The Importance of Shared Awareness for Human-Machine Symbiosis

- NDIA Human Systems Conference March 2017

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Aerospace Advanced Technology

High Functioning Teams

- Challenge of Dynamic, Complex Task Domains
- Requires high fidelity shared awareness among team
  - Goals
  - Evolving Situation
  - Roles and Responsibilities
- Importance of this exemplified in adoption of Crew Resource Management (CRM)
  - Communication and Decision practices in Flight Operations focused on shared awareness

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Current Gaps in Human-Machine Teaming

Not mutually beneficial

- Opaque intelligent systems
- No awareness of human state by machine
- No common language

How effective would it be teaming with human with no common language?

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Machine Transparency

- Important for developing human mental model of machine teammate
- Of increasing importance when teaming with autonomous and semi-autonomous systems
- Transitioning of authority and autonomy between human and machines
- Transparency facilitates trust and acceptance

Transitioning from strong, silent automation to collaborative, expressive autonomy

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Human State Awareness

- Typically focus on providing human with machine state, not vice versa

- Effective teaming involves recognizing and adapting to changing states of others

- However, most complex systems assume fixed state
  - E.g. Flight operations---assumes crew are well-rested, vigilant, and have complete, accurate knowledge of systems

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Awareness Gaps

- Human mental models become de-coupled from system state

- In symbiosis, machine infers gaps in awareness
  - With initiative to query and correct

- Automation limits, opportunity for Autonomy
  - Asiana Flight 214 Accident

Morphing automation to autonomy to have the awareness and initiative required for true collaboration

Common Language

- Aviation: ATC and crew think in Clearances
  - BUT this needs to be translate into avionics mode logic

- Representational differences in navigation
  - Humans: semantic/qualitative
  - Machines: metric/quantitative

- Not just "user interface" issue– since underlying functional logic is fundamentally different from human cognitive constructs

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Human Machine Testbed

- Address empirical and technical questions
- Coupled with complex task environment
  - E.g. automation enabled flight operations
- Evaluate methods to identify awareness gaps
- Assess performance impact of machine intervention logic

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Preliminary Findings

- Importance of computational framework to manage teaming
  - CRM
- Value of joint reasoning on human state/behaviors and system state
- Human attention likely most scarce resource in human-machine collaboration

Thank you

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Questions?

