Dr. Ling Rothrock

## Human Performance Assessment and Modeling (HPAM) Lab

Evaluating Candidate Overview Displays Based on Existing Visualization Technologies

Objective:

The objective of this project was to evaluate the effectiveness of overview displays (following three candidates) in terms of operator task performance & situation awareness.
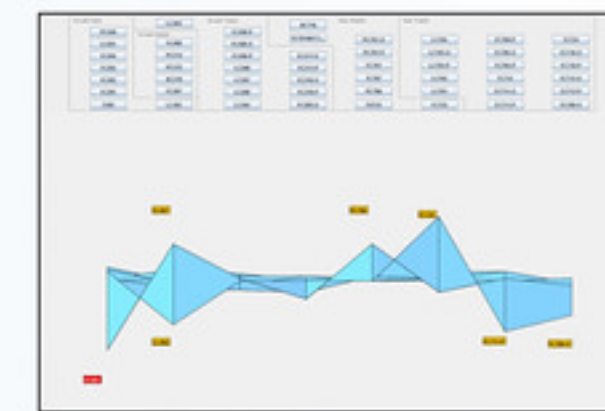1) the Calm Water representation being used by (BP)
2) the Heat Map representation being used by Sasol
3) the Visual Thesaurus display that was developed by Honeywell.

Calm Water   *Heat Map*   *Visual Thesaurus*

Experiment Set-up

Eye-tracking
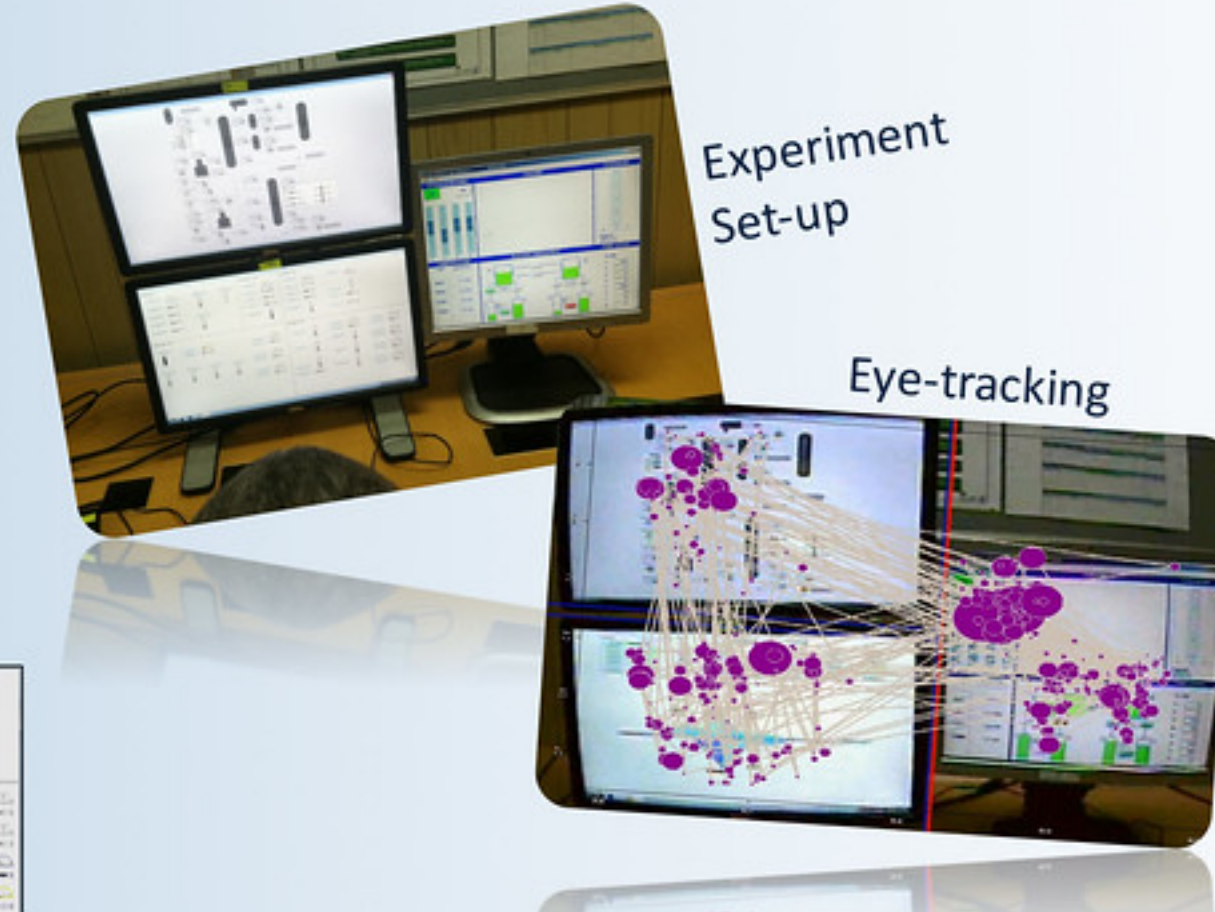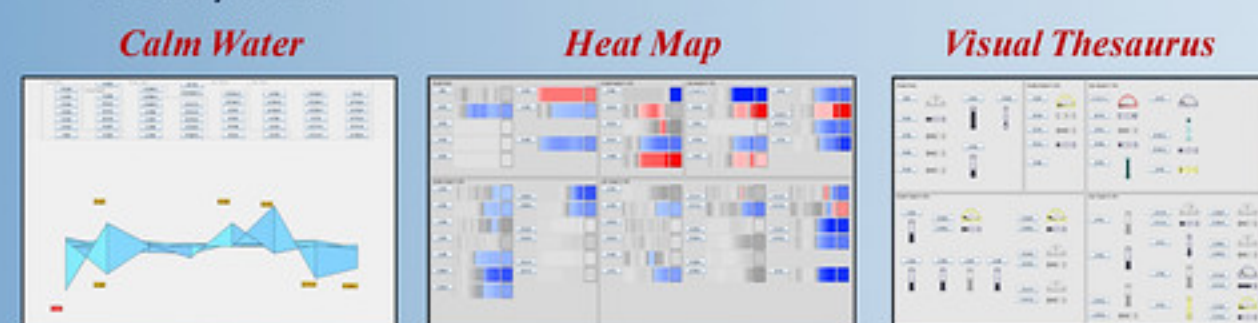
Results:

