Open House of the Human Systems Integration Division at NASA Ames Research Center

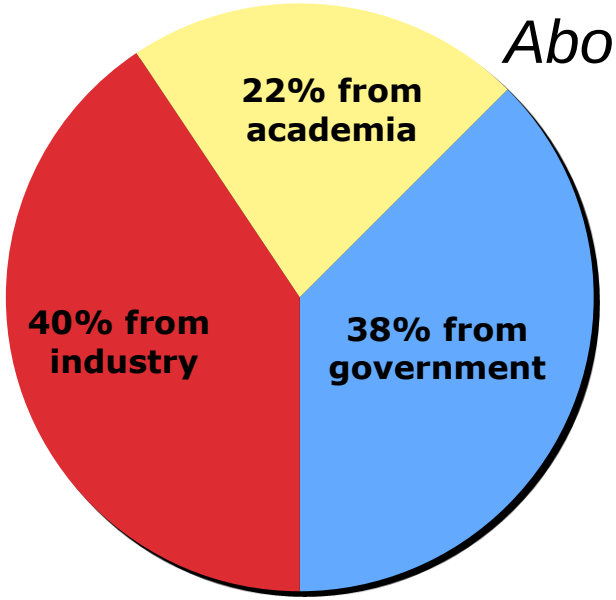
Wednesday, June 10, 2009

Introduction by Dr. Jeffrey McCandless

Deputy Division Chief
Human Systems Integration Division

Purpose of the Open House

- To share information on the Division's activities.
- To learn about your related work and interests.
- To forge contacts that may be useful for collaborations.



About 64 visitors are expected.

A Big Thank You To …

Lead Coordinator… Holly Latta

Plus … Albert Ahumada, Jolene Feldman, Naz Haghbin, Marlene Hernan, Eric Lee, Bonny Parke, Phil So, Barbara Sweet, Jason Toy

Breakfast compliments of… San Jose State University
Dr. Kevin Jordan
(Project Director and Professor of Psychology)
with Jennifer Granada and Audra Ruthruff

Orientation and Safety Overview

Agenda of the Open House

Time	Event	Location
8:00-9:00am	Donuts and coffee	Room 100
9:00-9:30am	Welcome by Dr. Pete Worden and Introduction by Dr. Jeffrey McCandless	Room 100
9:30-10:30am	Overview of each Lab by the Principal Investigators	Room 100
10:30-11:00am	Break and Lab Tour sign-up	Room 100
11:00-11:45am	Lab Tour #1	Labs
11:45am-1:15pm	Lunch	Courtyard
1:15-2:00pm	Lab Tour #2	Labs
2:00-2:45pm	Lab Tour #3	Labs
2:45-3:30pm	Lab Tour #4	Labs
3:30-4:00pm	Wrap-Up by Dr. Jeffrey McCandless and Gaye Graves	Room 100
4:00-5:00pm	Social	Courtyard
5:00-???	Informal Drinks and Dinner at Tied House Cafe & Brewery	Mountain View

Overview of NASA

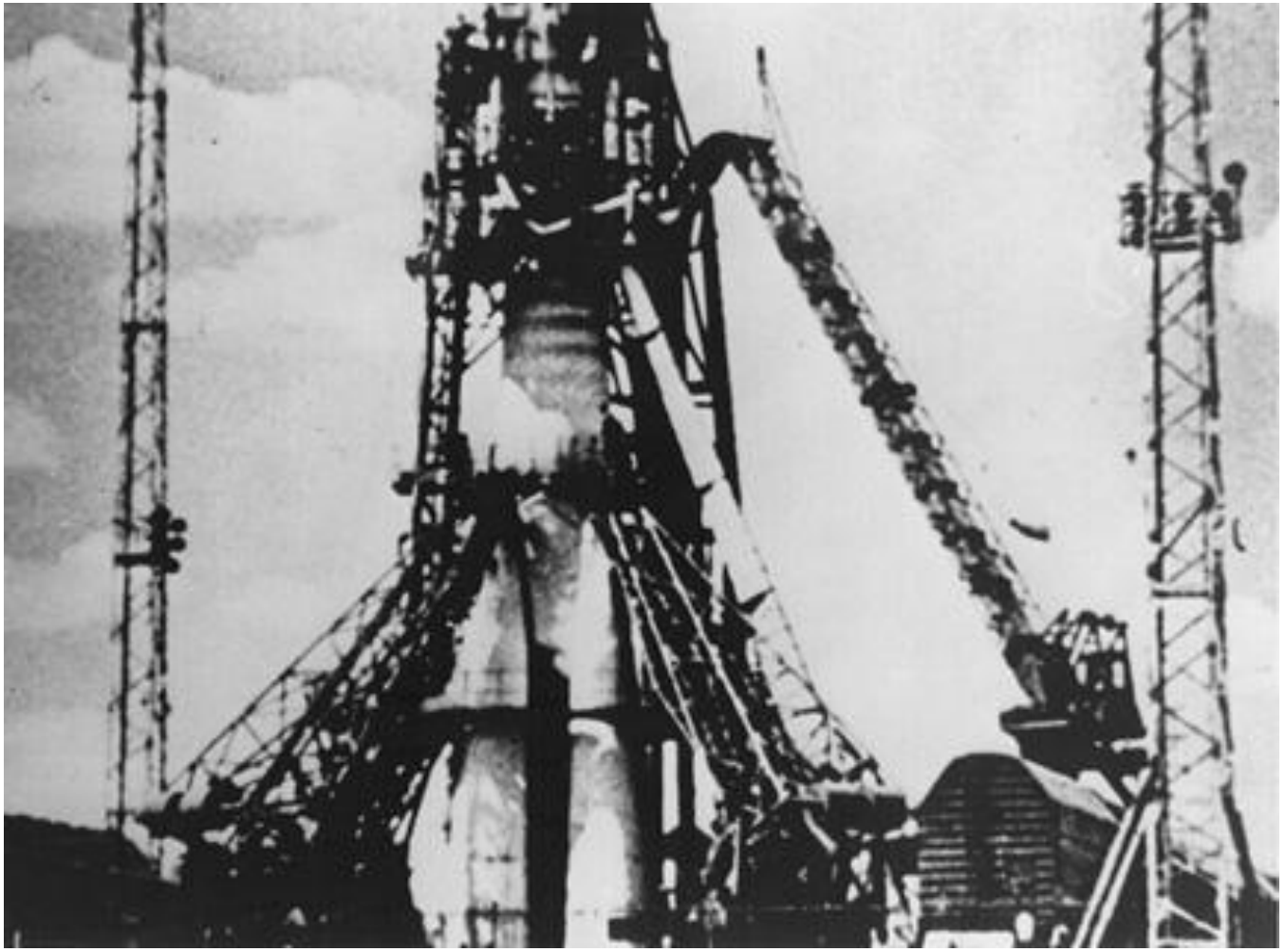
In 1903, the Wright Brothers flew their first powered aircraft.

Overview of NASA

In 1915, the National Advisory Committee for Aeronautics (NACA) was established.

Overview of NASA

In 1957, the Soviet Union launched Sputnik 1, the first artificial satellite.



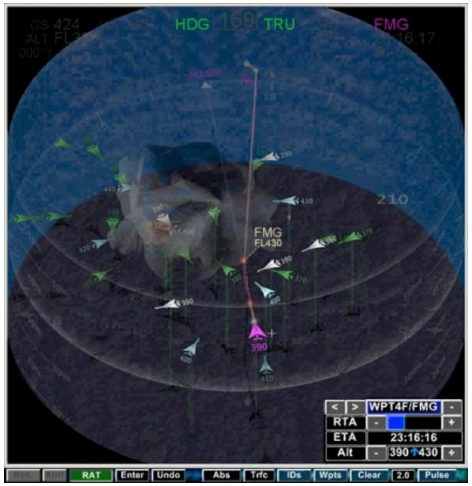
Overview of NASA

In 1958, the National Aeronautics and Space Administration (NASA) began operations.

