

Institute Insider

The Newsletter of the Institute for Ergonomics at The Ohio State University

At the forefront of Human Factors since 1950 Volume 10, No. 3, Autumn, 2007



COHAM Gains Local, National, and International Attention

Ohio State's new research facility, the Center for Occupational Health in Automotive Manufacturing (COHAM) continues to attract interest and news coverage.

The Center's Director, William Marras, officially opened COHAM in May, 2007. In the past six months, he has conducted numerous tours of the facility to business groups, news operations, and other organizations who are interested in learning more about the Center and also considering funding research studies aimed at reducing low-back pain and other types of work-related injuries.

In October, Ohio State's new President, Dr. E. Gordon Gee, and Akio Hamada, the President and Director of Honda of America Mfg., Inc., both visited COHAM and learned about OSU's Honda Partnership Program.

In November, COHAM was profiled on the ABC network program, *Good Morning America*. In this segment, which aired on November 9th, GMA's Sam Champion interviewed Dr. Marras about how research at COHAM is used to study work tasks and design jobs

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Ohio State President, Dr. E. Gordon Gee (second from left), visits COHAM. Pictured with Dr. Gee are (left to right): Dr. William Marras, Dr. Sue Ferguson, Gang Yang, Riley Splitstoesser, and Dr. Carolyn Sommerich.

Institute for Collaborative Innovation Focuses on Solutions to Data Overload Problems

The third Summer Institute on Collaborative Innovation was held June 6th through August 6th, 2007 at The Ohio State University. The purpose of this nine-week process, an interdisciplinary initiative at OSU-Converging Perspectives on Data (CPoD), was to pursue innovative solutions to data overload problems in information analysis and comprehension tasks.

A total of 25 individuals participated in this unique immersion experience. They included graduate and undergraduate students, as well as visiting professors from six different disciplines (design, art&technology, cognitive engineering, international security, linguistics, and psychology) and from five different universities.

Some of the themes explored collaboratively with invited attendees in small, parallel interactions were:

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Dr. David Woods (left), engages in discussions with participants at the Institute on Collaborative Innovation's Final Show. (photo courtesy of Cedric Sze.)

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Institute Members Participate at PREMUS 2007

In August, several Institute members presented talks and posters at PREMUS 2007, the Sixth International Scientific Conference on Prevention of Work-Related Musculoskeletal Disorders (Baltimore, MD):

Quantifying Load Moment Exposure in Distribution Center Work

Presenter: **Steve Lavender**
Co-Authors: William S. Marras, Sue A. Ferguson, Riley Splittstoesser, Gang Yang, and Pete Schabo



A Biomechanical Analysis of Push and Pull Induced Spine Loads

Presenter: **William S. Marras**
Co-Authors: Greg Knapik, Josue Gabriel



Low Back Pain Recurrence in Occupational Environments

Presenter: **William S. Marras**
Co-Authors: Sue A. Ferguson, Deb Burr, Pete Schabo



Trunk Velocity Predicts Recurrent Low Back Disorders

Presenter: **Sue A. Ferguson**
Co-Authors: William S. Marras, Deb Burr



Effects of a Repetitive Moderately Forceful Pinching Task on Sensory Nerve Conduction Velocity: A Primate Model of Carpal Tunnel Syndrome

Presenter: **Carolyn M. Sommerich**
Co-Authors: Steve Lavender, John Buford, Sahika Korkmaz, Jake Banks, William Pease

Applied Ergonomics Conference

The 2008 Applied Ergonomics Conference and Expo will be held March 10th-13th, in Orlando, FL. The AEC brings together practitioners from around the world to exchange ideas and share their expertise.

Highlights of next year's conference include:

- The highly visible ErgoCup® award competition
- The Applied Ergonomics Student Design Competition
- Dozens of presentations and in-depth workshops
- Facility tours
- An exhibit hall, featuring the latest in ergonomic products and services

More information and registration materials can be found at www.appliedergo.org/conference. **Special discounts apply to anyone registering from Ohio State University.**

IN THE NEWS



William Marras, Professor of Industrial, Welding and Systems Engineering; Physical Medicine and Rehabilitation; and Orthopaedic Surgery, was named a Fellow of the International Ergonomics Association. This is the highest award made by the IEA to individuals for their outstanding contribution to the science of ergonomics research, teaching or practice. Congratulations!