The Calm Water display resulted in better performance on the primary measures of:
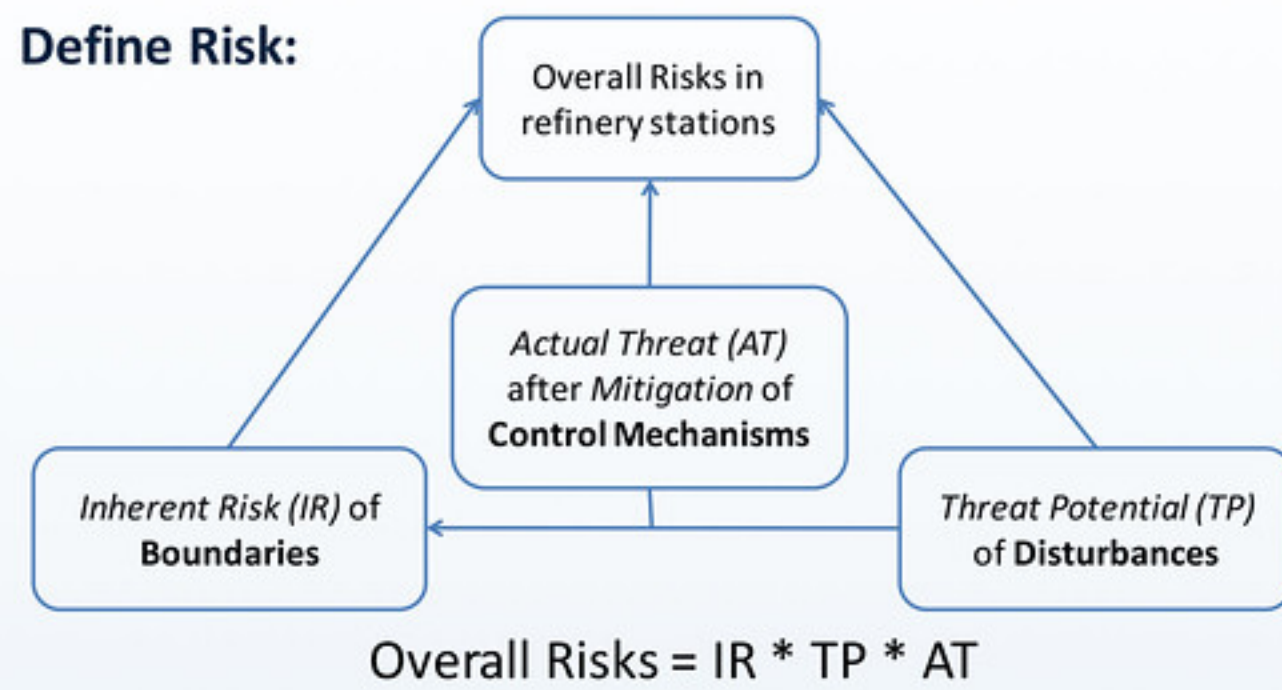- Click accuracy
- Response time
- System Monitoring Task in MATB

