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Research Spotlight Forum

Social Sciences & Decision Making

Human-Systems Integration for Remote Sensing

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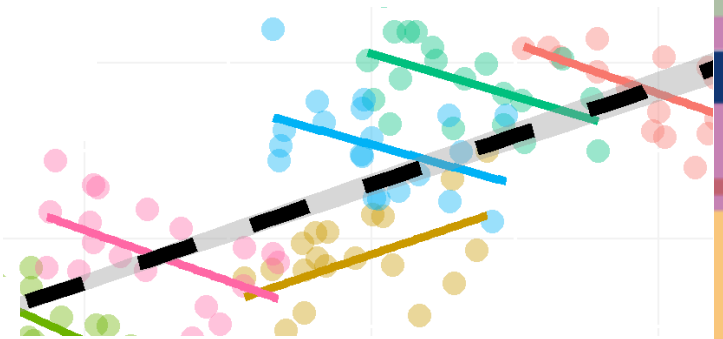
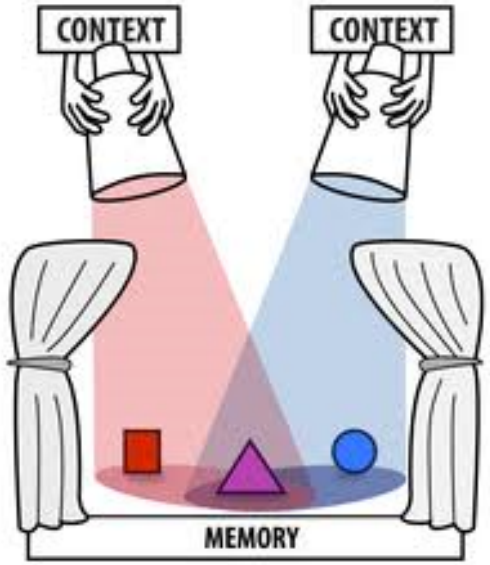
Formal Background

PhD in Cognitive Psychology

- Memory & Learning
- Visual Attention & Perception
- Quantitative Psychology

✓Focus on **basic, theoretical research** on how the mind works

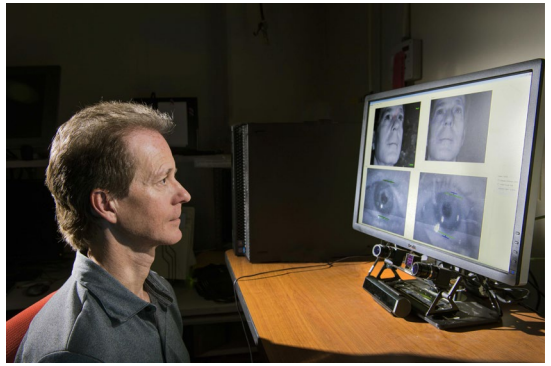


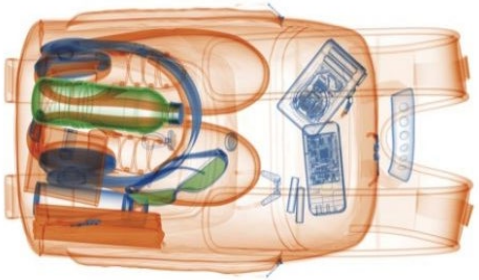


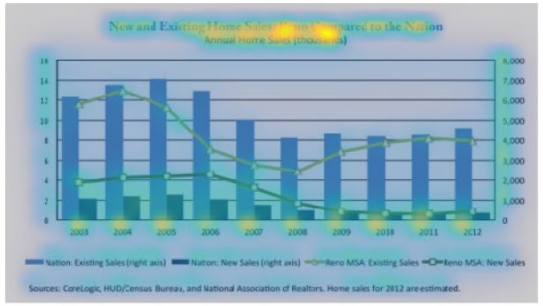
Research Areas at Sandia

- Visual search and decision making for imagery analysts
- Human comprehension of data visualizations
- Markers of performance decline in extreme environments
- Cyber disruption and deception
- Human-systems integration for geospatial intelligence in remote sensors

✓Focus on **national security research applications**—from basic, theoretical research to real-world applications







Funding Sources & Partners

Current:

- Remote sensor human machine interface work: CRADA with industry sponsor (partnering with USAF operators)

