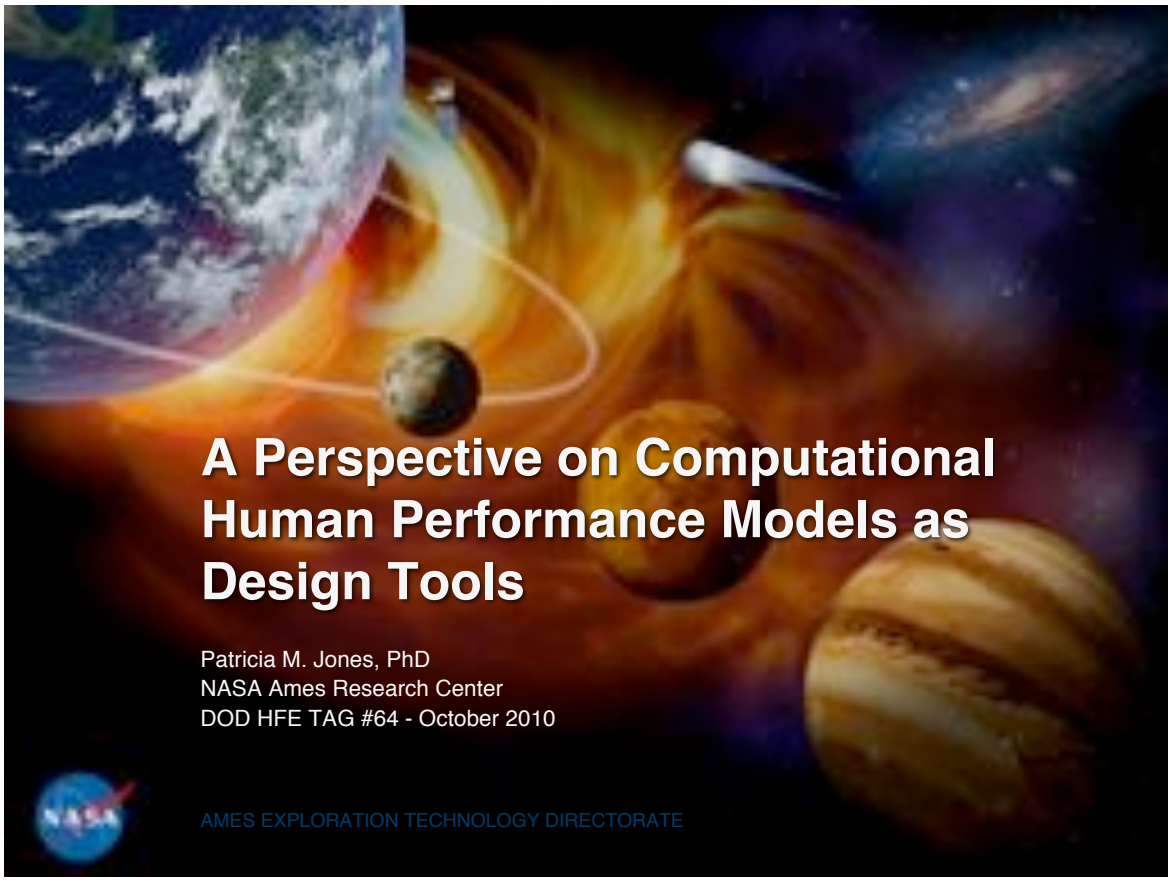


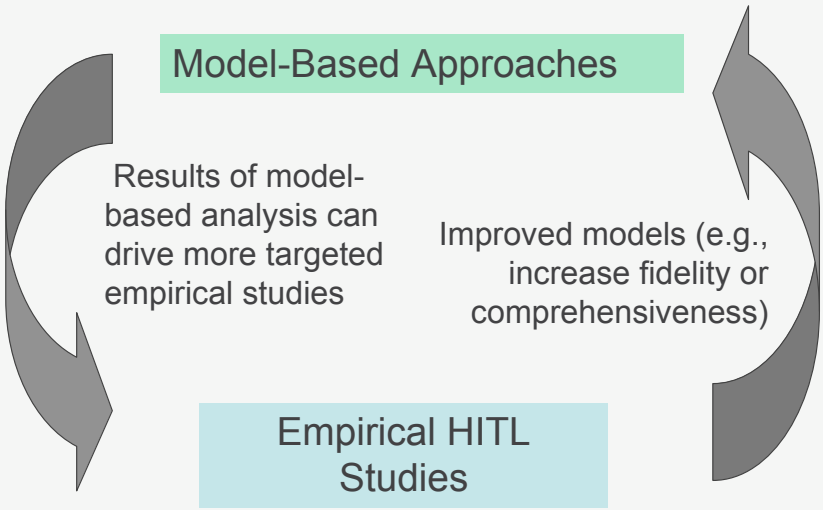
Designing and Validating Displays & Controls

