Content-Based Multimedia Analytics: Rethinking the Speed and Accuracy of Information Retrieval for Threat Detection

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Presentation Outline

- Increasing Complexity of Information Retrieval
- NATO IST-144 Approaches
- US DOD Approach
  - Video Analysis & Visualization
  - Text Analysis & Visualization
- Relevance of Approaches in Military Exercises
- Conclusion and Future Work

Increasing Complexity of Military Challenges Requires Multi-source Correlation & Fusion

NATO Information Systems Technology (IST)-144: Content-Based Multi-Media Analytics

Team Leader: US, UK

Membership: US, UK, TUR, Norway, CA, NE, RO

Open to Partner Nations : Yes

Start-End: *April 2016 – April 2019*

Meetings: Kickoff Apr 20-21 2016 (US)

Related activities: Translation, HCI, *Social Media*

Objectives: Explore novel techniques for near-real-time automated identification and mark up of objects, activities, events and relationships in unstructured information sources.

Themes / topics:

- **Pattern recognition approaches for multimedia**
- **Algorithms/techniques to exploit text/video**
- **Integrating provenance/trust in text**
- **Exploit embedded text/video in multimedia**
- **Military use cases for experimentation/tech demo**
- **Data collection, experimentation, value-added**

Research Topic Areas:

- **Intelligent Capture and indexing of motion imagery**
- **Expand the Deep Learning approach for semantic video analytics**
- **Explore the mechanisms by which text analysis results can be used to drive/exploit video and imagery indexing and retrieval**
- **Explore frameworks for optimizing multi-media analytics via systems engineering and architectural design concepts.**

US Science & Technology Seedling Program: Foundations for Context-Aware Information Retrieval for Proactive Decision Support

- The Problem:
  - Too much data is a common complaint in most operational domains
  - This limitation requires decision makers to mentally reconstruct, infer, and extract relevant information through laborious and error-prone internal processes
  - Automated mechanisms are needed for the timely extraction & prioritization of high-value decision-relevant information
- Our Research Goal:
  - Foundational research for next-generation context-aware, adaptive information retrieval services that address the behavioral characteristics of the decision maker, while overcoming inherent biases humans exhibit when exploring information

US Approaches to Video & Text Analysis

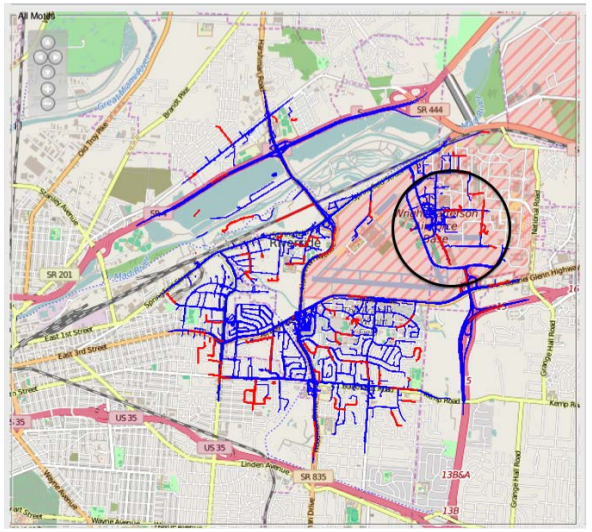
Two Exemplar Cases

- Video: Kinematic Motifs
- Text: Sociocultural Reasoning Framework

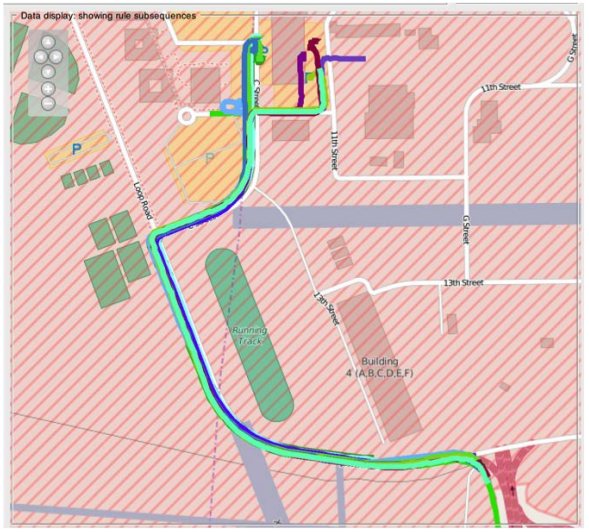
Kinematic Motifs – George Mason University