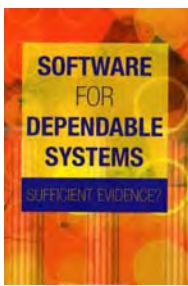
In November, **Jacob Banks** took a position as Research Specialist II at the Liberty Mutual Center for Safety Research in Hopkinton, MA. Jake received his Masters degree in 2005 under Dr. Steve Lavender and had been employed at OSU since then, working for Dr. Carolyn Sommerich. He can now be reached at 508-497-0214 or Jacob.Banks@LibertyMutual.com. Best of luck, Jake!



Carolyn Sommerich presented the lecture, *Teaching and Learning with Mobile Technology in High School: Observation and Intervention* at the Office Ergonomics Research Committee in Columbus, OH (September 6th - 7th, 2007). Her co-presenter was PhD student Sahika Vatan-Korkmaz.



David Woods was a part of the NAS/NRC Committee on Certifiably Dependable Software Systems, who recently published *Software for Dependable Systems: Sufficient Evidence?* This book discusses dependability in a software and systems context, illustrates how the growing use and complexity of software requires a different approach to ensure dependability, and recommends an evidence-based approach to achieve the greater dependability of software. This book is available from the National Academies Press.



On October 3rd, **Gary Allread** spoke about the research capabilities of OSU's Center for Occupational Health in Automotive Manufacturing (COHAM), at the Automotive Manufacturing Solutions (AMS) Conference in Dearborn, MI.

David Woods gave the Keynote Address, *Measuring How Design Changes Cognition at Work*, at the ACM Symposium on User Interface Software and Technology in Newport, RI (October 8th).



On November 15th, Raymond Damadian, one of the inventors of Magnetic Resonance Imaging (MRI), visited Ohio State and met with **William Marras**. They discussed how Dr. Marras is making use of Damadian's latest invention, the Upright MRI, which allows a person to be scanned while standing up. Marra Lab partnered with Dynamic Medical Imaging, which has an Upright MRI near the OSU campus. This technology allows for a more comprehensive understanding of the factors that affect spine health.



A Look at the Ergonomics "Big Picture" -- Understanding the Types of Factors Related to Injury was the topic of a lecture given by **Gary Allread** at the Risk Insurance Loss Control Association Conference in Lexington, KY (October 30th, 2007).

PUBLISH or perish

Recent publications written by Institute members (indicated in **boldface** font) include:



Are Back Supports Plus Education More Effective Than Education Alone in Promoting Recovery From Low Back Pain? Results From a Randomized Clinical Trial

DM Oleske, **Steven A. Lavender**, GB Andersson, and MM Kwasny, *Spine*, 32:2050-2057, 2007.

Can a New Behaviorally Oriented Training Process to Improve Lifting Technique Prevent Occupationally-Related Back Injuries due to Lifting?

Steven A. Lavender, EP Lorenz, and GBJ Andersson, *Spine*, 32:487-494, 2007.

Designing Ergonomic Interventions for EMS Workers Part II: Lateral Transfers

Steven A. Lavender, KM Conrad, PA Reichelt, AK Kohok, and J Gacki-Smith, *Applied Ergonomics*, 38:227-236, 2007.

Designing Ergonomic Interventions for EMS Workers Part III: Bed to Stairchair Transfers

Steven A. Lavender, KM Conrad, PA Reichelt, AK Kohok, and J Gacki-Smith, *Applied Ergonomics*, 38:581-590, 2007.

Interventions to Reduce Low-Back Injury Risk Among Youth Who Perform Feed Handling and Scooping Tasks on Farms

W. Gary Allread and Thomas R. Waters, *Journal of Agricultural Safety and Health*, 13(4):375-393, 2007.

Lifting that Involves Lateral Bending of the Trunk is More Harmful to the Lumbar Disc than that which Involves Flexing or Twisting of the Trunk

R.N. Natarajan, J.R. Williams, **Steve A. Lavender**, and G.B. Andersson, *53rd Annual Meeting of Orthopaedic Research Society Transactions*, paper 1022, 2007.

A New Non-human Primate Model of Carpal Tunnel Syndrome Based on Volitional Exertions

Steve A. Lavender, Carolyn M. Sommerich, J. Buford, **Jake J. Banks**, Sahika Vatan Korkmaz, and W.S. Pease, *53rd Annual Meeting of Orthopaedic Research Society Transactions*, paper 382, 2007.