Recent:

- Dynamic eye tracking for radar imagery analysts: LDRD
- Human comprehension of data visualizations: LDRD (Academic Alliances with UIUC and Georgia Tech)
- Wearables at the Canyon for Health: Defense Threat Reduction Agency (partnering with UNM Emergency Health, Digital Artefacts, and National Park Service)
- Cyber disruption and deception: DoD

Human-Systems Integration Lab

Current focus: providing theoretically sound, empirically validated guidance on how to make **remote sensing systems** better **support operator workflows and goals**

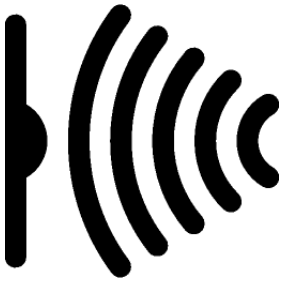
Multi-disciplinary team

- Ethnographic & qualitative research
- Vision science & cognitive psychology
- HCI, UX, Interaction Design
- Software developers
- Mathematics & computer science
- Engineering & sensor experts

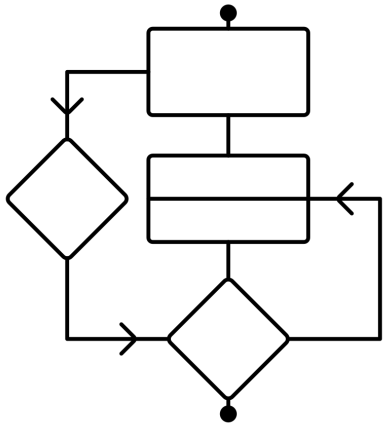
Human-Systems Integration in Remote Sensing Systems

Typical data pipeline for remote sensing systems for geospatial intelligence:

World full of things we'd like to know more about



World-class **sensors** generate lots of data



Sophisticated **algorithms** parse that data, extracting and combining to output important pieces

Operator takes output and uses it to support national security mission

Human-Systems Integration in Remote Sensing Systems

Keys to successfully transitioning to operator use in national security mission:

- Human machine interface (HMI) and supporting systems must take into account
  - Context of use
  - Operational workflow
  - Limitations and capabilities of operator and machines

- How?
  - Human-computer interaction and ethnographic techniques, supported by all stakeholders on team
    - Get everyone in the **same room** and out to see **context of use**
  - **Translational research** from complementary domains (e.g., vision science)

Human-Systems Integration in Remote Sensing Systems

Methodology that's worked for us:

- "Quick and dirty" version of **UX methods** traditionally developed for industry (often mobile or web)
  - Take what works, forget the rest
  - Combine with methodologies from other domains (e.g., business or human factors)
  - Know your domain—national security software is different than typical mobile apps (e.g., captive audience, "delight" is nice but not a focal point)
- Bring in **stakeholders** early and often—facilitate discussions between them
  - Engineers (build the sensors)
  - Computer scientists (develop algorithms)
  - Software developers (HMI)
  - Big wigs ($$ and decisions)
  - Operators (mission understanding)
- Go to the operators and understand their **context of use**
  - Field studies, semi-structured interviews, wireframes
  - …but don't make big changes based on a single operator's feedback!

Human-Systems Integration in Remote Sensing Systems

Success story:

- System was given CAT1-DR by Air Force
  - Error-inducing and practically unusable
  - Sensor wasn't even being turned on
- Improved by:
  - Simplifying HMI
  - Mapping out and understanding operator workflow
  - Going to context of use and eliciting feedback directly from operators
  - Bringing software developers and engineers into the "know" on both context of use and best practice for HMIs
- Led to:
  - Validated improved design (e.g., SUS evaluation increased from an F to A+)
  - "Buy in" from operators and software developers
  - Increased use of the sensor

RESEARCH NEEDS

Identifying and supporting other national security missions that have similar issues with poor HMIs

- Take methodologies and lessons learned from work on current remote sensing systems and apply to new areas

Translational research for human-systems integration

- Let's not reinvent the wheel—what other domains can we draw from to fix cruddy software?

Software developers

- Upcoming projects in pipeline
- Boutique software for experimental data collection platforms

Questions?

Thanks! Feel free to follow-up via email: kmdivis@sandia.gov