D&C design, development, test and evaluation is based on knowledge of goals, task and information requirements, system constraints, capabilities and limitations of the target user populations…

How to situate this in the context of commercial space systems is under discussion.

One example: Suppose NASA does V&V of commercial space concepts using a combination of model-based analysis and empirical testing

DDT&E Integrated Strategy



Example: Browser usability for novices

- Step 1: Small exploratory novice user study with think-aloud verbal protocols
- Step 2: Generate design alternatives
- Step 3: Predict expert performance with CORE cognitive model for all three alternatives
- Step 4: Empirical validation of model
- Step 5: Refinement and analysis
- Step 6: Final user studies with both experts and novices

Knight, A., Pyrzak, G. and Green, C. (2007). When Two Methods are Better Than One: Combining user study with cognitive modeling. *Proc. CHI 2007*, ACM 978-1-59593-642-4/07/0004, pp. 1783-1788.

Some Models Focus on Specific Genres of Tasks or Processes

- Signal detection theory
- Fitts Law
- Hick-Hyman Law
- **Spatial Standard Observer**

Assuming you can map the problem of interest into that framework

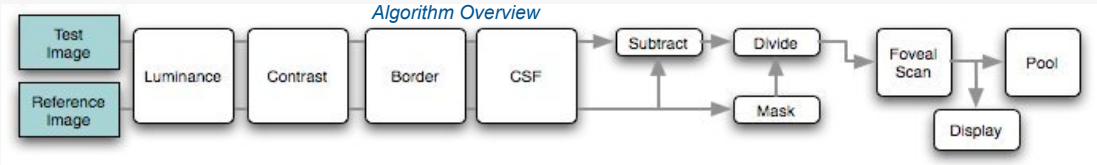
Spatial Standard Observer: predicting visibility

- Simple engineering tool to measure target visibility
- Replaces human observer in systems engineering
- Based on science model
- http://vision.arc.nasa.gov/sso/
- US Patent #7,783,130 B2 (8/24/10)
- Users include FAA, ARL, industry

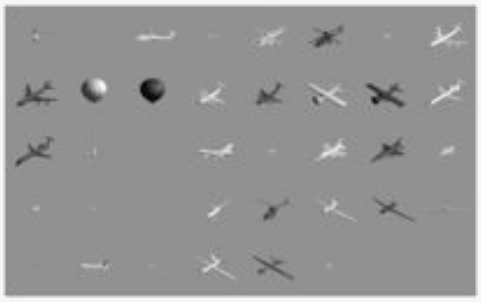
Target Identification

Orbiter Damage Inspection

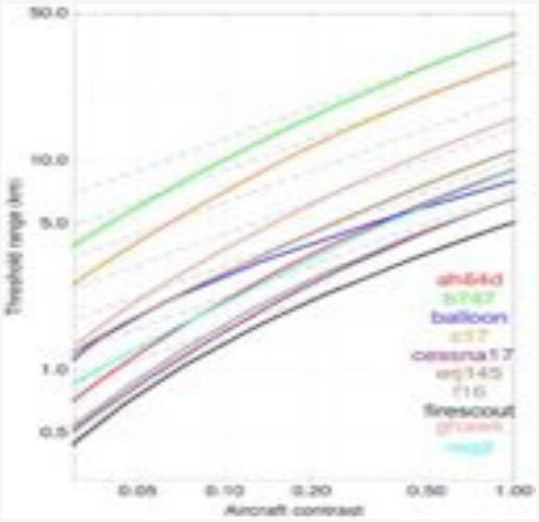
Algorithm Overview



Watson & Ahumada (2005) *Proc. IEEE Systems, Man, and Cybernetics*.