The Development of an Electromyography Driven Biomechanical Model of the Human Shoulder

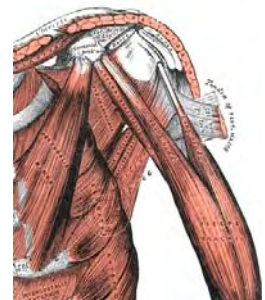
Thesis Abstract - Lee Mazurek

Objective. The objective of this effort was to build a functional EMG driven shoulder model that can be used to aid in the understanding of common occupationally related shoulder disorders.

Background. Epidemiological evidence suggests that work related shoulder disorders are linked with manual material handling, repetition, work above shoulder level, and psychosocial factors. Previous shoulder models have either had difficulty approximating the body's control system or have only been useful in limited postures.

Methods. Information was synthesized into a conceptual biomechanical model of the shoulder. The model was driven with motion capture data, measured external loading, and recorded electromyography data from a limited number of subjects. The importance of various modeling attributes was investigated by varying experimental conditions for each subject. Several strength testing setups were explored in order to find a method which is best for calibrating the model. MRI image based muscle attachments and historical cadaver based attachments were used to calculate muscle moment vectors. A simple muscle length tension relationship was also investigated.

Results. A conceptual model of the shoulder was synthesized, and numerical simulations showed promising results in several test postures and conditions. Model performance varied depending upon several variables. Cadaver-based attachments with a rudimentary length-tension curve yielded acceptable modeling solutions in a limited number of exertion directions and did not find a solution in the remaining exertion directions. Both models tested with MRI-based attachments and a length tension curve found solutions for nearly all conditions, but had more variable performance. A test predicting the glenohumeral joint reaction force for thirty degrees of elevation in the coronal plane yielded similar magnitude and direction predictions to historical models.



Conclusion. The glenohumeral joint can be approximated with a mechanical model, which may be used to better understand the nature and mechanism of shoulder injuries. However, work needs to be done in order to increase the fidelity of several modeling inputs.

**Institute Member Activities at
the 51st Annual Meeting of the Human Factors & Ergonomics Society**

October 1st - 5th, 2007, Baltimore, MD

Members of OSU's Institute for Ergonomics once again had a large presence at this year's HFES meeting. The lectures, panels, and an invited address in which members participated are listed below. Members' names are shown in bold.

Lectures

Assessing Medication Safety Technology in the Intensive Care Unit

Michael F. Rayo, M.B. Weinger (Vanderbilt), **Philip J. Smith**, J. Slagle (Vanderbilt), and T.R. Dresselhaus (VA San Diego Healthcare System)



A Biomechanical Analysis of Push and Pull Induced Spine Loads

William S. Marras, **Greg Knapik**, and **Josue Gabriel**



A Comparison of Computer Workstation Adjustments Made by Users Following Web-Based Instructions and Those of an Ergonomics Professional

Riley E. Splittstoesser, **Sahika V. Korkmaz**, **Carolyn M. Sommerich**, and **Steven A. Lavender**



Differences Between Lifting and Lowering Manual Material Handling Tasks in Distribution Centers

Sue A. Ferguson, **William S. Marras**, **Steven A. Lavender**, **Riley E. Splittstoesser**, **Gang Yang**, and **Pete Schabo**



Exploring Challenges of Information Dynamics Using an Animock

Shilo Anders, **Daniel J. Zelik**, T. Jacoby (Ohio State), **Emily S. Patterson**, and **David D. Woods**



Exposure to Ubiquitous Mobile Instructional Technology in a High School Setting: An Observational Study

Carolyn M. Sommerich and **Sahika Korkmaz**



Judging Sufficiency: How Professional Intelligence Analysts Assess Analytical Rigor

Daniel J. Zelik, **Emily S. Patterson**, and **David D. Woods**



Low-Back Pain Recurrence at Work

William S. Marras, **Sue A. Ferguson**, **Deborah Burr**, and **Pete Schabo**



Supporting Asynchronous Dialogs in the Communication of Army Operations Orders

Philip J. Smith and **Amy L. Spencer**



Supporting the Cognitive Work of Information Analysis and Synthesis: A Study of the Military Intelligence Domain

Justin Grossman, **David D. Woods**, and **Emily S. Patterson**



Team Cognition in Intelligence Analysis

S. Trent (U.S. Military Academy), **Martin Voshell**, and **Emily S. Patterson**



Toward a Functional Model of Quality Improvement Collaboratives

Emily S. Patterson, **Sharon Schweikhart**, **Shilo Anders**, S.M. Brungs and M.L. Render (VA Inpatient Evaluation Center)



Invited Address

Variability in Physical Load Between and Within Individuals at Work – Trick or Treat?