HPAM Lab Group

Research Partner

ASM 20 Years   Honeywell

PennState ARL   THE LEONHARD CENTER FOR THE ENHANCEMENT OF ENGINEERING EDUCATION

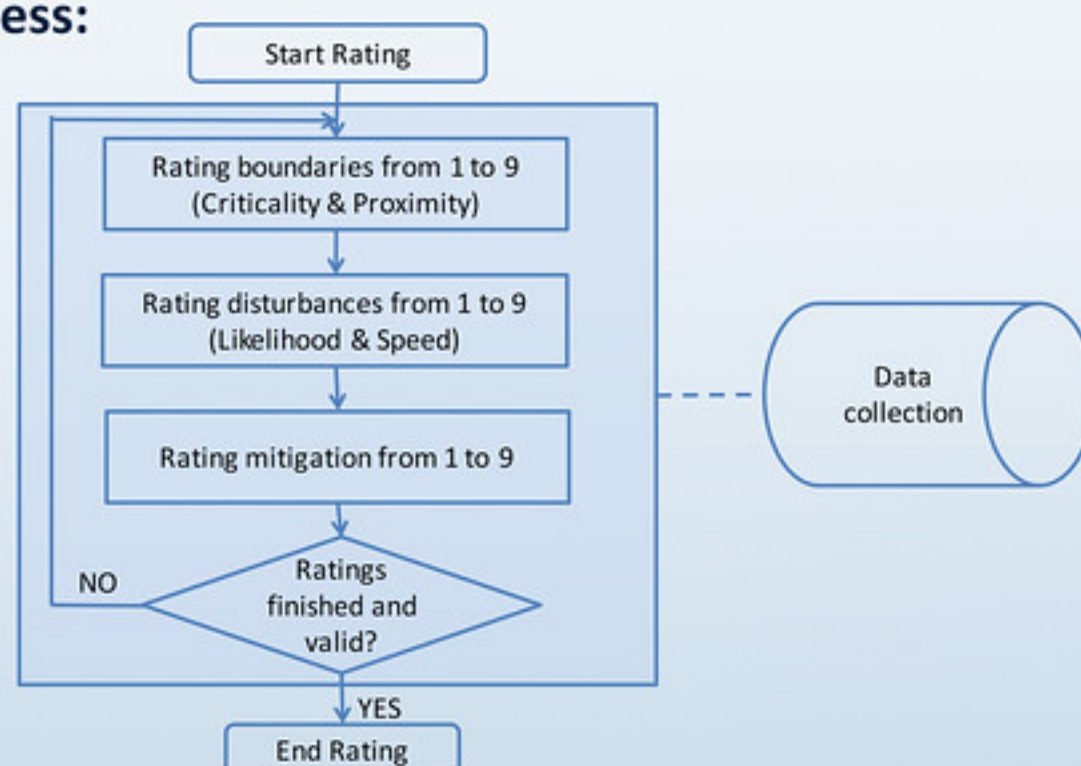## Measuring Operator Risk Awareness

Objectives:
1. To develop a metric evaluating site authority's (SA's) and operators' (Ops') risk understanding in refinery stations
2. To create a display design showing the gap between SA's and Ops' risk understanding
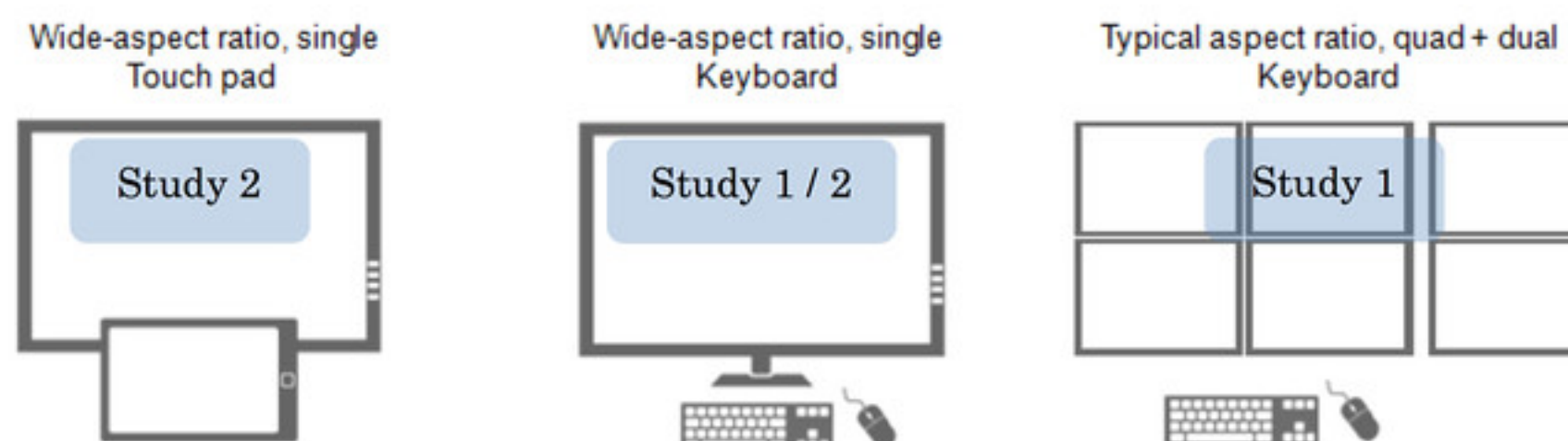
Define Risk:

Overall Risks in refinery stations

Actual Threat (AT) after *Mitigation* of **Control Mechanisms**