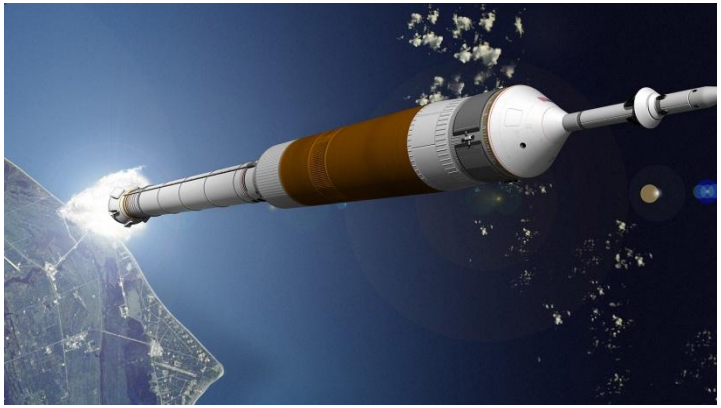
Overview of NASA

NASA Mission Directorates

Aeronautics Research



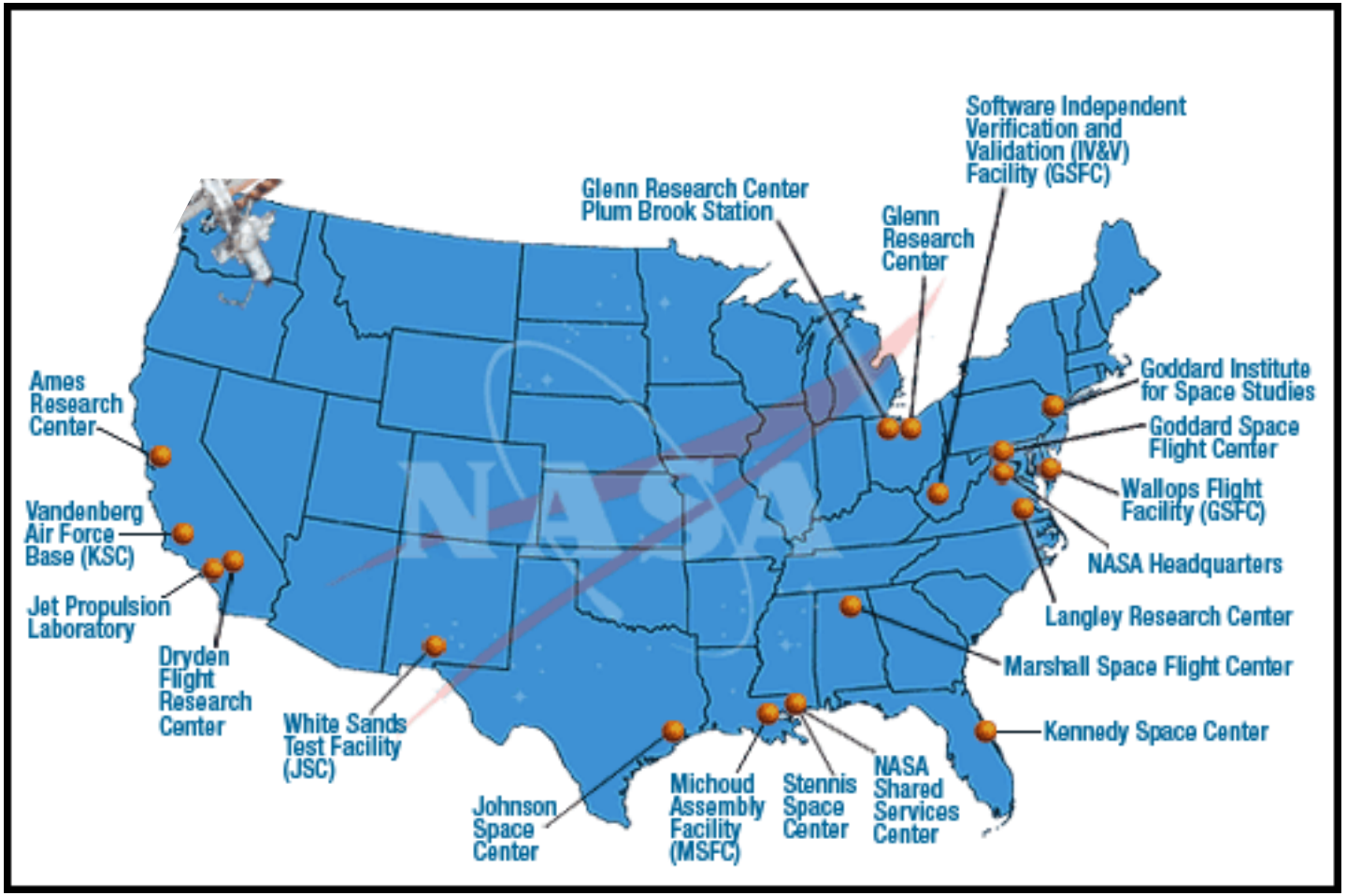
Exploration Systems



Science

Space Operations

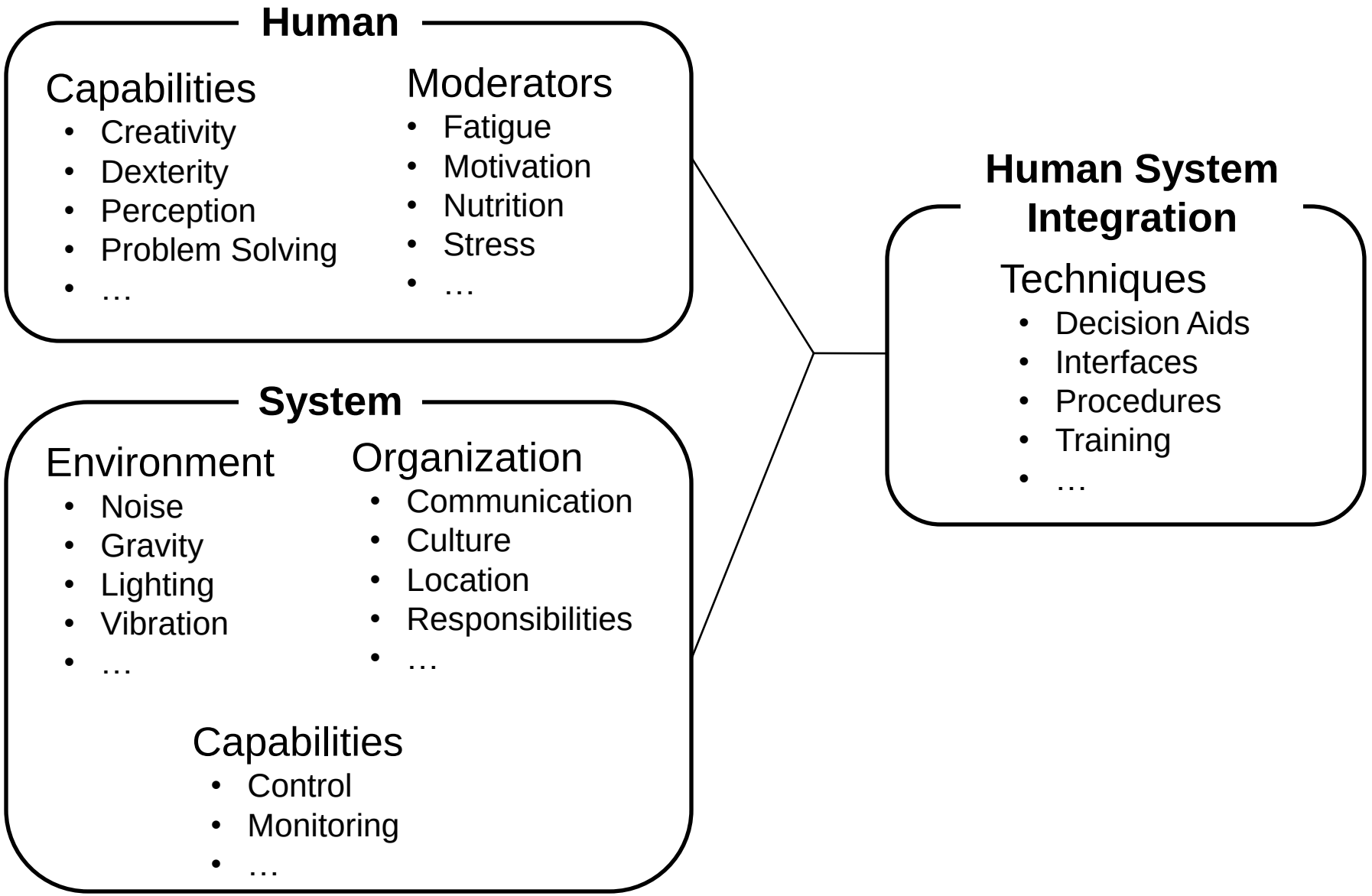
Overview of NASA



Overview of Ames Research Center

- Founded in 1939 as a lab of the National Advisory Committee for Aeronautics
- Over 2300 personnel
- Approximately $600M annual budget
- Partnerships and External Relations
  - NASA Research Park (Universities such as Carnegie Mellon , Singularity University, and UC Santa Cruz and Industry members such as Airship Ventures and Google)
  - NASA Lunar Science Institute
  - International Space University Space Studies Program
- Leader in areas such as
  - Aeronautics Research
    - Air Traffic Management
    - Aviation Safety
  - Exploration Technology
    - Intelligent Systems
    - Space Technology (e.g., thermal protection)
    - Supercomputing
  - Earth and Space Science
    - Astronomy
    - Lunar Crater Observation and Sensing Satellite (June 17 planned launch)
  - Human Systems Integration

Overview of the Division



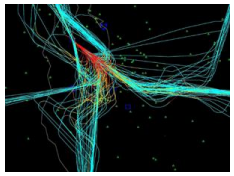
This diagram is based on a chart from Dr. Cynthia Null, the NASA Technical Fellow for Human Factors.

History of the Division

Crew Resource Management

Line-Oriented Flight Training

Automation Design



System Monitoring, Data Visualization, Information Sharing

Human Exploration of Space

Aviation Safety Reporting System

1970

1980

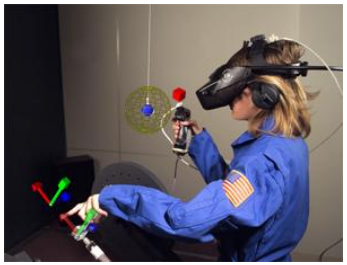
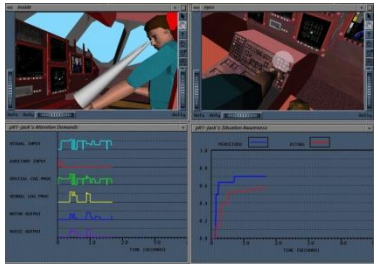
1990

2000

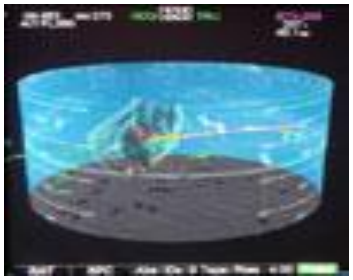
2010

Overview of the Division



- **Human-Machine Interaction**
  - Crew and vehicle scheduling tools
  - Problem analysis and correction action system
- **Human Performance**
  - Vision and auditory interface research
  - Crew cockpit design (e.g., spacecraft cockpits, virtual environments)
  - Perceptual, cognitive, and physiological analyses
  - Computational Model development
- **Integration & Training**
  - Flight deck display design and evaluation
  - Air traffic management integration for air-ground
  - Safety analysis and reporting systems
  - Training, procedures and team coordination



About the Division – By the Numbers

120+ Number of personnel (most with advanced degrees)

100+ Annual publications

15+ Patents

10+ Space Act Agreements and Interagency Agreements

Staff include representatives from:

- NASA (civil servants)
- San Jose State University Foundation
- Perot Systems Government Services
- Booz Allen Hamilton
- Planner's Collaborative, Inc.

Facilities include:

- Cockpit simulators
- Air Traffic Control simulation centers
- Human Performance labs (visual, audio, physiological)

Overview of Each Lab

9:30-10:30am
(Twelve 5 minute overviews for each lab)

This is like an infomercial, except the sessions are only 5 minutes, and it's not the middle of the night.