William S. Marras



Panels

Beyond See-One, Do-One, Teach-One: Applying HF to Clinical Training and Education

Panelists: G. Blike (Dartmouth), C.G.L. Cao (Tufts U.), S. Guerlain (U. of Virginia), C. Mackenzie (U. of Maryland), **Emily S. Patterson**, and F.J. Seagull (U. of Maryland)



Macro-cognition Metrics: Meaningful Measures for Complex Processes

Panelists: M. Letsky (Office of Naval Research), G. Klein (Klein Associates), R.R. Hoffman (Inst. for Human & Machine Cognition), N.J. Cooke (Arizona State U.), S. Burke (U. of Central Florida), and **Emily S. Patterson**



The Real Deal: Essential Lessons from Human Factors Leaders

Panelists: P.A. Hancock (U. of Central Florida), R. Pew (BNN Technologies), E.M. Roth (Roth Cognitive Engineering), T. Sheridan (MIT), and **David D. Woods**



Graduate Student News

New Students

Alicia Borgman

(borgman.3@osu.edu)

Advisor: Dr. Phil Smith

Hometown: Pleasant Grove, CA

Alicia comes to OSU after four years as a research analyst in a simulation software development environment, where she performed algorithm development and simulation system design, and oversaw testing and technical support processes. She has a Master's degree in operations research from Northeastern University in Boston and a Bachelor's degree in applied mathematics from the California State U., Long Beach.



Alicia spends her time hiking, cycling, and snowboarding. She also enjoys practicing karate, traveling the world, and photography.

Now at OSU, Alicia is studying cognitive systems engineering and is particularly interested in designing systems to improve human performance.



Rajiv Gumpina

(g.rajivkumar@gmail.com)

Advisor: Dr. Carolyn Sommerich

Hometown: Berhampur, Orissa, India

Rajiv attended the DePaul School in Orissa. He then got his Bachelor's degree in Mechanical Engineering at National Institute of Technology Kurukshetra (also known as B-Tech). There he was introduced to Industrial Engineering and decided to specialize in Human Factors and Ergonomics.



At OSU, Rajiv is working as a GRA and assisting Dr. Sommerich with a study on torque tool use.



Milestones

Mike Rayo won the Best Student Paper award from the Medical Systems Technical Group at the 51st Annual Meeting of the Human Factors & Ergonomics Society, held in Baltimore, MD (October, 2007). His paper was titled, *Assessing Medication Safety Technology in the Intensive Care Unit*. Congratulations, Mike!



In November 2007, Lee Mazurek finished his Masters' degree. His Advisor was Dr. William Marras. The abstract to Lee's thesis, *The Development of an Electromyography Driven Biomechanical Model of the Human Shoulder*, can be found on page 4. Lee is now interviewing for mechanical engineering jobs in the Northeast U.S. He is also starting a business to design, build, and sell hi-fi loudspeakers. Lee can be reached at mazurek.4@mazprojects.com. Good luck to you, Lee!



Winter 2008 Course Announcements

ISE 820 Behind Human Error Dr. David D. Woods (woods.2@osu.edu)

How do complex systems fail? What is the human contribution to success and failure? Why is reliability engineering fundamentally unable to deal with human performance? Why do stakeholders believe there is a "human error" problem? What is a safety culture? What is hindsight bias and how does it block our ability to improve safety? How can organizations develop proactive safety management measures?

This class goes behind the label human error to understand the factors that influence human performance, covers the research base on how complex systems fail, demonstrates how poor design creates predictable forms of error, examines patterns in our reactions to failure and fallacies about error that block organizational learning, and introduces new concepts about how organizations can be resilient or brittle.

Psych 816 Human Performance Theory: Decisions & Control

Dr. Richard Jagacinski (jagacinski.1@osu.edu)

This course will cover a variety of topics in human performance: signal detection and estimation in vigilance tasks and in dynamic contexts; speed-accuracy tradeoffs in choice and skilled movement tasks; perceptual-motor coupling in vehicular control; the organization of action; supervisory control of complex dynamic systems; and multi-task performance. Emphasis will be placed on quantitative descriptions of the fundamental limitations and the adaptive capabilities of the performer. Parallels between control theory and decision theory will be explored. There will be two lectures per week. Additionally, students will gain experience in simulating and evaluating dynamic control systems in a weekly laboratory session.

