

Kaleidoscope II

UAV Video MTI Characterization & Multi-Sensor Fusion

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Air Force MOIE

The logo for the MITRE Technology Program, featuring a stylized graphic of stacked blocks in yellow, orange, and blue to the left of the text.

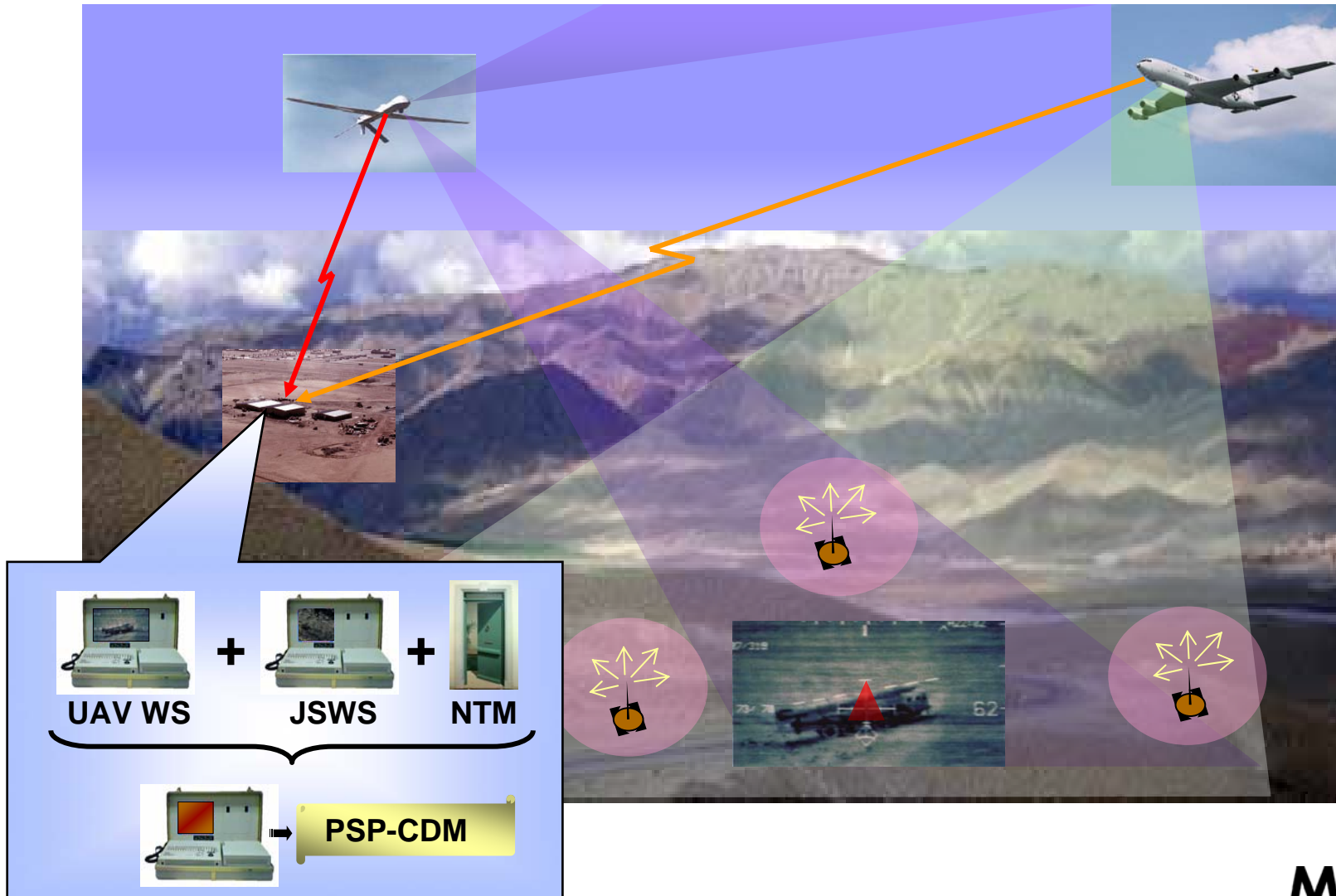
**MITRE
Technology
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Problem

- **Operations Centers**
 - **Overloaded with data; starved for information**
- **OIF/OEF highlighted need to improve integration of multi-source data**
 - **Collected information is not utilized to the maximum extent possible**
 - **Fleeting targets remain a challenge**
 - **Demand for UAV video exceeds availability**
 - **Access and utilization of UAV sensor data limits UAV utilization**

How can current sensor platforms/products be utilized for more effective time-critical targeting?

