Towards a Data Fission Framework: Optimizing Information Access for the Field Expert using Constrained Technologies

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Research Objective

- To increase the access to raw data for field experts who need timely low-level data for critical decision making.
- Our goal is to develop a framework to:
  - acquire data from incident command systems
  - acquire low-level raw data (real-time and archived)
  - accommodate field experts who bring their own interpretations to a situation
  - bypass information overload.

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Overview of Today's Presentation

- Our focus is on the:
  - Response phase for local incidents
  - Field expert data needs at the operational level
  - Incident specific limitations (environmental)
  - Information overload and balance
  - Information fusion and data consolidation
  - A data fission framework
  - Conclusions and future research

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Response Phase for Local Incidents

- We utilize the definition of response as provided by FEMA which "includes immediate actions to save lives, protect property and the environment, and meet basic human needs."

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Field Expert Data Needs

- For critical decision making, field experts (operational level) responding from an affected area need:
  - incident details for situational awareness
  - a common operational picture (COP)
  - real-time incident data
  - archived raw data.

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Incident Specific Limitations

- Field experts (operational level) responding from an affected area must navigate both:
  - environmental dimensions (terrain, weather, culture, resources) from the affected area where they are located
  - information communication technology (ICT) constraints (limited bandwidth, limited power, outages).

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Information Overload and Balance

- Civil military operations are a primary example
- Ackerman (2011) explains "The armed forces are overwhelmed by all the data its various sensors are sniffing out. They want a single data stream that combines drone video feeds, cell phone intercepts, and targeting radar."
- Utilizing raw data bypasses information overload and also is agile when information technology resources are constrained.

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Local Operating Picture-Constraints

- Critical resource needs at the individual level are two-fold:
  - Power (battery life) for necessary communication devices
  - Connectivity to network/Internet services for those same devices
- We use environmental data (climate, weather) as the starting point for our analysis for two reasons: 1) data is relevant and critical to both civil and military field experts in an affected area; 2) data is credible and unclassified.

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Non-military Data in Times of Crisis

- The joint doctrine for the planning and conduct notes that civil-military operations:
  - Need to leverage more nonmilitary instruments of national power
  - Should entail a more holistic, and balanced strategy
  - Be accessible to those working in the seams of power and gaps in organizations, phases, and processes.
- The use of social media for recent disasters highlights the vital role of non-military data.

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Information Fusion – A Definition

- Information fusion is defined as an "information process that associates, correlates and combines data and information from single or multiple sensors or sources to achieve refined estimates of parameters, characteristics, incidents and behaviors" (Llinas et al. 2004; Kludas et al. 2008).
- Information fusion is best represented in three levels named as follows: 1) data fusion; 2) intermediate fusion; and 3) decision fusion.

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Proposed Data Fission Framework
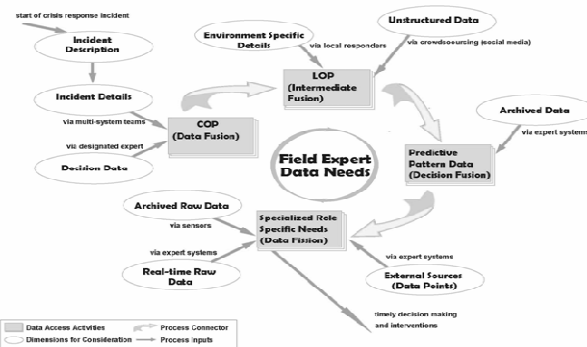
Conclusions and Future Research

- Work in progress investigates specific instances that align sensors with emergency management real-time data needs and archived environmental data.
- A two step approach focusing on the role of the human user and sensor data is proposed.
- A mathematical algorithm will be designed to support the data fission framework.

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Related Publications To-Date

- Gomez, Elizabeth Avery and Joe Chimento, "Information Access Challenges: Data Fission Needs of the Field Expert," *International Command and Control Research and Technology Symposium (ICCRTS)*, June 2011
- Gomez, Elizabeth Avery, and Michael Bartolacci, "Crisis Management and mobile devices: Extending Usage of Sensor Networks within an Integrated Framework," *Proceedings of the 8th International Information Systems for Crisis Response and Management (ISCRAM) Conference*, Lisbon, May 2011.
- Bartolacci, Michael and Elizabeth Avery Gomez, "Virtual SONET" Routing Architecture for Ad Hoc Networks in Environmental Monitoring and Emergency Management," *Wireless Telecommunications Symposium (WTS)*, April 2011.
- Gomez, Elizabeth Avery, "Towards Sensor Networks: Improved ICT Usage Behavior for Business Continuity," *SIGGreen Pre-ICIS Workshop*, December 2010.

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