The Labs of the Open House

Lab	Overview By
Airspace Operations Lab	Dr. Tom Prevot
Cognitive Engineering Lab	Dr. Michael Feary
Distributed Team Performance Lab	Dr. Judith Orasanu
Flight Deck Display Research Lab	Dr. Walt Johnson
Human-Centered Systems Lab	Dr. David Foyle
Human-Computer Interaction Lab	Guy Pyrzak
Intelligent Spacecraft Interface Systems Lab	Dr. Robert McCann
Operational Based Vision Assessment Lab	Dr. Barbara Sweet
Psychophysiological Research Lab	Dr. Pat Cowings
Vibration Test Facility	Dr. Brent Beutter
Vision Group	Dr. Beau Watson
Visuomotor Control Lab	Dr. Lee Stone

Airspace Operations Lab

Overview of the Lab

- ***Our mission*** in the Airspace Operations Laboratory (AOL) is to provide a better understanding of roles, responsibilities, and requirements for human operators and automation in future air traffic management systems.
- ***Our focus*** is on developing and evaluating operational concepts and technologies for the Next Generation Air Transportation System (NextGen) in a high-fidelity human-in-the-loop environment.

- ***Our team*** currently consists of 18 engineers, computer scientists and psychologists employed by NASA, San Jose State University and Perot Systems.
- ***Our technologies*** for rapid prototyping and simulations are developed by us and widely distributed and used within government, industry and academia. They include the *Multi Aircraft Control System* (MACS) and the *TCSim Route Analyzer/Constructor* (TRAC).
- ***Our research*** extends across the areas of Dynamic Airspace Configuration, Multi Sector Planning, Separation Assurance and Super-Density Operations. Results have been published in over 60 technical papers and journal articles.

- Point Of Contact: Dr. Thomas Prevot, 650-604-2441, thomas.prevot@nasa.gov
- Website: humansystems.arc.nasa.gov/groups/AOL

Airspace Operations Lab

What You Will Learn on This Lab Tour

You will see:

Operations

- The setup for the "Multi Sector Planner" human-in-the-loop experiment, a joint NASA/FAA evaluation of a mid-term concept for the Next Generation Air Transportation System (NextGen)
- A high-fidelity simulation of air traffic operations as envisioned for 2018

Prototypes

- New technologies for air traffic controllers to aid in separating aircraft from each other and from convective weather
- The experimental "Multi Sector Planner" stations with prototype displays

People

- Air traffic controllers
- Simulation support pilots
- AOL researchers

We will discuss:

Research on air traffic operations for the Next Generation Air Transportation System

Cognitive Engineering Lab

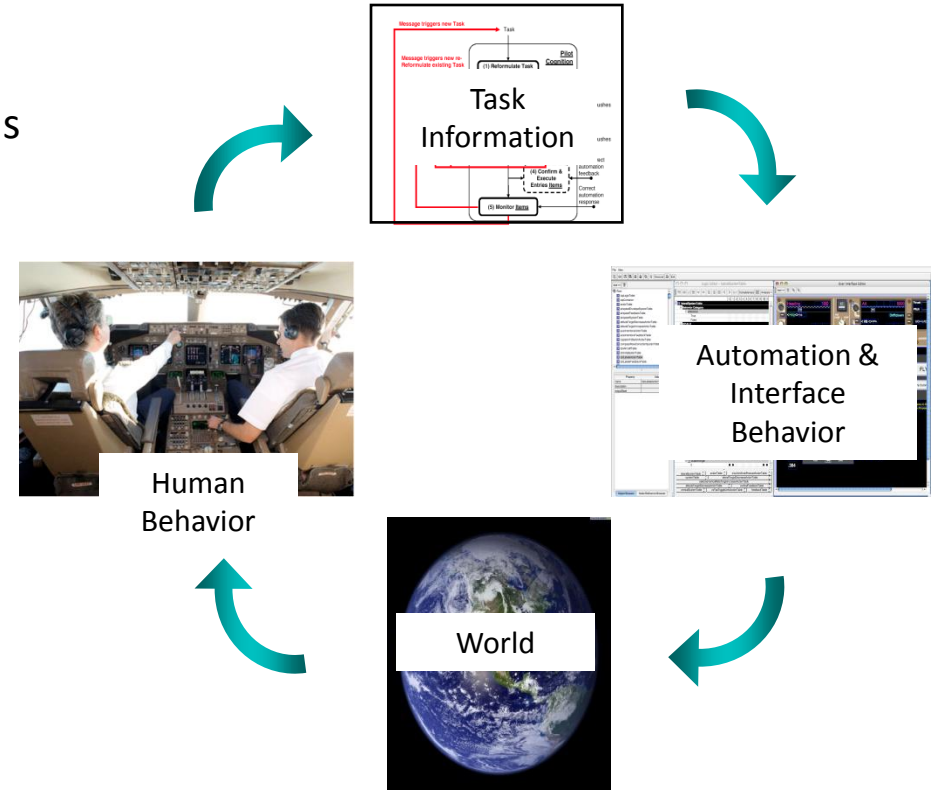
Overview

Purpose of Lab
- Develop automation interaction assessment tools
- Evaluate effectiveness of tools in design settings

Personnel
- 1 civil servant
- 3 contractors

Methodology
- Develop tools for task decomposition, prototype design and computational human performance analysis

Point Of Contact
- Dr. Michael Feary, Manager of the Automation Interaction Design Group
- Phone 650-604-0203
- Email Michael.S.Feary@nasa.gov



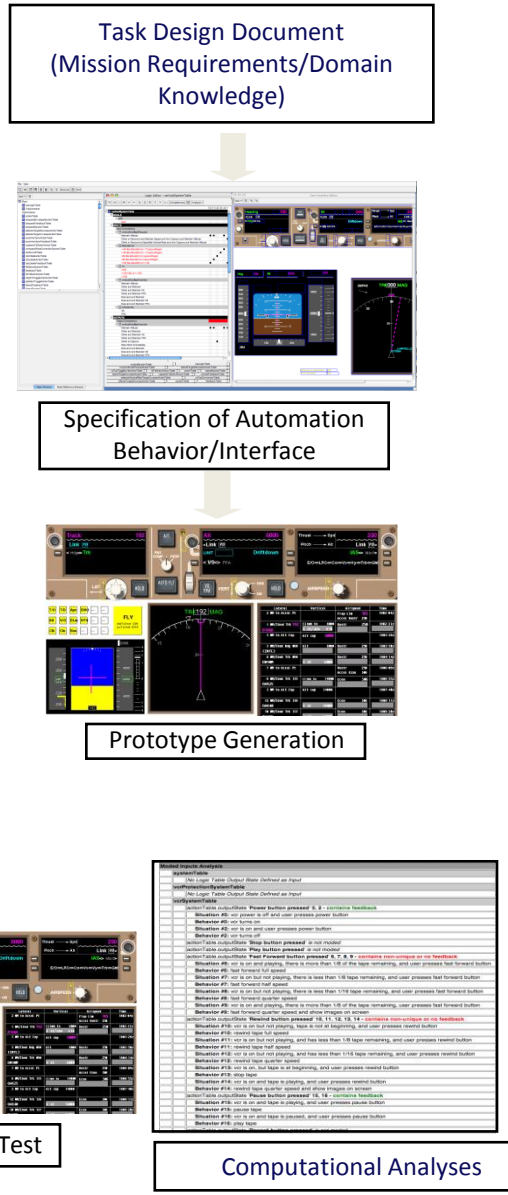
Cognitive Engineering Lab

You will see:

- Examples of design methods and tools
- Task Decomposition
- Design Prototyping
- Human Performance Analysis

We will discuss

- How methods and tools are used
- Examples of application in design
- Implications of use of tools in design and certification



Distributed Team Performance Lab

Purpose of Lab

- Conduct studies of team processes and performance in a controlled lab environment
  - What factors influence team cognition, cohesion, and performance?
- Testbed for evaluating team monitoring tools and support technologies

Personnel

- 1 civil servant
- 6 contractors/grantees

Methodology

- Collect data on teamwork skills, communication, cohesion, stress responses, and task performance while distributed team members perform 'missions'
- Manipulate team structure, stressors, and countermeasures

Point of Contact: Dr. Judith Orasanu, 650-604-3404, Judith.Orasanu@nasa.gov

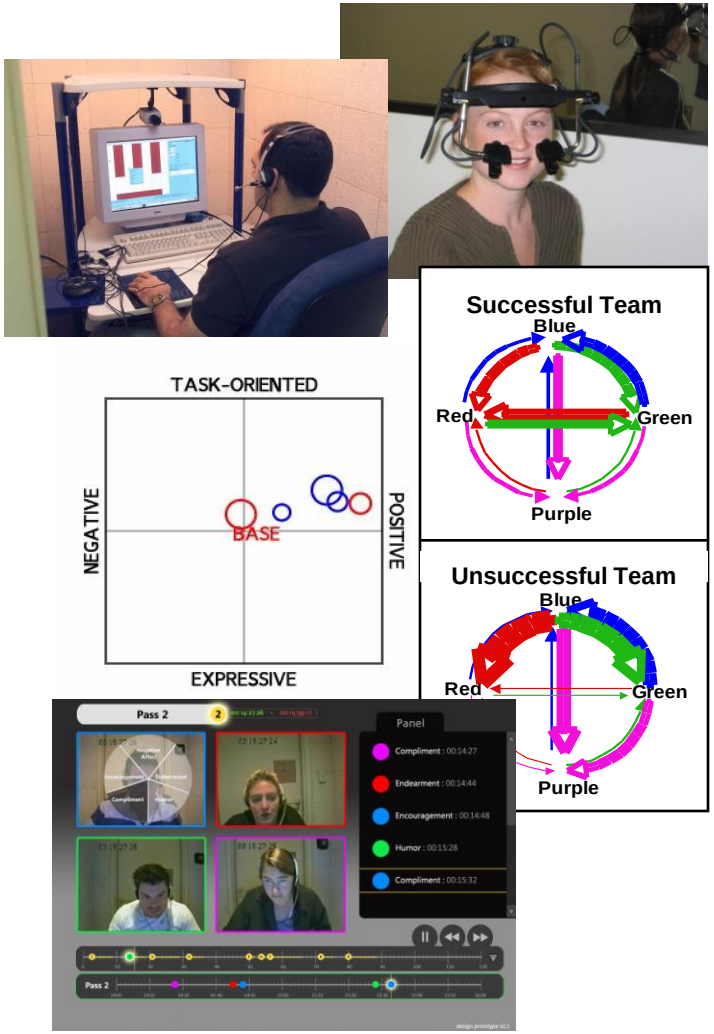
Tour of the Team Performance Lab

What you will see --

- Micro-world to simulate distributed team problem solving and decision making during lunar search missions
- Methodologies to monitor and record
  - Team communication
  - Facial expressions
  - Physiological responses
  - Team dynamics