Background



Objective

- **Video Target Tracking and Reporting**
 - GMTI from UAV video
 - Auto-generate video metadata
- **PSP Common Data Model**
 - Critical platform-sensor-processing parameters are captured/derived
 - Enables additional reasoning about collected data
 - i.e., spatial uncertainty about reported SPOI
- **Multi-sensor Fusion**
 - Exploits temporal and geo-spatial meta-data for each sensor report
- **Video Indexing and Retrieval**
 - Beyond platform/sensor position and AOI
 - Relevant “video events” used to narrow search space and return most relevant video segments

Activities

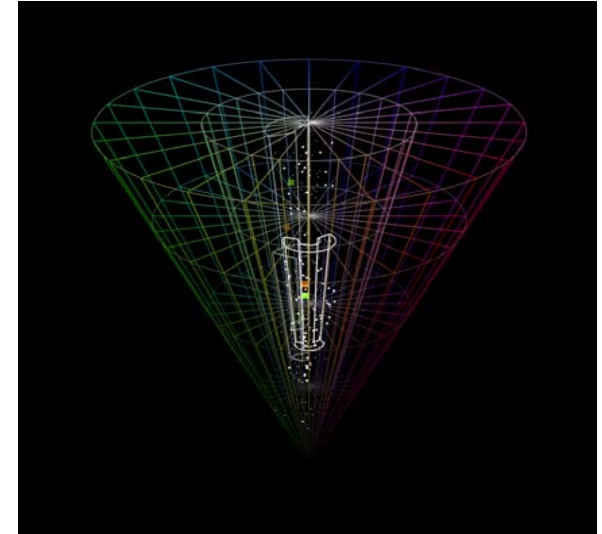
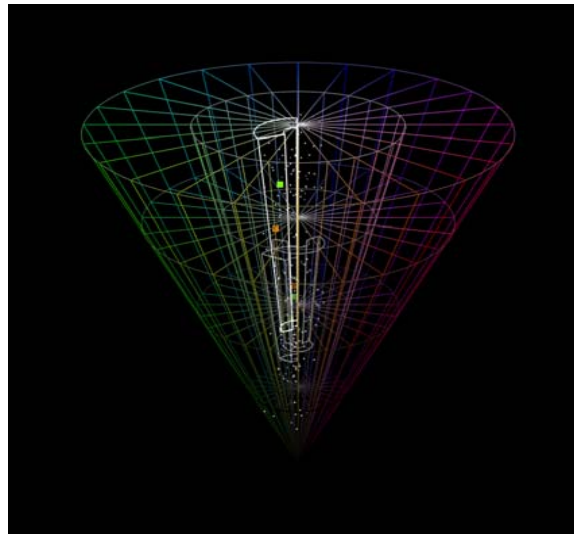
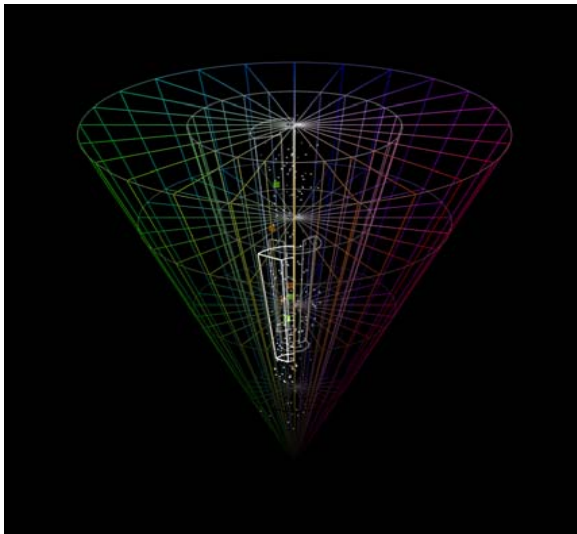
- **Planned/coordinated live JSTARS GMTI-UAV video coincident data collection @ Camp Blanding JRTC**
 - **Subject vehicles “ground truthed” w/GPS**
- **Introduced VMTI track generation as a viable, real-time information source derived from UAV video**
 - **Demo’d L16 J-msgs translated from VMTI tracks**
- **Introduced PSP-CDM**
 - **Highlights essential derivative data elements to facilitate reasoning of multi-sensor detections**
 - **Demonstrated “communicating color M2M”**
- **Developed/demonstrated real-time video frame geo-registration in a “no-cost” Google Earth client**
- **Developing content-based video indexing capability to rapidly locate/retrieve relevant video segments**

Highlight: Communicating Color M2M *Hue-Saturation-Value Statistics*

- Color averaged over several frames for entire vehicle
- HSV sub-volume boundary parameters captured in CDM
 - Mean and median statistics also determined/captured

