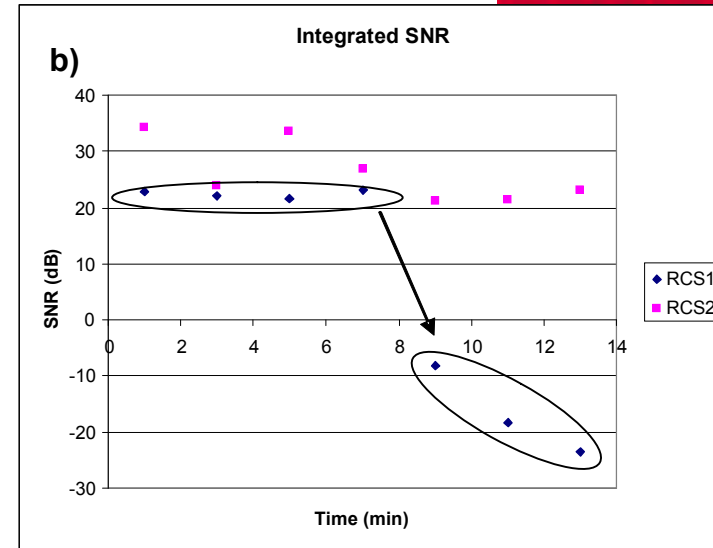
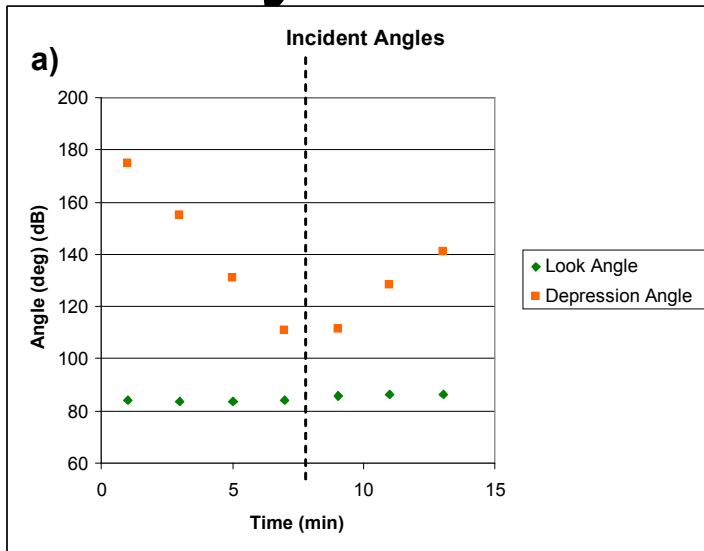


Aircraft to Target View

Approach: Use and analyze Radar Cross Section (RCS) model of ground targets. Use STK's Radar Module to evaluate effectiveness of SAR sensing.

Please note, the scenario and RCS file used here were developed and received from AGI.

RCS Analysis



Results show that after about 8 minutes into the simulation, (a) the SAR incident angles and the geometry of the target are in a configuration such that (b) the signal to noise ratio and (c) probability of detection are significantly reduced for a target with RCS1. Please note that RCS2 is a notional, smaller RCS.

The binary nature of the probability of detection of a target with RCS1 would yield significantly different results from the previous basic access calculations.

Visualization – Middle Eastern Scenario

Problem: Demonstrate BAE Systems' concepts of operation in a customer-related mission.