Inherent Risk (IR) of **Boundaries**

Threat Potential (TP) of **Disturbances**

Overall Risks = IR * TP * AT

Rating Process:

Start Rating → Rating boundaries from 1 to 9 (Criticality & Proximity) → Rating disturbances from 1 to 9 (Likelihood & Speed) → Rating mitigation from 1 to 9 → Ratings finished and valid? → NO / YES → End Rating

Data collection

Results:
- Difference in risk awareness between operator and manager is statistically significant

Overall Risk Understanding
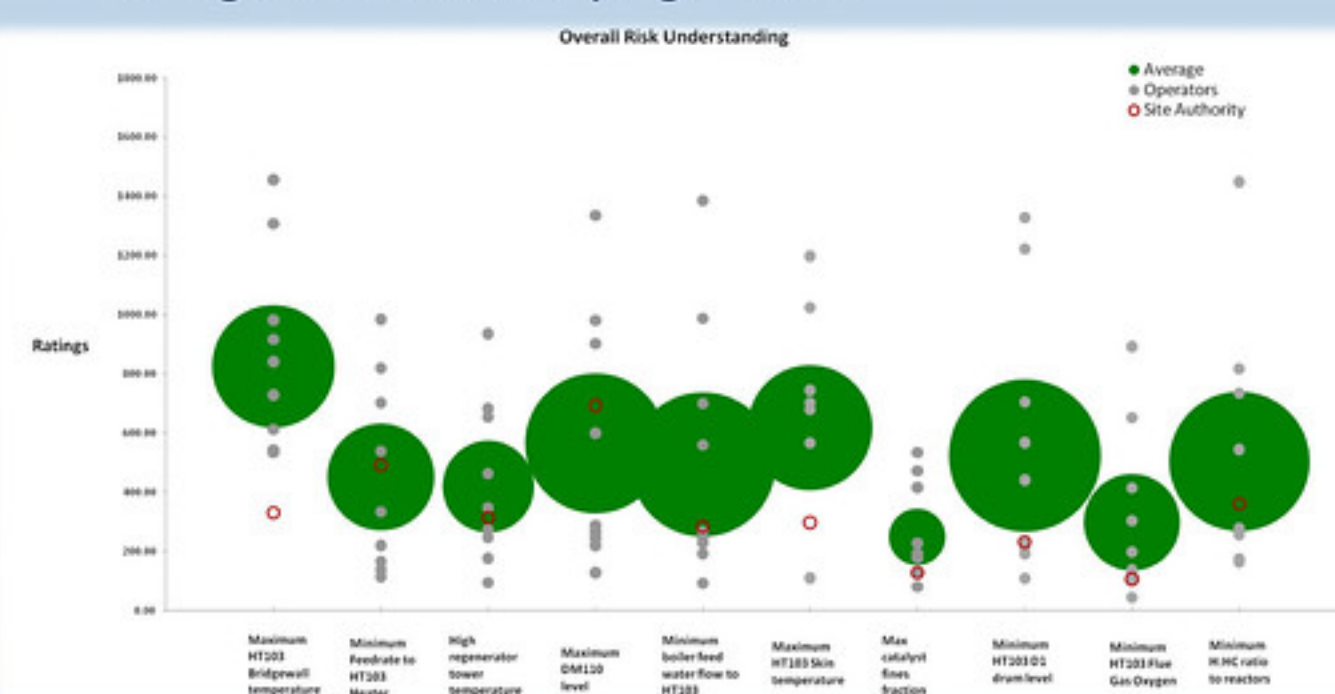
An Evaluation of New Console Technology: Console Fundamentals Project