Issues to discuss

- Indicators of team cohesion and dysfunction
  - Signs of individual and team stress
  - Teamwork skills
- Value of lab as a testbed for evaluating new team monitoring and support technologies
- How best to support team performance in aerospace and other high-risk, high-stress environments



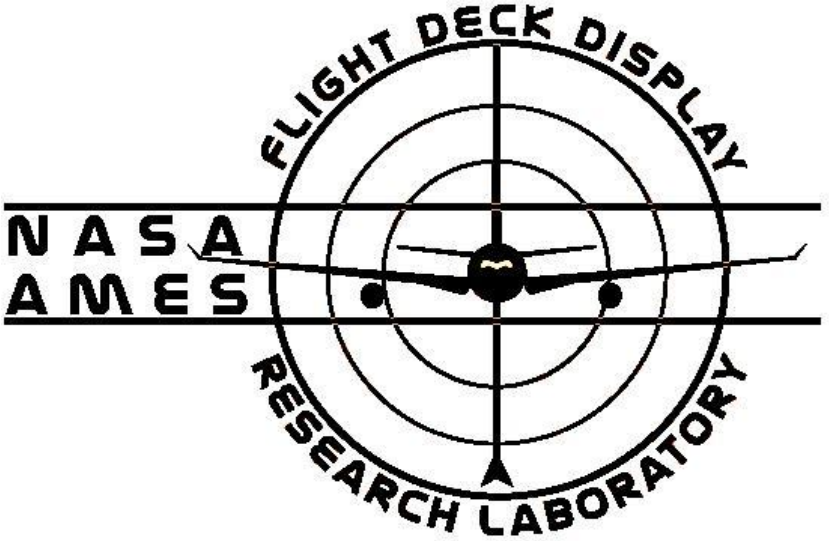
Flight Deck Display Research Lab

Overview of the Lab

Purpose of Lab
- Develop advanced airside automation, displays, and interfaces to support NextGen concepts of operation.
- Develop and evaluate NextGen distributed air-ground-automation ATM concepts in HITL simulations.

Personnel
- 2 civil servants
- 8 contractors

Methodology
- Part-task studies and multi-participant HITL simulations of air-ground-automation concepts which evaluate:
  - situation awareness
  - workload
  - performance



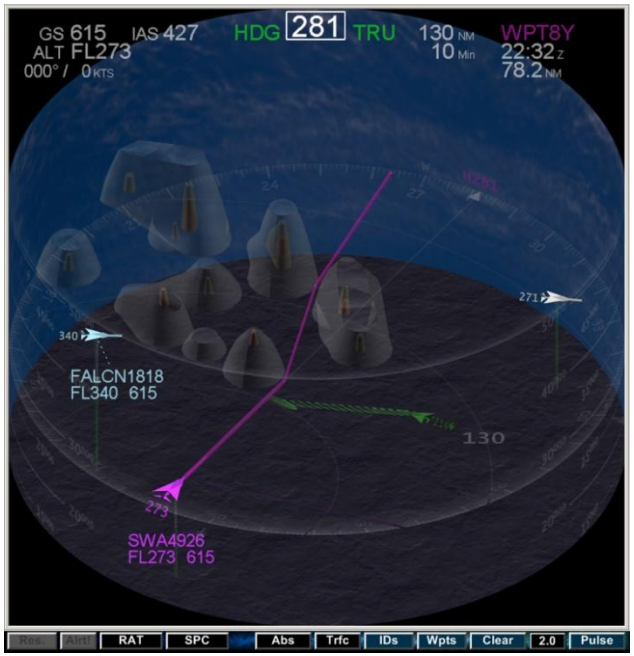
Point Of Contact
Dr. Walter Johnson, 650-604-3667
Email Walter.Johnson@nasa.gov

Flight Deck Display Research Lab

What You Will Do on This Lab Tour

You will see:

- Boeing 777 two person simulator with four screens
- FDDRL Cockpit Situation Display
- Eye Tracker



We will discuss

- NextGen concepts being evaluated by FDDRL
- Methods for non-intrusive measuring of situation awareness and workload
- How to integrate findings and results into applied settings
- Advanced displays and automation

Human-Centered Systems Lab (HCSL)

Overview

Purpose of Lab

For NextGen, using human-centered design principles, determine:

- Impact of pilot-A/C performance on NextGen Surface Traffic Management Systems
- Pilot interface requirements for time-based taxi clearances
- Flight deck impact of interactions of in-air and airport surface systems

Personnel

- 1 civil servant
- 4 contractors, 1 graduate student (SJSU)

Methodology

- Collect objective data on pilot/aircraft conformance, off-nominal events, situation awareness, and workload
- Analysis and Human Performance Modeling (using MIDAS v5.0

Point Of Contact

- David C. Foyle, PhD, HCSL Director
- Phone 650-604-3053
- E-mail david.foyle@nasa.gov

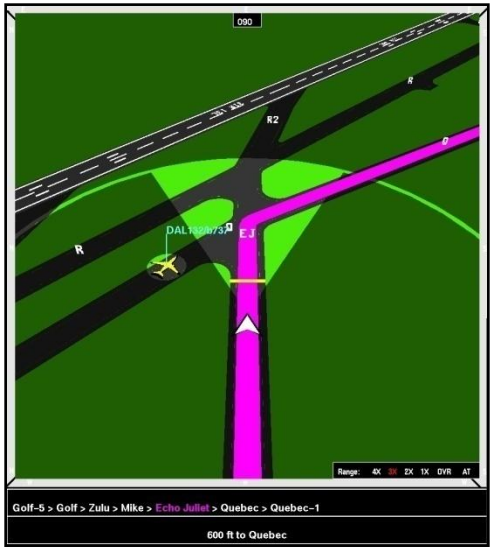
Human-Centered Systems Lab (HCSL)

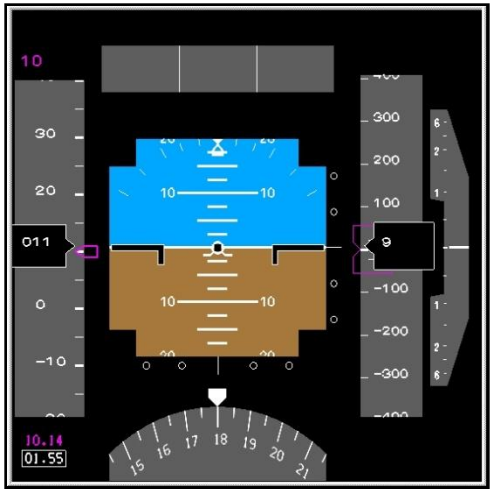
HCSL components:

- Medium-fidelity simulator (DFW airport taxi)
- Scenario Generation tool

Discussion:

- NextGen time-based taxi clearance concepts/requirements
- NextGen flexible departure concepts/requirements
- Data (ICNS 2009 paper)





Human-Computer Interaction (HCI) Lab

Who We Are…

- Generalized group of **HCI practitioners** focused on **developing and delivering mission critical software**.

What Do We Do?

- **Interview, observe, and analyze work processes** of scientists, engineers, mission managers, data analysts, stakeholders and end-users with-in NASA as well as in other domains.
- For the Constellation Problem Reporting tool we spent **over 600 hours** observing and collecting user data.

What's Our Goal?

- Develop high quality software with **usability** and **design** as the lead.

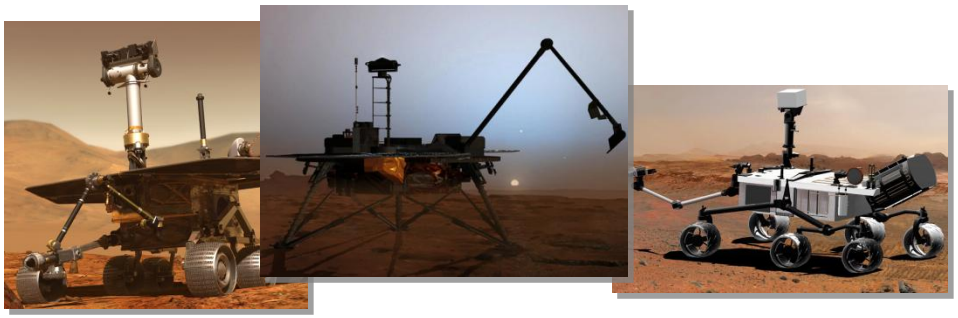
How Do We Accomplish This?

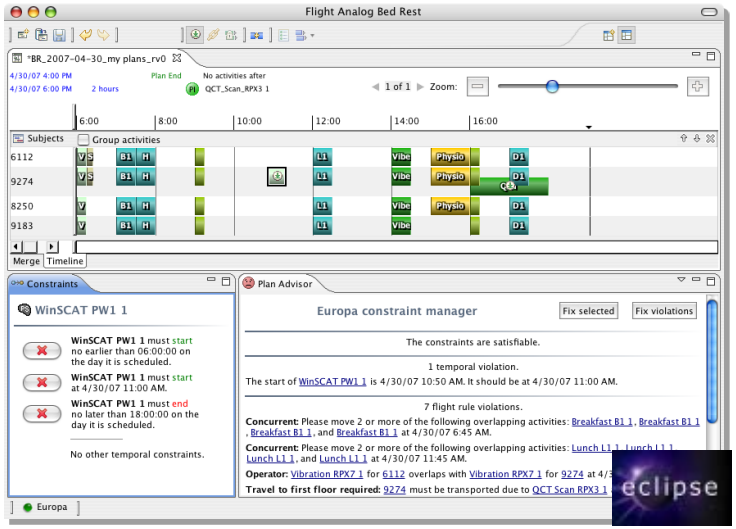
- Leverage our groups **technical understanding** of the latest technology and **open source tools.**
- See CHI2009 experience report by C.Green et al. for more info.