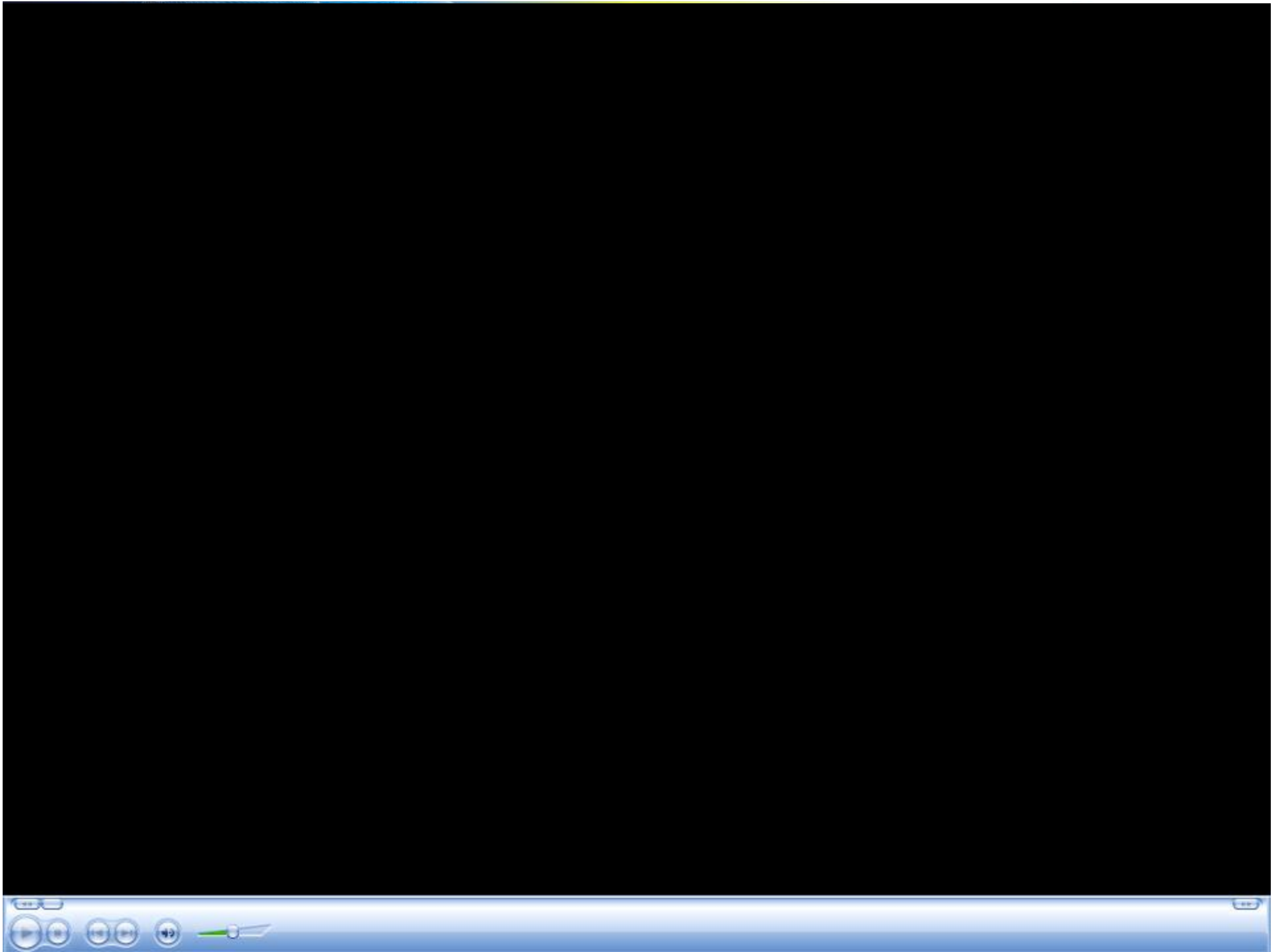
Approach: Use STK's extensive visualization capabilities to develop a terrorist scenario whereby several BAE Systems capabilities could be demonstrated within a dynamically changing ISR mission.

VDF Example

Please note, this is a contrived scenario to illustrate some of STK's capabilities.
All scenario and vehicle attribute data are obtained using STK defaults.

Integration with Google Earth

- Problem: Share BAE Systems' concepts and scenarios with customers that prefer to use Google Earth for visualization.
- Approach: Leverage AGI's ability to integrate with external viewers and integrate scenarios with Google Earth.
- Rationale:
 - Provides ability to share visualization of ISR mission concepts with customers that prefer to this viewer
 - Advantages with Google Earth include custom, shareable layers, its wide distribution and familiarity with customers, and its extensive, publicly accessible imagery database.



Summary

- Leveraged STK to analyze Intelligence, Surveillance, and Reconnaissance (ISR) missions.
- Examined interoperability and effectiveness of ISR missions with multiple platforms
 - Communications
 - Target detection
 - Radar cross section (RCS) modeling and analysis
 - Detailed visualization
- Demonstrated STK integration with Google Earth and other capabilities relevant to our customers

STK is a critical capability used to demonstrate BAE Systems' roles as ISR System Developers and Mission Capability Integrators.

Acknowledgements

- The presenters wish to recognize John Gallucci, Mark Klausner, Rusty Sailors, and the rest of the PMVA team from BAE Systems for their contributions to this project.
- We also wish to thank Jennie Fleury, Mike Bruchanski, Nick Daugherty, and others at AGI for all their help with STK.

Contact

BAE Systems / Network Systems
Performance Engineering, Modeling & Simulation, Visualization & Analysis
(PMVA)
10920 Technology Place, Mail Zone 604E
San Diego, California 92127

Ray Miraflor
ray.miraflor@baesystems.com
858-592-5220

Steven Carrillo
steven.carrillo@baesystems.com
858-592-5568

Dale Bardin
dale.bardin@baesystems.com
858-592-4436