- Spatial Trajectory Mining
  - fundamental challenges of identifying meaningful features or patterns that characterize trajectory data (e.g. the Wide Area Motion Surveillance (WAMI) data, GPS data, etc.) and the establishment of normality in the tracks (cf. patterns of life) for the purpose of anomaly detection.
  - Charactere user behavior and detect novel patterns in trajectories based on frequently occurring patterns (kinematic) motifs.
  - Frequent patterns in temporal or spatiotemporal data provide useful high-level information about the data. For example, one could potentially summarize a set of trajectory data by the frequently taken routes, frequently visited locations or a sequence of locations.

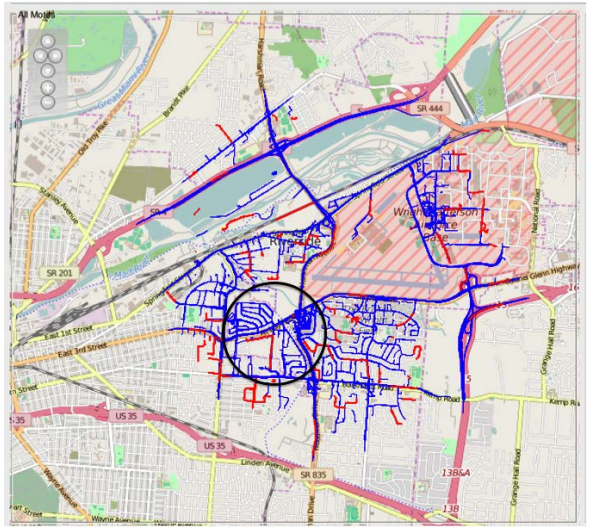
Kinematic Motifs – George Mason University