Human-Computer Interaction (HCI) Lab

Science Planning Interface For exploration (SPIFe)

Provides tactical activity planning for ALL current and planned Mars surface missions and will be the scheduling interface for ISS (2010). Built on Eclipse, utilizing the Europa AI planning engine.





Mission Assurance Systems (MAS)

Highly evolvable, web-based, open-source system based on Bugzilla platform and YUI, designed to support centralized NASA-wide Safety, Quality and Missions Assurance data needs for Constellation.

Four Constellation SR&QA Systems and 2 ISS Systems are supported by a single code base.

We work closely with Mozilla, CMU, and the open source community on usability research and future improvements to Bugzilla.

Over 2,500 users

Intelligent Spacecraft Interface Systems (ISIS) Laboratory

NASA is implementing a bold new vision for human exploration of the solar system

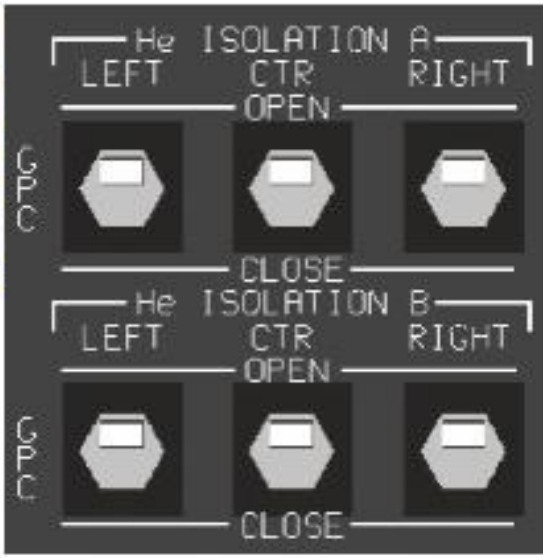
- A major requirement for exploration missions is enhanced onboard (autonomous) fault management capability, as speed-of-light limitations will eliminate the possibility for tightly-coupled troubleshooting between crew and ground.
- Several challenges must be overcome to manage malfunctions without ground assistance
    - Exploration vehicles will have to be equipped with advanced automation that assists the crew with fault management activities
    - Operational concepts will have to be developed to enable real-time collaboration between automation and crew (human-machine teaming).
    - These operational concepts will have to be verified and validated.

The ISIS lab provides an integrated environment where operational concepts for advanced operations concepts can be tested and evaluated via human-in-the-loop simulation.

Intelligent Spacecraft Interface Systems (ISIS) Laboratory

What You Will See

Simulation of current malfunction management operations

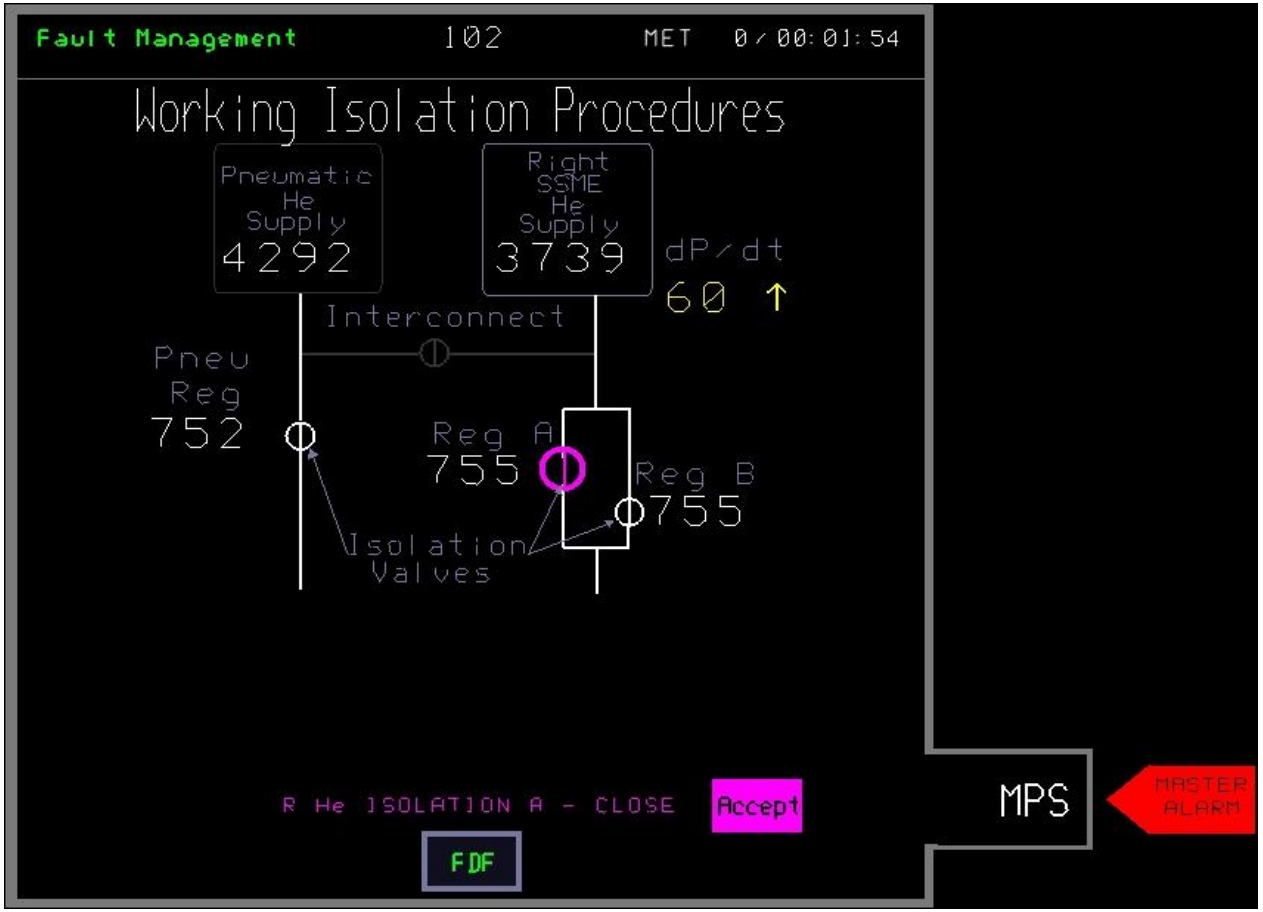


MPS He P (Pre MECO)
1. Check dP/dT
If after MECO -60: 2. Shut dn MN ENG per MPS CMD/HYD/ELEC >>
If He REG P ↑ or ↓ : 3. (Aff) He ISOL – CL Otherwise: 4. (Aff) He ISOL A – CL If no decr in dP/dT: 5. (Aff) He ISOL A – OP B – CL If no decr in dP/dT:. 6. (Aff) He ISOL B – OP

Intelligent Spacecraft Interface Systems (ISIS) Laboratory

What You Will See

Simulation of candidate advanced fault management concept for next-generation spacecraft



Operational Based Vision Assessment (OBVA)

Overview of the Project

Purpose of OBVA

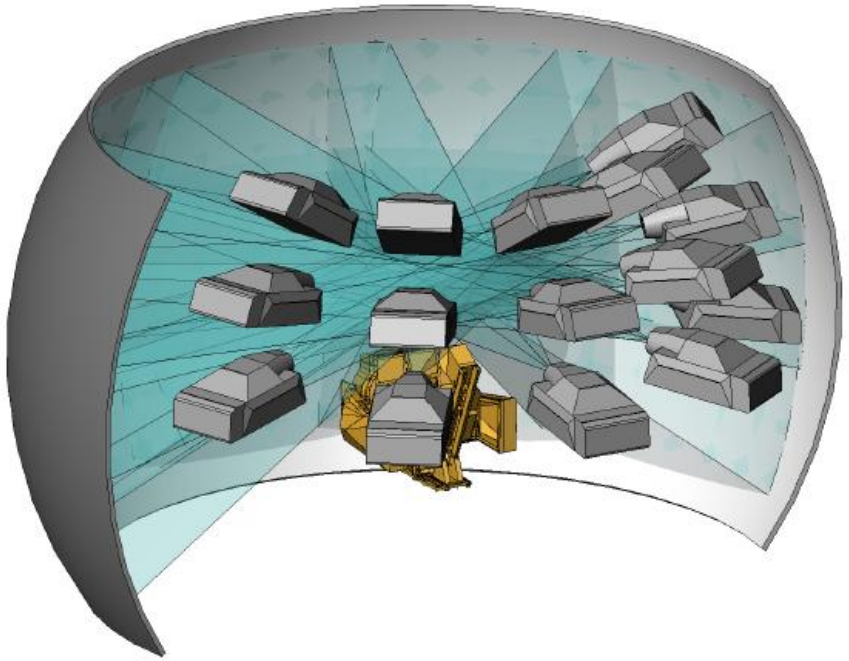
- Develop a flight simulator for the Air Force that will enable them to conduct experiments to determine the effect of pilot vision on operational performance

Collaborators

- NASA
  - Human Systems Integration Division
  - Simlabs
- Air Force
  - AFRL
  - USAFSAM
  - Advanced Programs Office
  - Office of the Surgeon General

Point Of Contact

- Dr. Barbara Sweet, OBVA Project Manager
- Phone 650-604-0006
- Email barbara.t.sweet@nasa.gov



Operational Based Vision Assessment (OBVA)

What You Will Learn on This Lab Tour

We will discuss
- OBVA Program and Objectives
- Technical Challenges
- Current Activities

You will see:
- High-resolution projector
- Demonstrations of
  - Effects of display resolution
  - Effects of display temporal properties

Psychophysiological Research Lab

Overview of the Lab

Purpose of Lab
- Investigate relationships between physiology and behavior.
- Examine impact of environment on health and performance.
- Study how humans adapt in space, land, sea and air vehicles.
- Assess and correct hazardous operator states (fatigue, stress).

