Cognitive Engineering in Health Care

We are engaged in a variety of projects which apply human factors and cognitive engineering to analysis and design of health systems. These projects include:

**Cognitive Work Analysis and Iterative Design of Novel Displays for Emergency Medicine:** This multi-year project involves Dr. Ann Bisantz and Dr. Li Lin at UB, along with HF students Theresa Guarrera, Nicolette McGeorge, Sudeep Hegde Nat Benda, and David LaVergne, and collaborators at Medstar Health’s National Center for Human Factors in Health Care (led my Dr. Terry Fairbanks and Dr. Zach Hettinger). After a multi-year process of CWA modeling and iterative display design, summative usability tests, and a comparison of the new displays to a traditional display in a clinical simulation center experiment, showed that the cognitive engineering design displays had better support for cognitive work and may lead to better situation awareness for some team members, without increasing workload.

**Team Communication in Robotic Surgery:** PhD student Judith Tiferes Wang and Dr. Ann Bisantz our collaborating with surgeons at Buffalo’s Roswell Park Cancer Institute to understand how characteristics of teams and surgical situations impact communication in robotic assisted surgery.

**Resilience Engineering Tool to Improve Patient Safety:** PhD student Sudeep Hegde and Dr. Ann Bisantz are collaborating with Dr. Zach Hettinger at Medstar to develop an online tool which will collect and share information regarding success stories in creating and maintaining resilience and patient safety in health systems.

Recent HF Publications


HFES Student Chapter Update

Inter-University Workshop (IUW) 2014

Each year the State University of New York at Buffalo, the University of Waterloo, and the University of Toronto rotate hosting the Inter-University Workshop (IUW) on one of their campuses. This single-day student conference showcases current and proposed research related to human factors engineering and other related disciplines, such as biomechanics, ergonomics, cognitive engineering, user experience, and design research in academia and industry. The purpose of this event is for students from Western New York, Southern Ontario, and elsewhere to gain professional experience presenting their research in a friendly, low-pressure forum (and garnering subsequent feedback and constructive criticism) as well as to take advantage of networking opportunities with other attending peers, keynote speakers, professionals, and faculty members. While the day's events are centered on student presentations, the IUW also features keynote speakers, a poster competition, and a social/networking dinner to follow. To encourage participation, the workshop is held at no cost to attendees.

The HFES student chapter at UB is excited to host 15th annual IUW, which will be held at UB on November 15th, 2014. Planning meetings started in the spring of 2014 and the entire club has been working hard to continue this successful tradition.

To learn more about the event, please visit iuw2014.eng.buffalo.edu

Outreach Activities: ubHFES set up a booth at the Junior Robotic Surgeon Challenge organized by the Roswell Park Cancer Institute. Eight club members talked with more than 80 high school students and their parents about human factors. Our display included multiple posters, a slideshow presentation, and ergonomic tool demonstrations.

LaTeX Seminars: ubHFES hosted three hour-long classes to teach students LaTeX to industrial engineering students.

Exploring Human-Cyber Transportation System Interaction

The transportation research team led by Dr. Changxu (Sean) Wu at ISE recently received a new NSF grant for investigating driver behavior in connected and automated vehicles. The human element will constitute a critical component of tomorrow's Cyber Transportation Systems (CTS), either as drivers interacting with wireless messages in connected vehicle settings or as driver-passengers when vehicles are automated. Given that no engineered system will work perfectly all of the time, this raises important questions relating to the nature of the interaction between CTS and the human driver. Whereas the focus of the current literature has primarily been on hardware and software, in this pioneering project the Dr. Wu and his research team will instead explore human-CTS interaction as the central design consideration. In accordance with this vision, Dr. Wu and his research team will develop and experimentally validate an innovative computational framework (mathematical model) for CTS that quantifies the effects of system design parameters on the key elements of human cognition and performance, which in turn will enable the derivation of design requirements and optimal parameter settings for connected and automated vehicles in order to maximize human safety.
ISE Department Welcomes Dr. Matthew Bolton

