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Advanced Sensor Fusion

S&T Campaign: Sciences for Maneuver
Logistics and Sustainability

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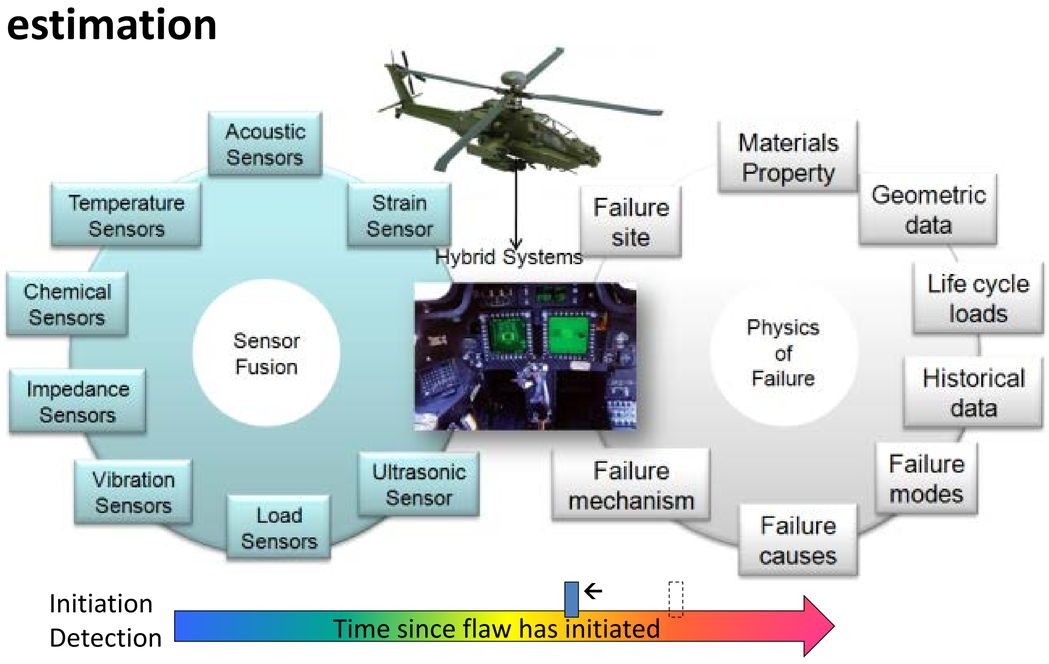
Research Objective

- **Develop an advanced sensor fusion framework for anomaly detection, health monitoring, and life prediction of dynamic rotorcraft components**
- **Combine information from physical damage models and heterogeneous sensor data to provide accurate state estimation**

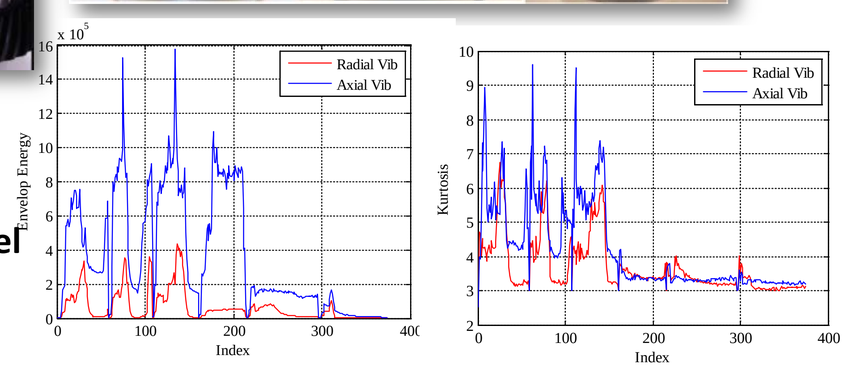


State Estimation using Sensor Fusion & Physics Models

Challenges

- **Fusing evidence from heterogeneous sensor networks**
- **Adapting existing theory such as Chvátal's art gallery algorithm or compressed sensing method to optimize number of sensors and location**
- **Determining probability of detection of a hybrid system**

- **Vibration data**
- **Oil density**
- **Acoustic emissions**
- **Physical wear model**
- **Fatigue model**
- **Performance data**