Objectives:
- Test the effect of display layout / screen type on performance in a process control task (managing a tank farm).
- Test the effect of interaction device on performance in a process control task (managing a tank farm).
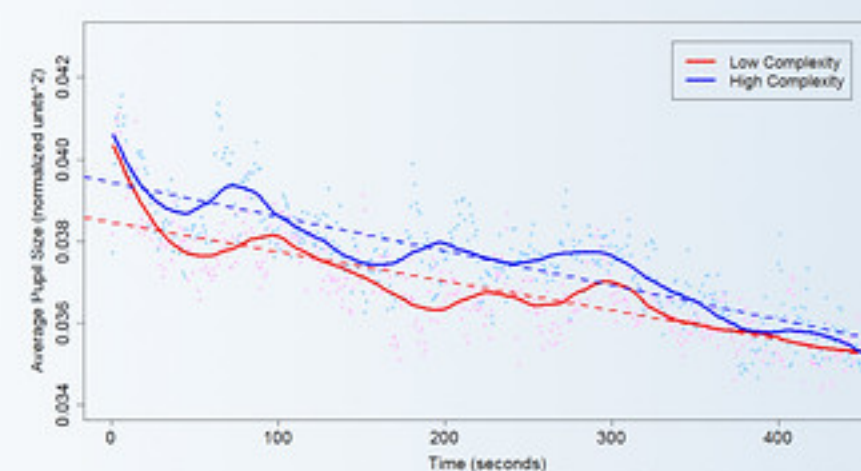
Wide-aspect ratio, single Touch pad — Study 2

Wide-aspect ratio, single Keyboard — Study 1 / 2

Typical aspect ratio, quad + dual Keyboard — Study 1

Eye Tracking for Live Measures of Workload in A Refinery Control Room Process Monitoring Task

Background:

In process industry control rooms, it is difficult to know when the human operator is overloaded. During high cognitive workload, managing a process becomes dangerous as mistakes can lead to disasters.

Methods:

Used a Arrington Research head-mounted eye tracker to record operator visual behavior while monitoring a simulated crude process plant at various stages of complexity.

Findings:

The average pupil size over time for low (red) and high (blue) complexity. Linear fits are statistically different, $F_{(1,448)}=705.94$, $p=0.000$.