Assistant Professor Matthew L. Bolton is the Director of the Formal Human Systems Laboratory (FHSL). Dr. Bolton obtained his Ph.D. in systems engineering from the University of Virginia, Charlottesville. Before joining the University at Buffalo (UB) in 2014, he worked as a Senior Research Associate at the NASA Ames Research Center through the San José State University Research Foundation and as an Assistant Professor of Industrial Engineering and Computer Science at the University of Illinois at Chicago. The FHSL employs four Ph.D. students. It also hosted two international students in 2014: one from the Tsinghua University, Beijing, China and the other from ENSEEIHT, Toulouse, France.

Formal methods are analysis techniques that support the ability to mathematically prove properties about target system models. The FHSL conducts research focusing on the use of formal methods and human performance modeling in the engineering of complex, safety-critical systems that depend on human-automation interaction. The FHSL has received funding on projects sponsored by the European Space Agency, the National Science Foundation (NSF), and the NASA Ames Research Center. Dr. Bolton is currently the PI on an NSF award titled “EAGER: Automatically Generating Formal Human-computer Interface Designs from Task Analytic Models” where he is investigating how to automatically generate human interface designs with performance and usability guarantees from task analytic models and formal usability properties. He is also the institutional PI on a NASA Ames sponsored, collaborative project with GA Tech called “Scenario Development Through Computational and Formal Modeling for Verification and Validation of Authority and Autonomy (A&A) Constructs in Aviation” investigating how to use formal methods synergistically with simulation to investigate function allocation in airspace systems. Ongoing research is also investigating how formal methods can be used to detect and eliminate simultaneous masking (a condition where concurrent sounds can make one or more imperceptible) in medical alarms.

Dr. Bolton’s research articles have appeared in IEEE Transactions on Systems, Man and Cybernetics; Human Factors; the International Journal of Human-Computer Studies; Applied Ergonomics; the International Journal of Aviation Psychology; Computational and Mathematical Organization Theory; and Innovations in Systems and Software Engineering. He has also authored a number of conference papers, three of which have received awards.

Human Factors Faculty have Key Roles in Home Health Center

HF faculty members Dr. Ann Bisantz, Dr. Lora Cavuoto, and Dr. Victor Paquet are leading the development of new person-centered information technology, sensing systems, assistive technologies and home environments to advance health and function via the home as part of a new UB Center of Excellence, Home Health and Well-Being through Adaptive Smart Environments (Home-BASE). The Center capitalizes on ISE collaborations with UB faculty from Biomedical Engineering, Rehabilitation Sciences, Nursing and Architecture to complete research intended to transform health and healthcare practices.

Current projects include the development of new ways to continuously monitor asthma in the home, and new home-based rehabilitation approaches that provide significant long-term functional benefits to those who have experienced stroke or have COPD. One project involves the use of a home-based portable exercise measurement system for people who have suffered a stroke. The system uses everyday objects such as a “smart can” to track performance and provide real-time feedback, with the aim to enhance motor function and gain greater independence.

Recent HF Ph.D. Dissertations


HF Research in the News

Research by Assistant Professor Lora Cavuoto was recently featured in a press release by the American Industrial Hygiene Association. Her study found that workers who are obese may have significantly shorter endurance times when performing workplace tasks, compared with non-obese counterparts. Cavuoto notes that "our findings indicated that on average, approximately 40 percent shorter endurance times were found in the obese group, with the largest differences in hand grip and simulated assembly tasks." Coverage regarding the study has appeared in a variety of news outlets including Medical News Today, WNEW-FM in Washington,D.C., England's Daily Mail, and KYW-TV in Philadelphia. The study was also featured in the September issue of IE magazine.

Dr. Cavuoto specializes in biomechanics, occupational ergonomics, and occupational safety and health. She recently received a grant from the National Institute for Occupational Safety and Health (NIOSH) to develop revised force-endurance models that account for individual characteristics.