ISE 673 Cognitive Systems Engin. Dr. Phil Smith (smith.131@osu.edu)

This course focuses on approaches to designing everything from consumer products to web sites to large-scale distributed systems, with a focus on making them more useful, usable, and more likely to be used. It takes an interdisciplinary approach, building upon research from anthropology, AI, cognitive psychology, computer graphics, communication, computer science, group dynamics, human factors engineering, industrial design, information science, instructional design and marketing. Particular emphasis is placed upon human-computer interaction, ranging from the design of Websites to the design of advanced decision support tools.



Research Corner

This issue of the Bulletin summarizes recently published research

Designing Ergonomic Interventions for EMS Workers Part II: Lateral Transfers

Steven A. Lavender, KM Conrad, PA Reichelt, AK Kohok, and J Gacki-Smith, *Applied Ergonomics*, 38:227-236, 2007.

Designing Ergonomic Interventions for EMS Workers Part III: Bed to Stairchair Transfers

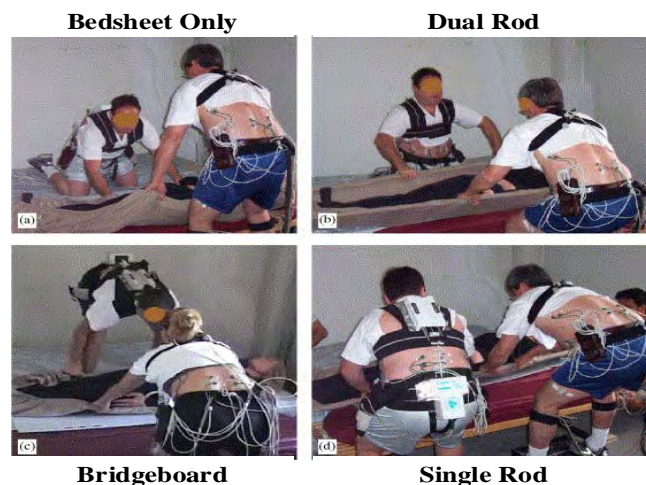
Steven A. Lavender, KM Conrad, PA Reichelt, AK Kohok, and J Gacki-Smith, *Applied Ergonomics*, 38:581-590, 2007.

Abstracts:

Recent work tested ergonomic interventions aimed at reducing the low back musculoskeletal loads experienced by firefighters/paramedics (FFPs) providing emergency medical services (EMS) when performing lateral transfers between beds and stretchers or between stretchers and hospital gurneys.

The interventions, developed using focus groups, were a bridgeboard to reduce the frictional force resisting the lateral sliding of the patient, the use of rods along each side of the patient to facilitate the grasping and handling of the bedsheets on which the patient is typically transferred, and a single rod that, when rolled in the bedsheets, resulted in the task being changed from a lifting task to a pulling task.

Eleven two-person teams laterally-transferred a 75 kg dummy with each intervention between a bed and simulated stretcher. Two roles were defined. For the two sided transfers, the FFP roles were termed "stretcher-side" and "bed-side." Surface electromyographic (EMG) data were collected from eight trunk muscles, on each participant, along with spine kinematic data. Additionally, kinetic data were obtained for the FFPs in the stretcher-side role.

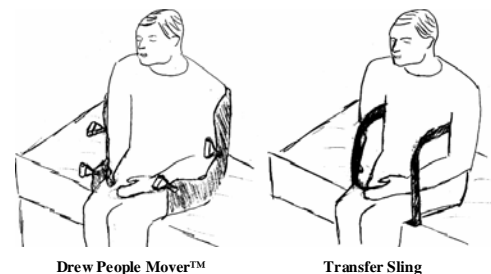


Trunk flexion moments and erector spinae activity were reduced for the FFP in the stretcher-side role when using the bridgeboard and the single rod both individually and in combination. The single rod reduced the erector spinae activity in the FFP who typically would have been on the bed. For FFPs in both roles the single rod increased latissimus dorsi activation relative to the standard bedsheets transfer condition, although, this effect was moderated when the single rod was used in combination with the bridgeboard. Ratings of perceived exertion also supported the use of the single rod relative to the corresponding control condition.