Dr. Ling Rothrock

Human Performance Assessment and Modeling (HPAM) Lab
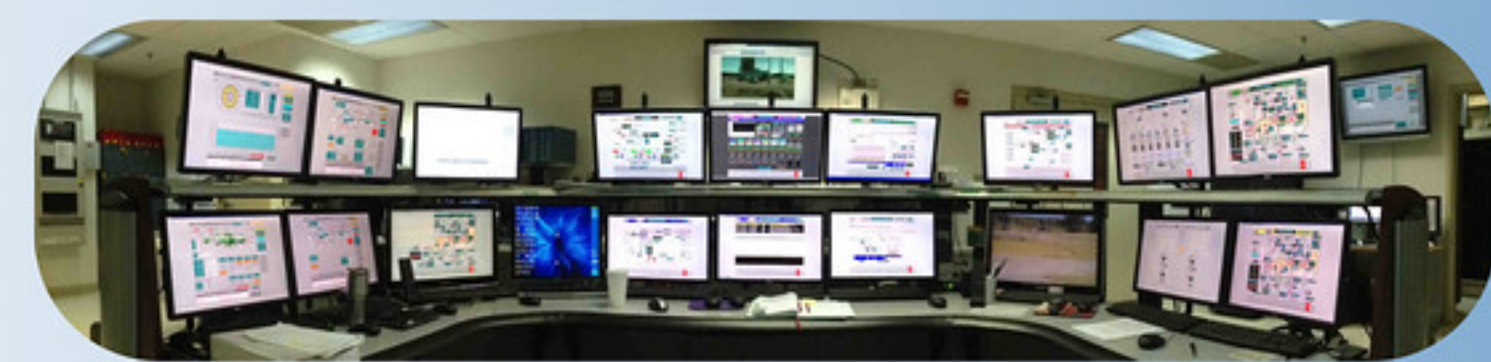
Research interests
- Human decision making
- Supervisory control

Specializes in
- Human-in-the-loop simulation
- Human judgment modeling
- Human performance measurement
- Individual & team training

Contact
lxr28@engr.psu.edu
814-865-7241

HPAM Lab Group

Research Partner

ASM 20 years
Honeywell
PENN STATE ARL
THE LEONHARD CENTER FOR THE ENHANCEMENT OF ENGINEERING EDUCATION

Desk-cycling

Sit-stand

Walking

Physical Activity for Workplace Vigilance Decrement Avoidance
(with Dr. Andris Freivalds)

Objective
- To use eye tracking technology as well as physiological measures to determine if, and how often, physical activity (physical fitness equipment, sit-stand consoles, and stretch exercises, etc.) in the workplace can enable continuous vigilance in process control monitoring tasks.


GAMIFICATION CONT

Enriching Engineering Education Using Peer-based Gamification of Challenging Course Concepts
(with Dr. Guodong Pang)

ga·mi·fi·ca·tion [gay-muh-fi-kay-shuhn] integrating game dynamics into your site, service, community, content or campaign, in order to drive participation.
(see Bunchball)