Personnel
- 2 civil servants
- 6 students

Methodology
- Measure physiological, performance and self-report data
- Autogenic-Feedback Training Exercise (AFTE) countermeasure

Points Of Contact
- Dr. Patricia S. Cowings, P.I. Psychophysiology Lab
- Dr. William B. Toscano, Co-Investigator
- Phone 650-604-5724
- Email Patricia.S.Cowings@nasa.gov

Psychophysiological Research Lab

What You Will Learn on This Lab Tour

You will see:

- Rotating chair test facility
- Autogenic Feedback Training Exercise (AFTE) training screens and subject room
- Ambulatory physiological monitoring devices

We will discuss

- Methods administering AFTE
- How to integrate findings and results into applied settings
- Potential applications on airsickness in the military, crew fatigue in commercial aviation, improving performance in high stress environments and introducing crew training in operational settings.

Vibration Test Facility

Overview of the Lab

Purpose of Lab

- Assess impact of flight-like whole-body vibration on human operational capabilities and ability to maintain situation awareness of vehicle operational state.
- Quantify vibration effects on the usability of different forms of candidate next-generation cockpit display format symbology such as text, vehicle position, and vehicle attitude display indicators.

Personnel

- 5 civil servants
- 3 contractors

Methodology

- Part-task studies and simulations of CEV ascent thrust oscillations which evaluate the impact of vibration on:
  - situation awareness
  - workload
  - performance
  - manual control

Points Of Contact
Dr. Bernard Adelstein , 650-604-3922
Dr. Brent Beutter, 650-604-45150
Email: Bernard.D.Adelstein@nasa.gov
Email: Brent.R.Beutter@nasa.gov
Website: http://isis.arc.nasa.gov

Vibration Test Facility

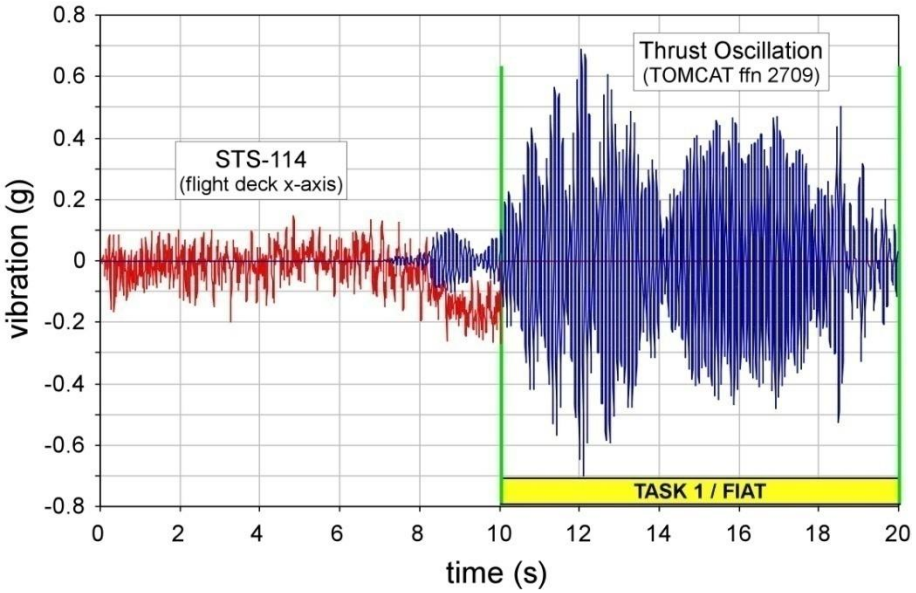
What You Will Do on This Lab Tour

You will see:

- Human Vibration Test Facility
- Demonstration of the Ascent Thrust Oscillation Impact on Human Performance Study

We will discuss

- CEV launch g-forces and thrust oscillation
- Human response and tolerance to environmental stressors such as vibration and sustained G loading that are unique to space launch



Vision Group

Andrew B. Watson

http://vision.arc.nasa.gov
andrew.b.watson@nasa.gov

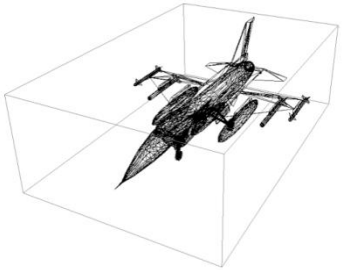
Vision Group

- World class reputation
- 124 Publications/PI
- Two Fellows of OSA
- SID Otto Schade Award
- ARVO Special Recognition Award
- NASA H. Julian Allen Award

Vision Group

- Visual Human Factors
- Vision Science · Visual Applications
- Models · Tools
- World & Displays

Aircraft Visibility



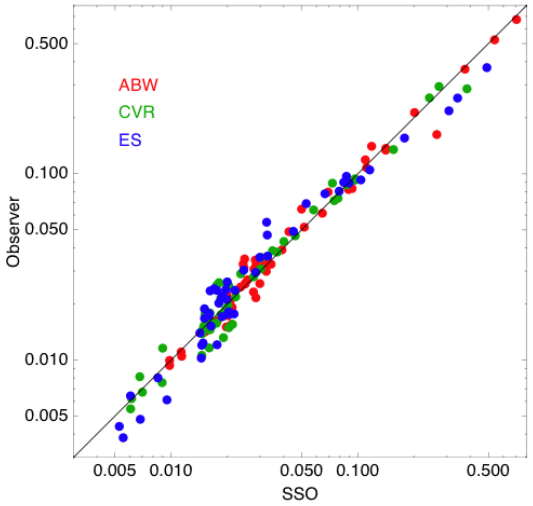
3D Model

Coloring
Lighting
Distance
Viewpoint
Background

Rendering Parameters

2D Image

Movie



ah64d

b747

balloon

c17

cessna172

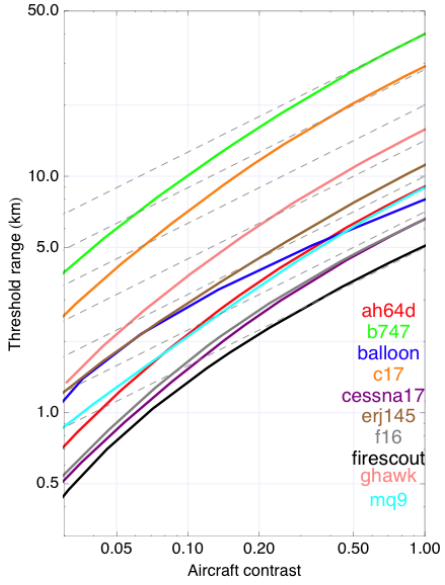
erj145

f16

firescout

ghawk

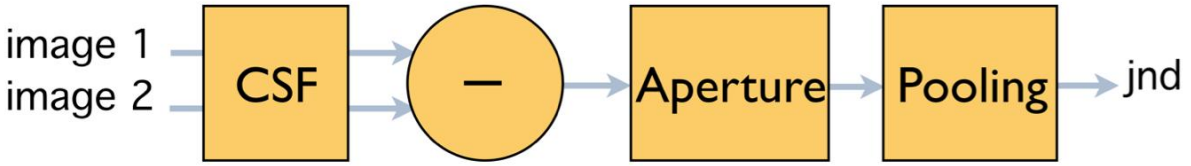
mq9

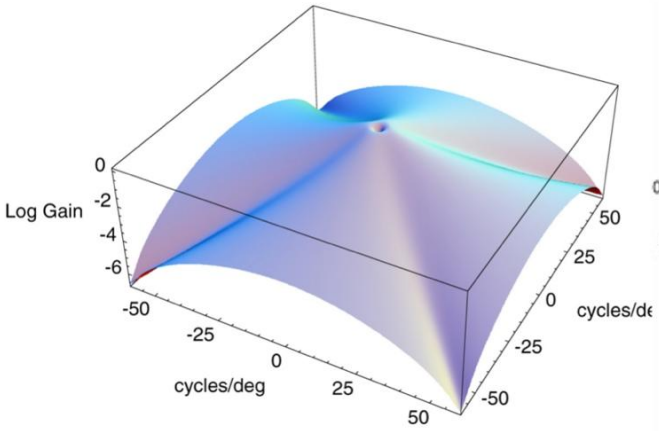


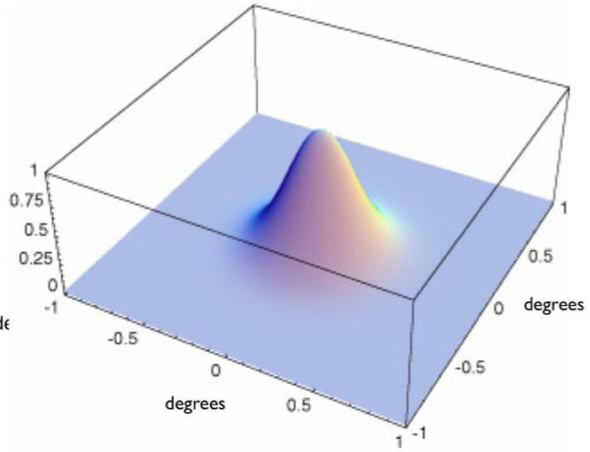
Display Measurement

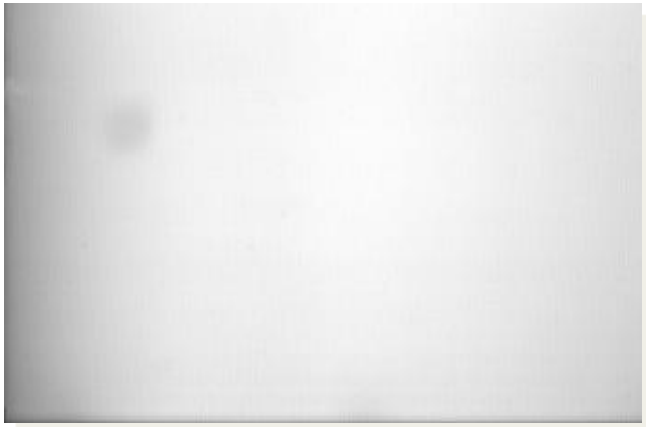
- 118 Million large LCD Q1 2008
- Visual Mura inspection
- Automated inspection via SSO
- NASA Patent Licensed