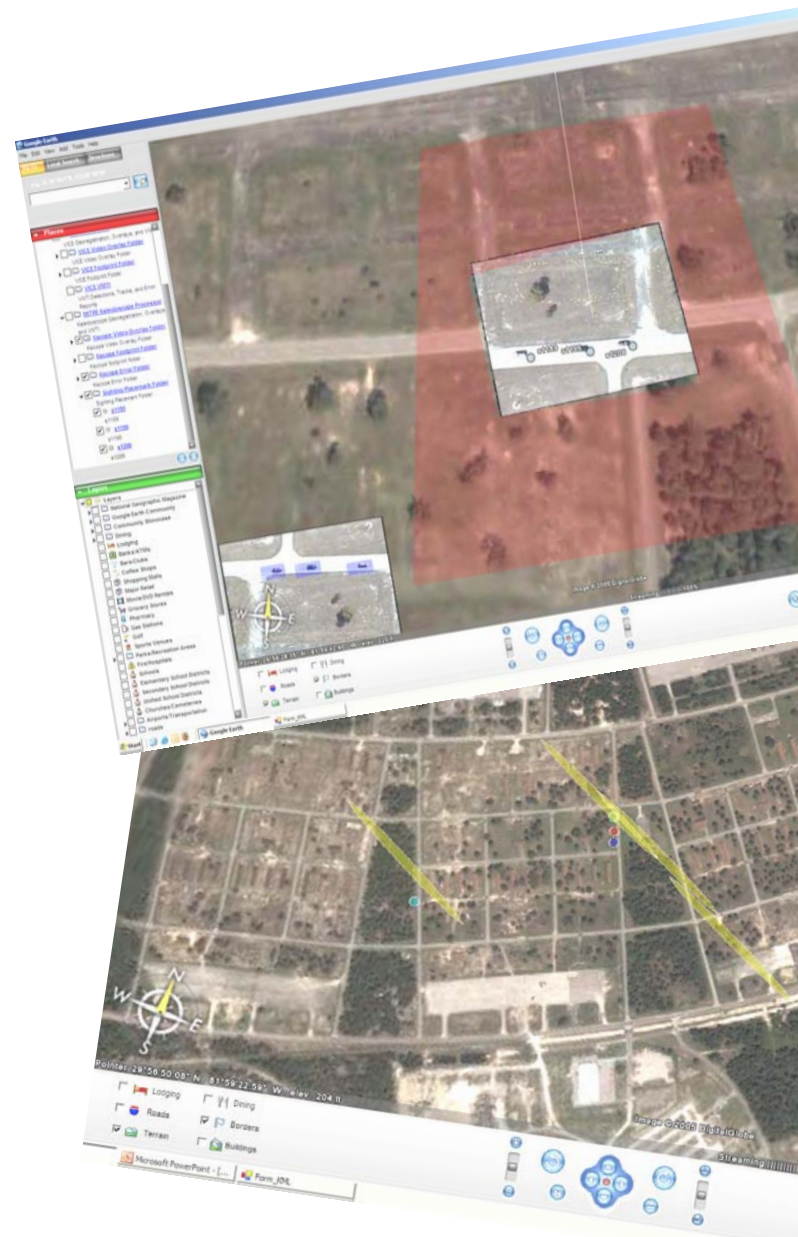


Camp Blanding Data
Scan Eagle EO Video



Demonstration: Google Earth Client

- Photogrammetric model computes extent of geo-registration uncertainty
 - Critical parameters in PSP CDM
 - DTED effects addressed
 - CJMTK (ray-casting) & open-source ortho-rectification procedures
- Real-time VMTI “dots” overlaid on geo-registered video frame*
- A “no cost” VICE+ client
- Ready for initial operational use



* Reduced frame rate

Impacts

- **Significantly improves accessibility, integration and utilization of UAV video**
 - VMTI track generation
 - Low-bandwidth alternative to transfer information contained in the video scene
 - Content-based video indexing and retrieval
 - Target features
 - Platform position & sensor AOI
- **Employs simple reasoning to accomplish multi-sensor fusion at low computational costs**
 - Enables M2M cross-correlation of motion imagery with other heterogeneous sensor modalities
 - Increases utility of collected ISR data

Future Plans

- **Efficient content/model-based video indexing**
 - Move towards autonomous scene understanding
 - Derive an event ontology to describe UAV video
 - Instantiate with “video event markup language”
 - Explore optimal spatial-temporal index strategies
- **Feature-based geo-registration algorithms**
 - Improve video geo-registration accuracy
 - Reduce VMTI track spatial uncertainties
- **Emerging MPEG Video Compression Standard**
 - Exploit object-oriented metadata generation to improve target tracking and indexing capabilities