Project Objective
- To enrich existing engineering course materials by "gamifying" course concepts that have been challenging to past students.
- To enhance fundamental undergraduate educational experience using gamification applications created through a project-based collaboration between students and instructors.
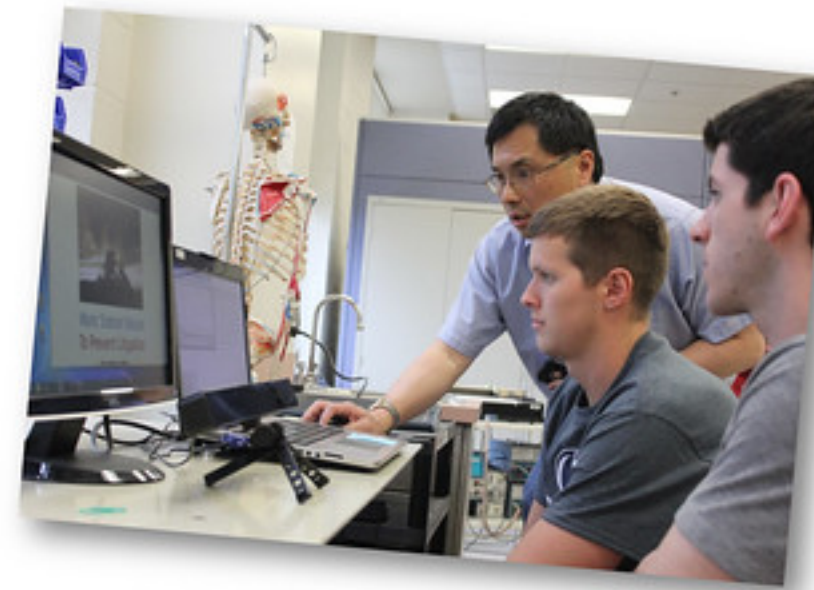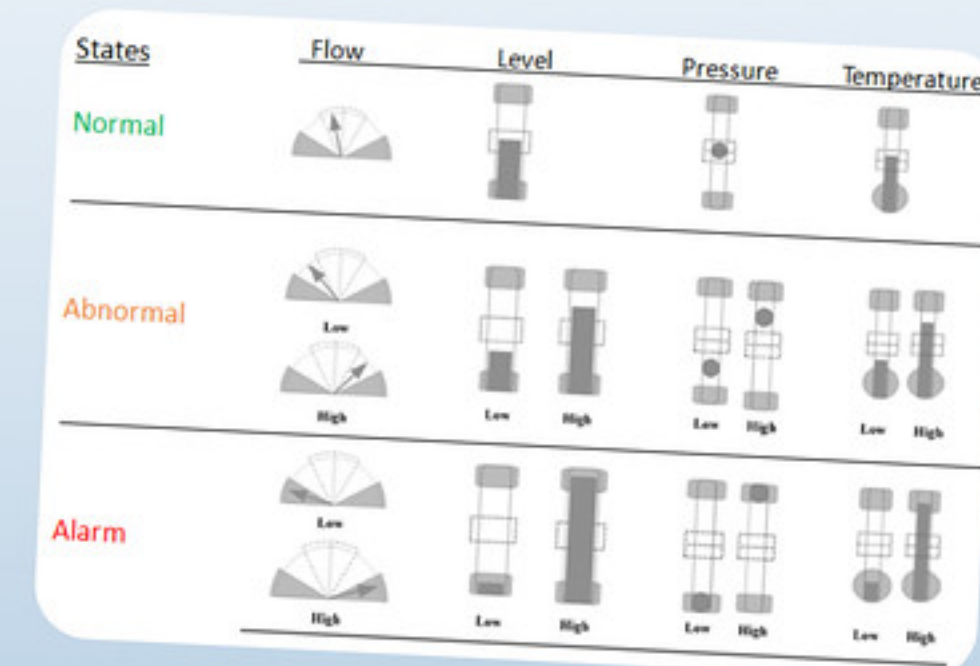
Courses involved:
- IE 302: Engineering Economy
- IE 311: Principles of Solidification Processing
- IE 322: Probabilistic Models in Industrial Engineering
- IE 323: Statistical Methods in Industrial Engineering
- IE 327: Introduction to Work Design
- IE 453: Simulation Modeling for Decision Support

An Eye-Tracking Evaluation of Visual Thesaurus Shapes

Motivation
The Visual Thesaurus shapes, as individual objects, have never been empirically evaluated in terms of their individual effectiveness for comprehension and change detection. It is not clear at the moment if the currently used shapes are optimally designed.

States	Flow	Level	Pressure	Temperature
Normal				
Abnormal				
Alarm				

Objective
To use eye tracking technology to investigate basic perceptual recognition behaviors of each Visual Thesaurus shape for comprehension and change (event) detection.