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Backup

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Global Representation
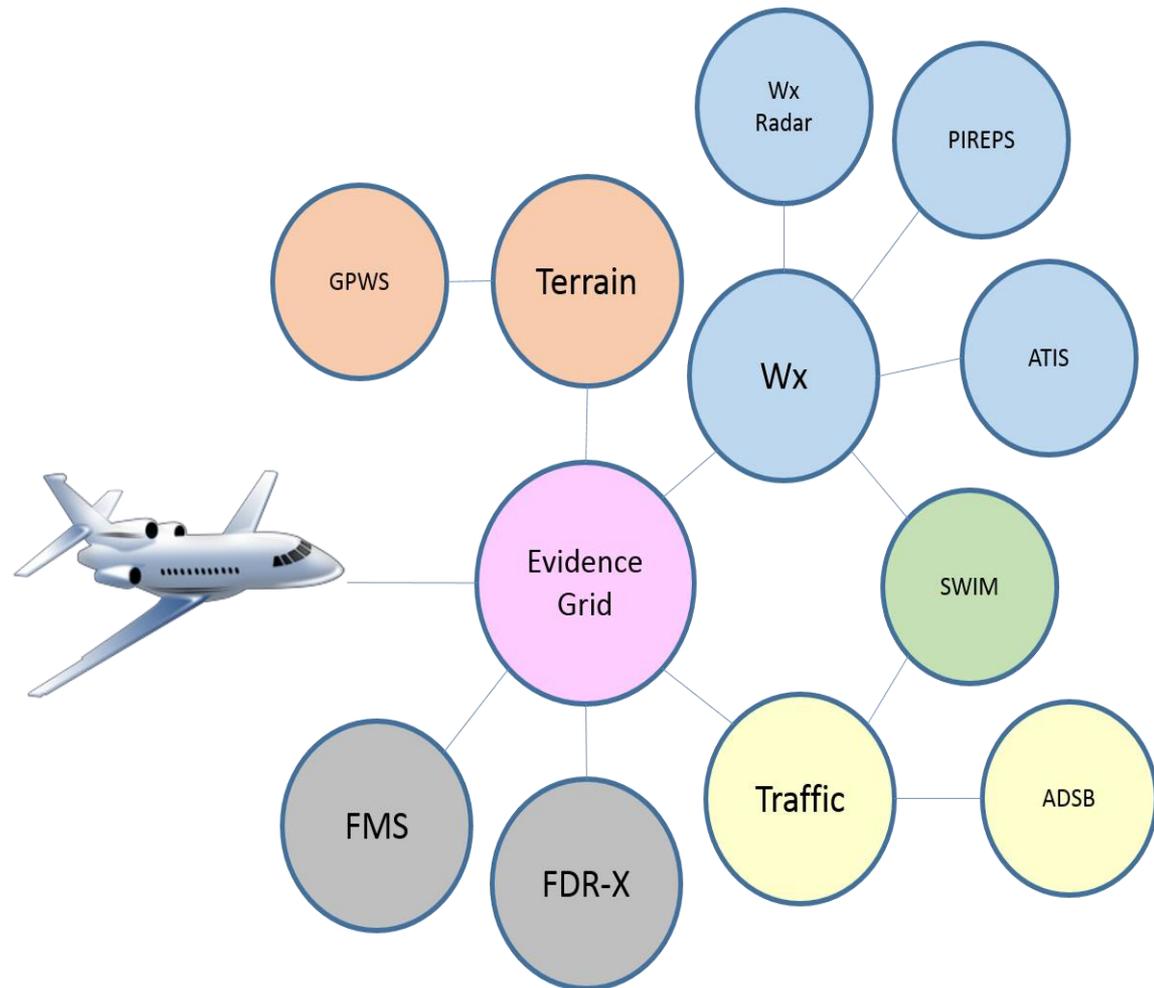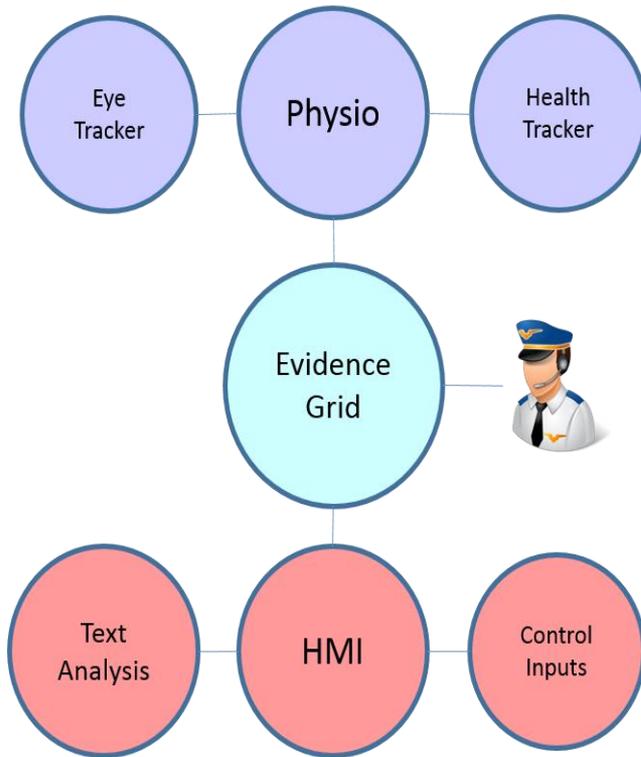
Speech Recognition and Generation

- Natural medium for collaborating
  - Validated Speech Recognition in challenging acoustical environments
  - Honeywell ATC transcription—modality management to support flight crew

- Likely interaction
  - Call Outs
  - Reading Checklist to support joint performance
  - Respond to pilot verbal requests—e.g., requesting charts, display changes

Streamlining interactions on the flight deck

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