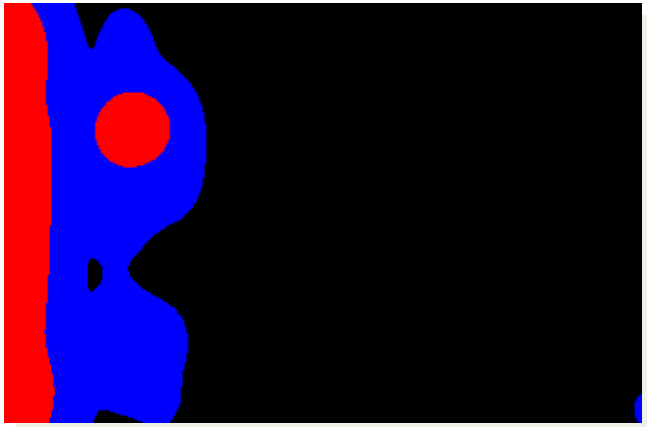
SSO Mura Inspection





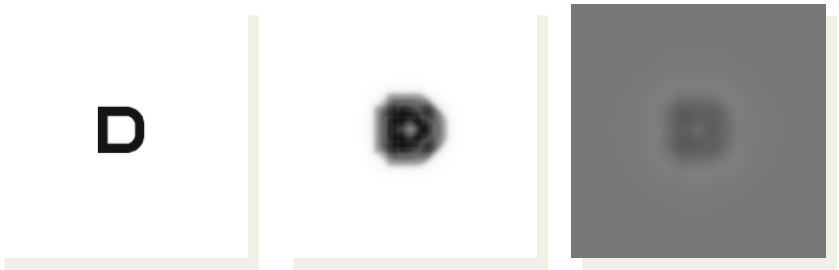


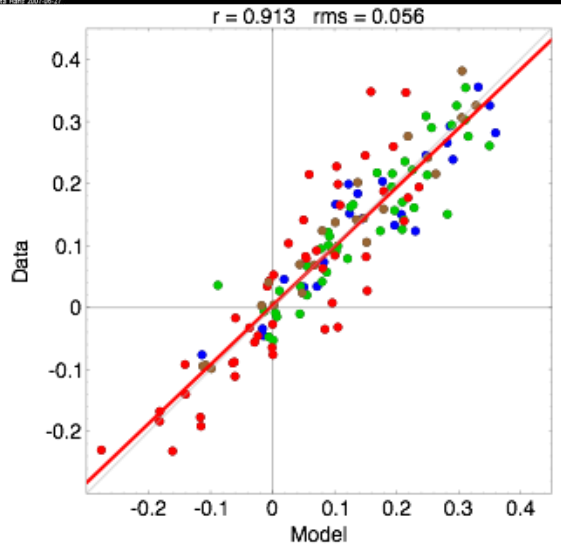




Acuity Prediction

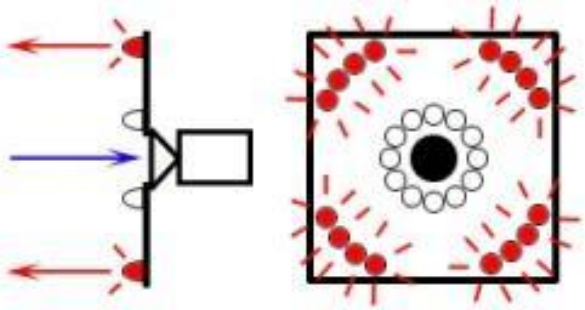
- Wavefront aberrations
- Letter images
- Vision model
- Acuity predictions



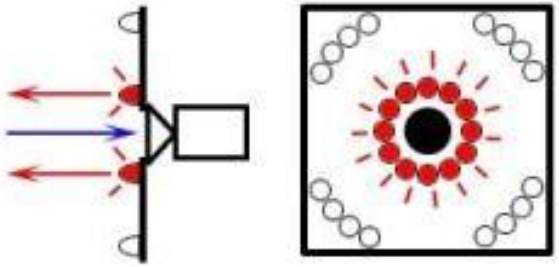


Active illumination pupil-finder

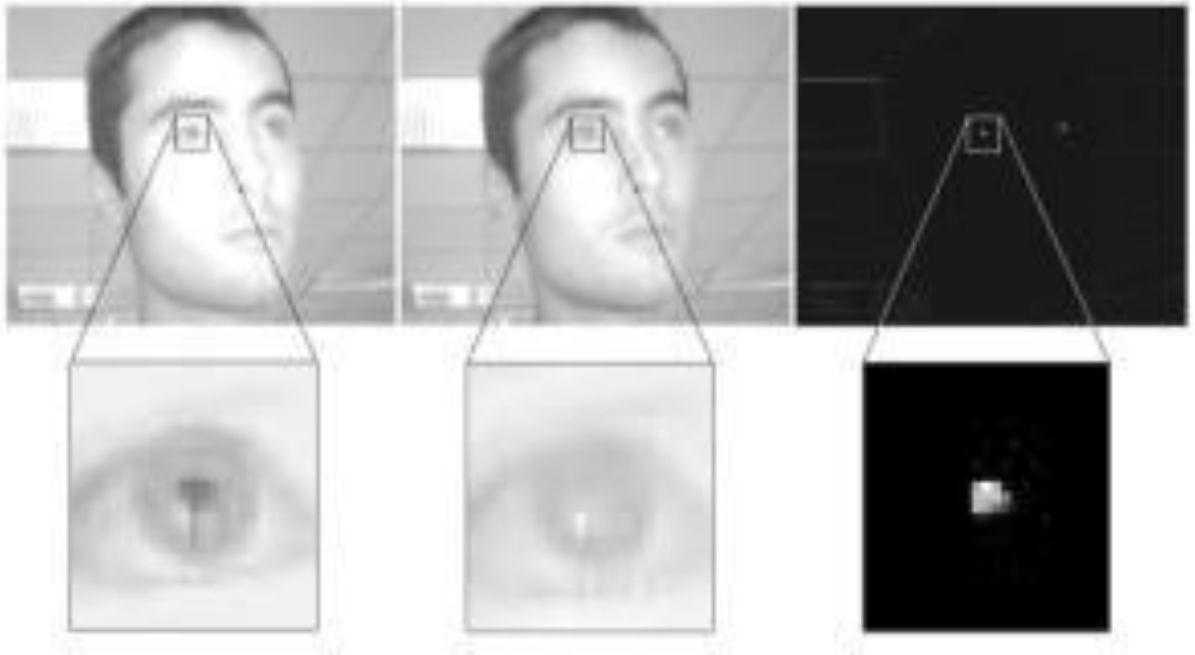
- simplifies machine vision problem of eye location
- used for real-time control of active vision system for remote gaze tracking



Off-axis illumination for dark pupil



On-axis illumination for bright pupil

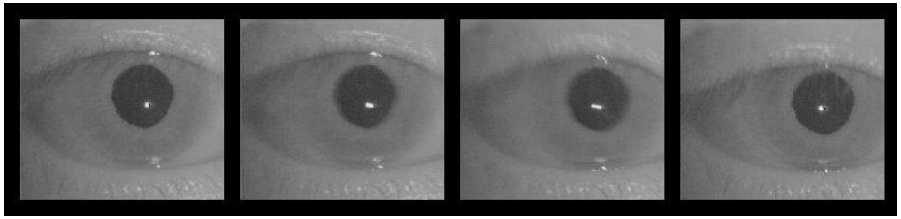


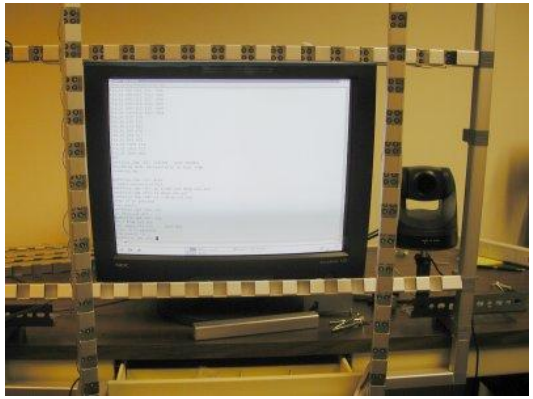
Difference image shows pupils
(with motion and interlace artifacts)

Active illumination saccade velocimeter

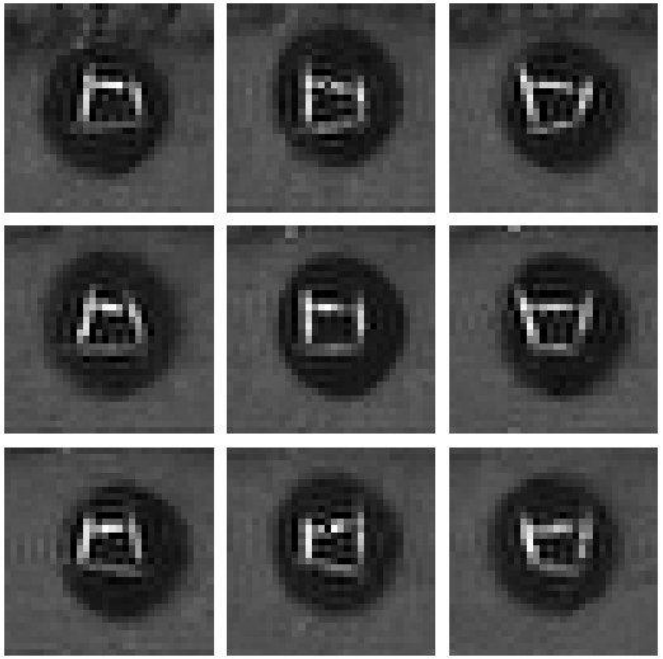
- allows measurement of eye velocity in a single image
- applications in fatigue assessment, fitness-for-duty testing

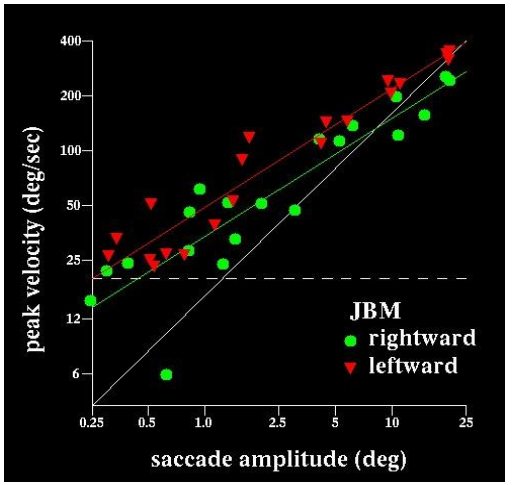
A saccade is completed in 1-2 frames in conventional 60 Hz video





Novel apparatus consists of linear illuminator arrays, energized sequentially within a single frame. Reflections appear tilted when eye is moving.