An evaluation of area of interest with eye-tracker
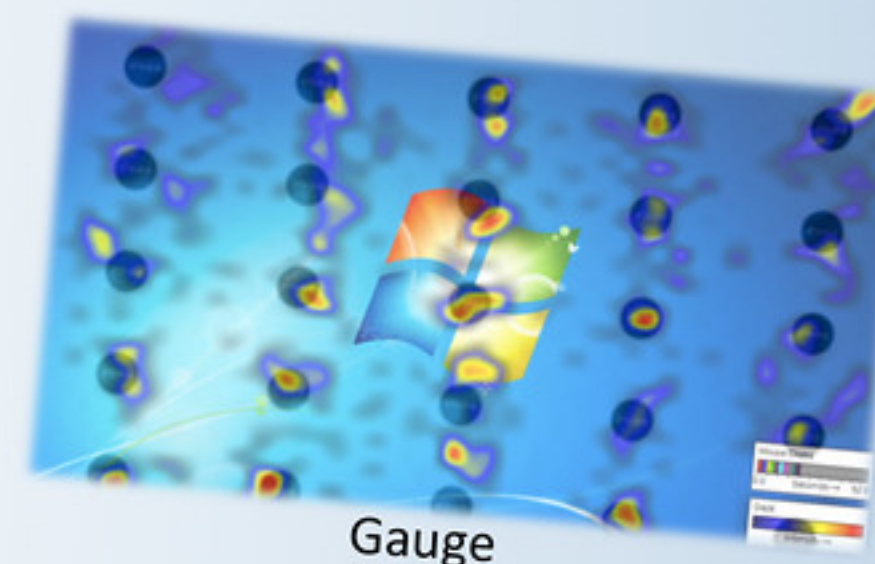
Objective:
To evaluate people's dynamic area of interest on the computer screen in two tasks (Gauge and Equation)
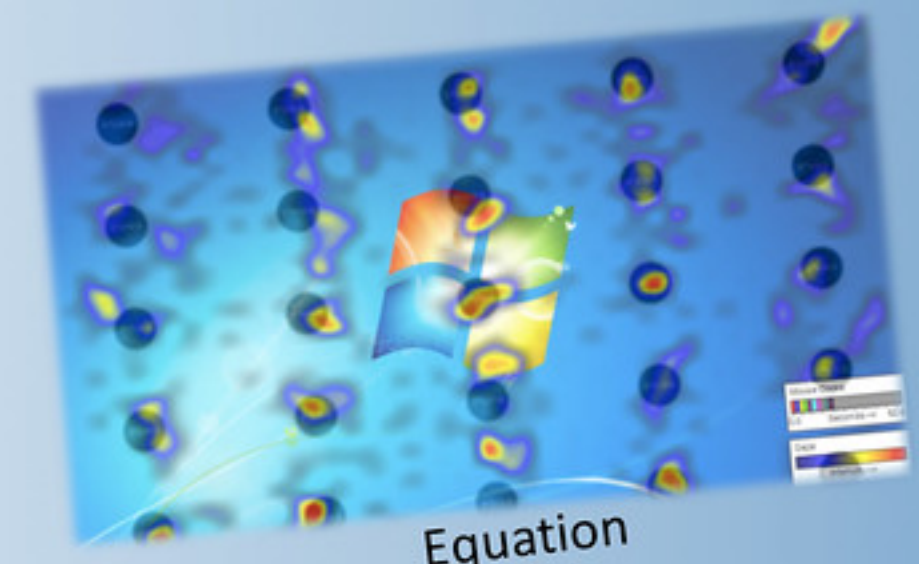
Methods:
We will be using eye-tracker data to find the best distance between two targets.
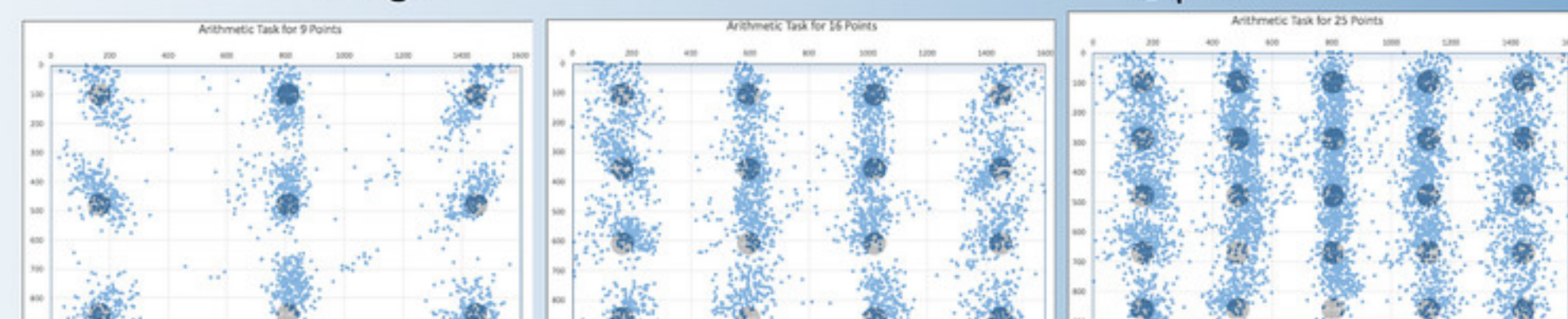
Contribution:
The research could be used to find the best layout of the targets on the screen and increase the users' experience and efficiency.

Gauge

Equation

What is going on right now...