A second study tested interventions aimed at reducing the low back musculoskeletal loads experienced by FFPs who transfer patients between beds and stair chairs.

The interventions, developed or selected using focus groups, were a prototype Drew People Mover™, and a Transfer Sling. These interventions changed the coupling between the EMS worker and the patient. They were compared with an under-axilla lift.

The same eleven teams of FFPs transferred the 75 kg dummy between a bed and a stair chair. Both interventions were tested



using two-person transfers. In addition, the Transfer Sling was tested using a one-person transfer. Surface EMG data were collected from eight trunk muscles from each participant along with spine kinematic data. Additionally, ground reaction forces were acquired and used to estimate directional spine moments using a 3D linked-segment model for one of the participants in each team.

In the two-person transfers there was 19 deg less trunk flexion ($p=.002$) for the FFP on the patient's left side and a trend towards less motion for the FFP on the patient's right side ($p=.079$) when using the interventions. Both FFPs showed reductions in the ipsilateral erector spinae activity using the Drew People Mover and the Transfer Sling that averaged approximately 9% MVC, which corresponds to a 21% decrease in the muscle activation levels. While the overall EMG was greater when performing a single-FFP transfer, the Transfer Sling reduced the bilateral erector spinae activity by approximately 20%. During the two-person transfers, the FFP on the forceplate to the right side of the patient showed a reduction in the forward bending moment using the Drew People Mover relative to the Sling and Underaxilla conditions. During the single-person transfers only the twisting moment was significantly reduced through use of the Transfer Sling.

These objective measures, when combined with the subjective ratings of perceived exertion and the verbal feedback lead us to recommend the use of these interventions for bed to stairchair transfers.

COHAM, continued from page 1

aimed at reducing low-back pain. Dr. Marras's graduate students and staff also placed sensors on Sam, who then performed a parts assembly tasks using COHAM's vehicle carrier system.

The article generated from this nationally televised segment, *Cutting Edge: Stopping Back Pain Before It Starts*, can be found at <http://abcnews.go.com/GMA>.



Akio Hamada, President and Director of Honda of America Mfg., Inc., studies the ROFA overhead vehicle carrier at COHAM.



Dr. William Marras, COHAM Director, discusses low-back pain with Sam Champion, of ABC television's *Good Morning America*.

Data Overload, continued from page 1

How scenarios capture what makes intelligence analysis under data overload challenging:

- Energy disputes in Khazakstan and relations to Russia-Chinese-US political and economic agendas
- Early detection of bio-terrorist threats
- Long-term planning following decisions to use DDT to reduce malaria

How to abstract generic patterns from challenging face valid scenarios:

- Ethnocentric assumptions about social networks
- Faction analysis (to avoid oversimplification of organizational unity)
- Predicting changes of leadership
- Side effects of plans
- Emergent collaboration by increasing anticipated reciprocity
- Coming up-to-speed in a new knowledge area

How to leverage the research literature:

- Rigor in the analytic process
- Diverse perspectives to interpret significance of data
- Trust and reciprocity
- Uncertainty
- Adaptive capacity for organizational resilience

How to innovate:

- Seeding the search for promising directions
- Diverse backgrounds and talents
- Flexible "clusters" of interest form opportunistically around discovered leverage points
- Delayed commitment to a specific framing of the problem
- Pacers to maintain momentum

The Institute's Final Show was held August 30th at OSU's Knowlton School of Architecture. This event utilized several diverse scenarios, such as cross-cultural issues in central Asia to study disease outbreaks and interaction of energy and security to demonstrate themes from uncertainty, culture, factions. The Show interactively demonstrated how the state-of-the-art can be advanced for addressing challenges in inferential analysis exacerbated by data overload conditions.



Student Dan Zelik (right), answers questions at the ICI Final Show, held at the OSU Knowlton School of Architecture. (photo courtesy of Cedric Sze.)

About CPoD

The CPoD is an interdisciplinary consortium of world-class researchers in Information Analysis and Comprehension. The consortium pools expertise in cognitive systems engineering, political science, design, cognitive science, field research, perception, and computer science to solve problems at the intersections of people, technology and work. The CPoD is affiliated with the Institute for Ergonomics and the Cognitive Systems Engineering Laboratory at The Ohio State University.

Questions? Contact Dr. Emily Patterson, Associate Director, CPoD, patterson.150@osu.edu.