**Heterogeneous Battlefield Sensor Networks:**

A Bio-Inspired Overlay Architecture

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**CONOPS**

- Sparse number of very capable sensors
- Monitor up to 100 Km²
- Sensors cannot communicate with each other
- Small network of UAV’s for data exfiltration

**Path Planning**

- Key capabilities
  - Path planning
  - Event detection
  - Data fusion
    - Source localization
    - Event classification
  - Heterogeneous sensor networks

**Localization**

- Choose Route to Minimize Cramer-Rao Bound

**Classification**

- Alternative Method: Zhou/Lamont Quadratically Constrained Least Squares
  
  \[
  \min \| A x - b \| \quad \text{subject to} \quad x^T C x = 0
  \]

  \[
  x = (A^T A + \lambda C)^{-1} A^T b
  \]

  \[
  \phi(\lambda) = \sum (x_i^2 - \alpha (1 + \lambda \alpha_i)^2 = 0
  \]

  LaGrange Multiplier \( \lambda \)

- Comparative Analysis

**Field Test**

- Why Swarms?
  - Identify global minimum - classify acoustic signatures

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**Key capabilities**

- Path planning
- Event detection
- Data fusion
  - Source localization
  - Event classification
- Heterogeneous sensor networks

**Accomplishments**

- Developed core software algorithms
- End-to-end system simulation
- Field tested key system capabilities with heterogeneous sensor network and UAV
- Demonstrated source location errors ~3 m from field data

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