Watson, A., Ramirez, C. V., & Salud, E. (2009). Predicting Visibility of Aircraft. PLoS ONE, 4(5), e5594, http://dx.doi.org/10.1371/journal.pone.0005594.



predictions of visibility range as a function of aircraft contrast for various craft.

 Funding: FAA

Other Models are “architectural”

MIDAS - task network architecture

CORE - cognitive architecture

MIDAS Flight Deck Application Model

Microsaint Environment Traffic Model

- Simulated aircraft movement in air/on ground
- Sends position data to MIDAS model

MIDAS Task Network and Behavioral Model

- Crew procedures
- Visual attention
- Perception
- Memory
- Task workload primitives
- Workload by phase of flight
- Workload / SA timelines

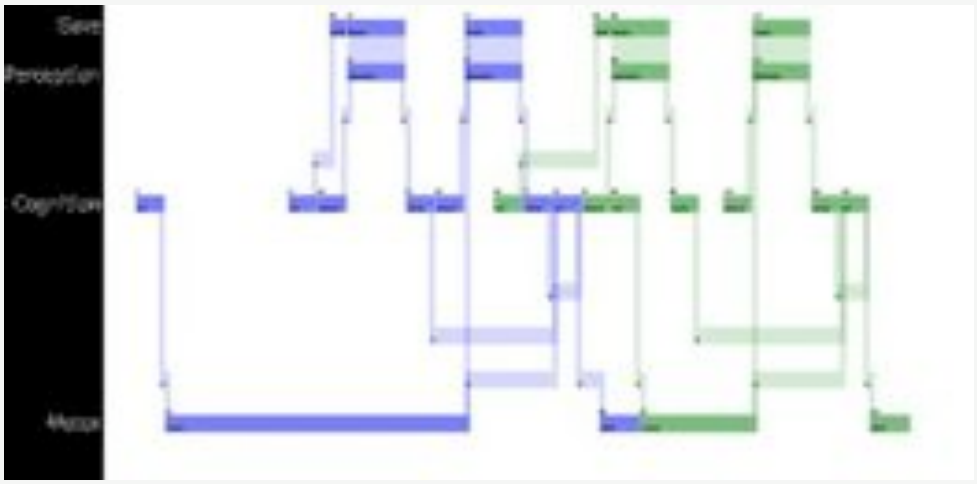
Crewstation and Anthropometric Model

- Boeing 777 cockpit
- Anthropometric representation of Captain, First Officer, ATC

Funding: NASA Airspace Systems Program

Ames Research Center - Exploration Technology

CORE: Constraint-Based Optimal Reasoning Engine. **Predicts time and speed/accuracy trades**



NASA Ames Human-Computer Interaction Group
http://hci.arc.nasa.gov/pages/2004/10/corexprt_1.html

Distinctions in Modeling

- Level of Detail
  - Conceptual - Computational - Mathematical
- Level of Task Specificity
  - Task-Independent - Task-Dependent - Device-Dependent
- Discipline Focus
  - e.g., Physiological, visual, cognitive, motor, social…

A spectrum of Human Health and Performance

	Survivability (Biomedical Perspective)		Mission Success: Task Performance (HSI/HF Perspective)	
Human Processes	•Bone •Muscle •Pulmonary •Cardiovascular •Radiation • Immunology	•Neurovestibular •Spatial disorientation •Space motion sickness •Space Adaptation Syndrome •Fatigue • Behavioral health	•Anthropometry •Biomechanics •Visual perception •Auditory perception •Tactile perception •Attention, Memory •Decision making •Motor control •Communication	• Performance Readiness •Fitness for Duty •Situation awareness •Workload •Planning •Response execution
System design	• Life support •Environmental monitoring and control • Dust containment	•Habitability •Ergonomics •Comfort •Reachability •Waste systems •Food systems •Stowage	•Legibility •Intelligibility •Usability •Maintainability •Human-automation interaction •Advanced multimodal interfaces	