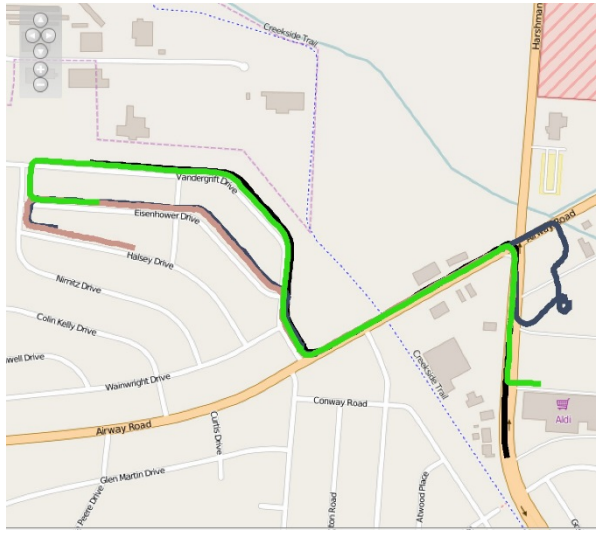


(a) WAMI tracks

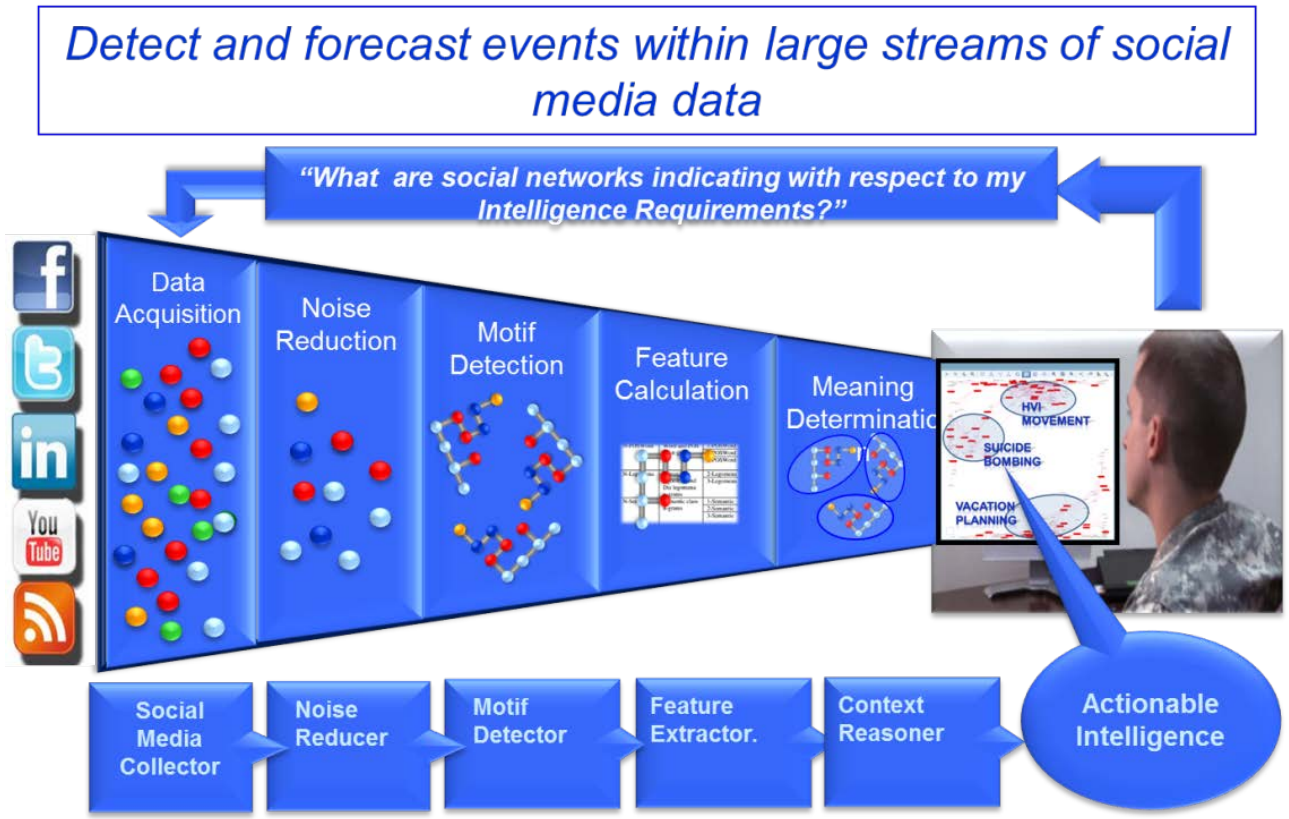


(b) A repeated route





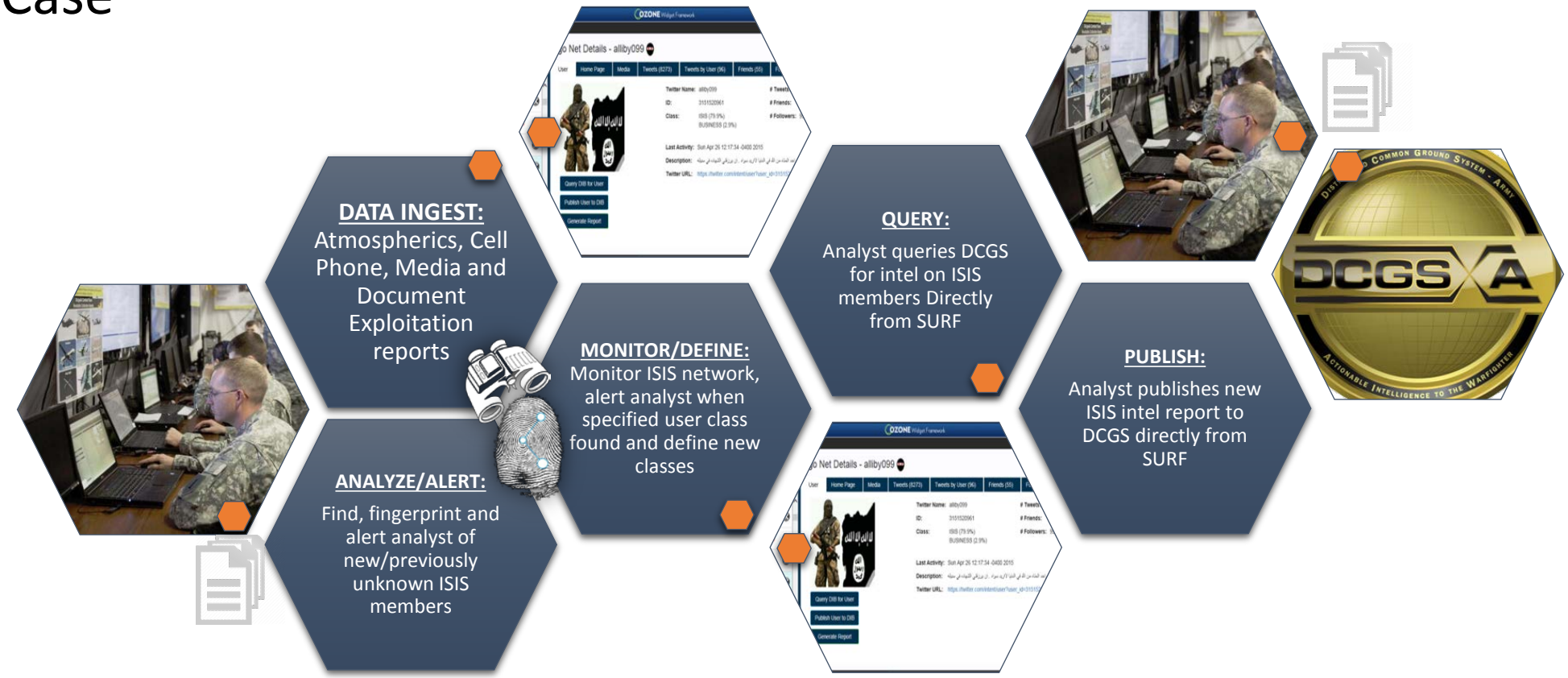
Sociocultural Reasoning Framework – (SURF) Securboration



- Process overwhelming volume of Social Media data
- Automate discovery & monitoring of targeted user classes
- Language agnostic – not dependent on natural language processing or nuances of Social Media
  - Successfully tested on Arabic, English, French, and Spanish
- Deploy in a web browser or Ozone Widget Framework
- Standards based SOA capability integrates with existing systems

Sociocultural Reasoning Framework – (SURF) Securboration

Use Case



Military Exercises to Demonstrate Value Added & Maturity of Technology

- Naval Postgraduate School (NPS) Joint Interagency Field Experiment (JIFX), Camp Roberts, CA
- Semi-structured, collaborative learning environment
- Government, private, academic, and industry technologists meet to share ideas and emerging capabilities
- November 2016: Video and Text analytics technologies will be demonstrated with open source data collected from CA vehicle data
- Outcomes:
  - Users will develop SA summary with/without prototype tools
  - User surveys and feedback

Conclusions and Future Work

- Kinematic and Text-based *Motifs* useful for characterizing behavior to detect novel patterns based on frequently occurring patterns
- Patterns can summarize data and signal anomalous activity
- Further investigate video indexing & frame info processed on sensors
- Exploit imagery indexing using semantic identifiers & human evaluations of results
- Explore motion-based index generation for retrieval of context
- Evaluate how text results can drive video indexing and retrieval
- Consider frameworks for optimizing multimedia analytics

Questions?