Visuomotor Control Lab

Overview

- ***Our mission*** in the Visuomotor Control Lab (VCL) is to better understand human sensorimotor and perceptual processes that underlie oculomotor and manual control performance in aerospace-relevant search and tracking tasks.

- ***Our focus*** is on measuring and modeling human performance in order to predict performance effects of display and interface characteristics as well as cognitive factors.

- ***Our major technological contribution*** has been the development and validation of oculometric analysis tools for examining bottom-up (display) and top-down (cognitive) influences on human visuomotor performance. Our approach is to use eye-movement metrics to quantify human perceptual/cognitive status.

- ***Our research*** extends across the areas of motion perception and search, gaze stabilization and tracking, and manual control. Results have been published in over 45 journal articles, reviews, and technical reports.

POC: Dr. Lee Stone, 650-604-3240,
Leland.S.Stone@nasa.gov

Visuomotor Control Lab

Research Areas

Performance limits:
- Direction Discrimination
- Speed and Acceleration Discrimination
- Ocular Pursuit Tracking
- Saccadic Visual Search
- Manual Control

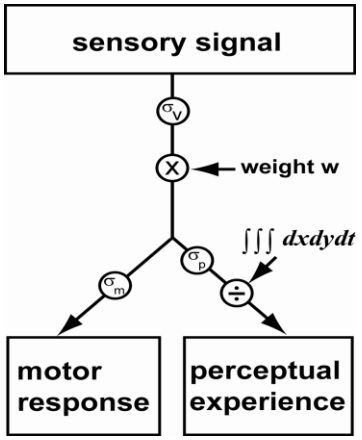
Cognitive Factors:
- Expectation
- Reward
- Interpretation

Models
- Pursuit
- Visual Search
- Display Navigation
- Visual Decision Making

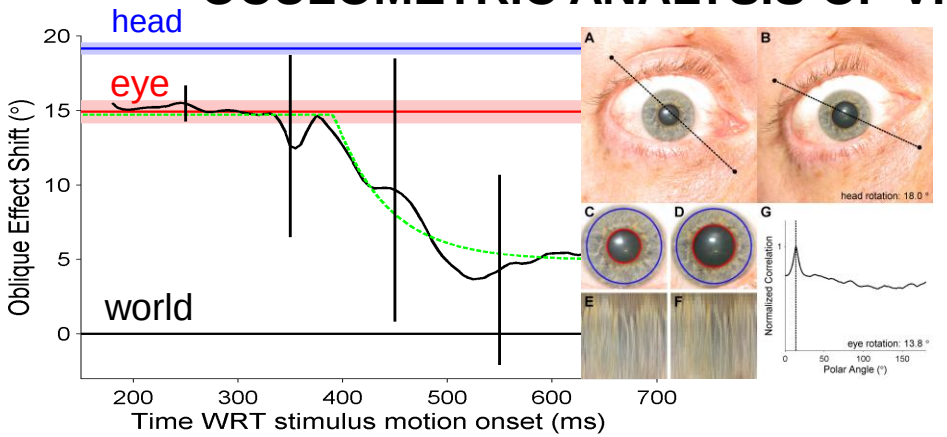
Stakeholders
- Pilots (supporting OBVA)
- Astronauts (supporting SHFE)
- Display/Interface Designers (NASA)
- Air Traffic Controllers (proposed)

DISPLAY NAVIGATION

SIGNAL DETECTION THEORY MODELS



OCULOMETRIC ANALYSIS OF VISION



Agenda of the Open House

Time	Event	Location
8:00-9:00am	Donuts and coffee	Room 100
9:00-9:30am	Welcome by Dr. Pete Worden and Introduction by Dr. Jeffrey McCandless	Room 100
9:30-10:30am	Overview of each Lab by the Principal Investigators	Room 100
10:30-11:00am	Break and Lab Tour sign-up	Room 100
11:00-11:45am	Lab Tour #1	Labs
11:45am-1:15pm	Lunch	Courtyard
1:15-2:00pm	Lab Tour #2	Labs
2:00-2:45pm	Lab Tour #3	Labs
2:45-3:30pm	Lab Tour #4	Labs
3:30-4:00pm	Wrap-Up by Dr. Jeffrey McCandless and Gaye Graves	Room 100
4:00-5:00pm	Social	Courtyard
5:00-???	Informal Drinks and Dinner at Tied House Cafe & Brewery	Mountain View

Wrap-Up Discussion
(3:30-4:00pm)

Next Steps

- We need your feedback!
  - Tell us what research areas you found most interesting.
- Stay in touch!
  - Visit our website, http://hsi.arc.nasa.gov
  - Learn more about our research.
  - Download a research paper or fact sheet.
  - Contact someone using our “Personnel” page.
- Interested in collaborating?
  - Read the NASA Partnership Agreements Summary in your packet.

For additional information, contact:

- Dr. Patty Jones (Acting Division Chief)
  patricia.m.jones@nasa.gov
- Dr. Jeffrey McCandless (Deputy Division Chief)
  jeffrey.w.mccandless@nasa.gov
- Gaye Graves (Special Assistant for New Business)
  gaye.graves@nasa.gov
- Any of the Principal Investigators

Once again, a Big Thank You To …

Lead Coordinator… Holly Latta

Plus … Albert Ahumada, Jolene Feldman, Naz Haghbin, Marlene Hernan, Eric Lee, Bonny Parke, Phil So, Barbara Sweet, Jason Toy

Breakfast compliments of… San Jose State University
Dr. Kevin Jordan
(Project Director and Professor of Psychology)
with Jennifer Granada and Audra Ruthruff

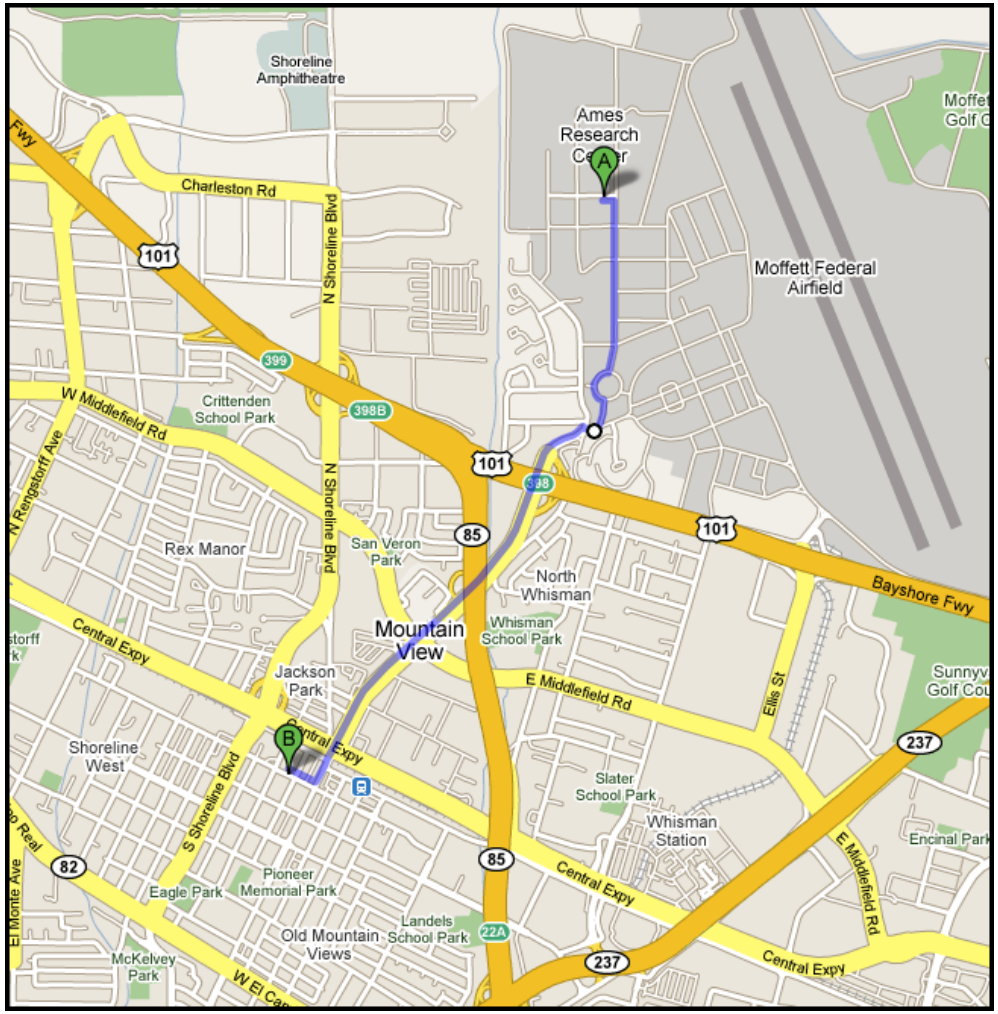
And thank you for joining us!

Informal Social Hour
(4:00-5:00pm)

It's Music Time
with the
Monta Vista Jazz Combo

Justin Chen
Dylan Davis
Laxman Dhulipala
Maxwell Felt
Shreepal Shah

For more discussions, go to the Tied House Café & Brewery starting around 5pm



Tied House Café & Brewery
954 Villa Street (near Castro Street)
Mountain View, CA
650-965-2739

Located about two miles south of NASA Ames.

Directions:

1. Exit the Main Gate.
2. Stay on Moffett Blvd.
3. Moffett Blvd becomes Castro Street.
4. Stay on Castro Street.
5. Cross the train tracks.
6. Turn right on Villa Street.