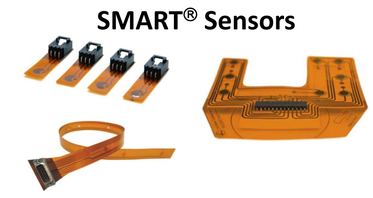


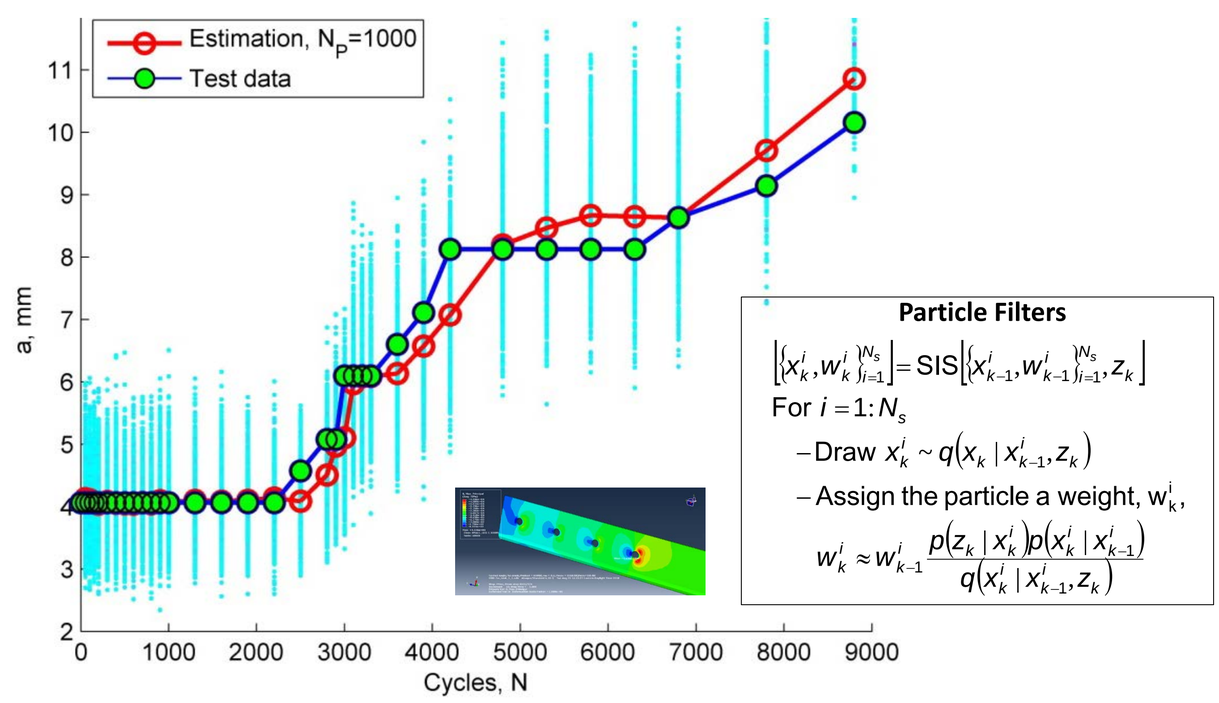
Sensor Fusion for Bearing Health Monitoring

ARL Facilities and Capabilities Available to Support Collaborative Research

- **Acoustic emission, optical Fiber Bragg interrogator**
- **Eddy Current and ultrasonic flaw detectors**
- **Full-field imaging systems and DIC**
- **Acoustic SMART sensors and actuators**
- **Pulsed thermography**
- **High-speed oscilloscope**
- **LabView data acquisition systems**

SMART® Sensors

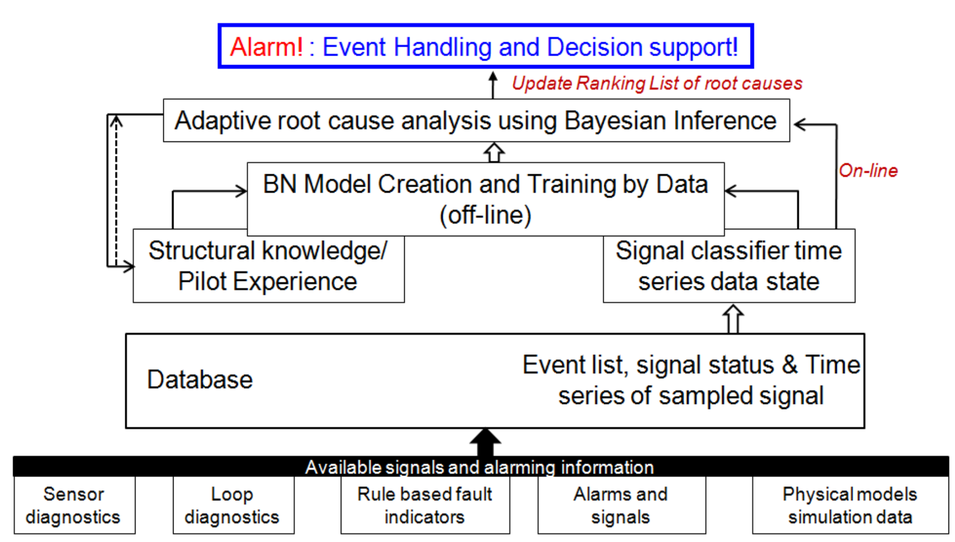




Particle Filters for Fatigue Crack Estimation

Complementary Expertise/ Facilities/ Capabilities Sought in Collaboration

- **Modeling and analysis such as ultrasonic wave defect interaction modeling, acousto-ultrasonic mode conversion and integrated structural prognostics and diagnostics**
- **Advanced signal processing algorithms, compressive sensing, matrix-completion, and signal source separation**
- **New sensor fusion paradigm such as hybrid architecture, sparse and distributed sensor array, and intelligent decision support systems**



Hybrid Sensor Fusion Architecture with Decision Support

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