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Medical Virtual Reality Simulators: Have We Missed an Opportunity?

By Mark W. Scerbo

Interest in simulators for training has a long history within the human factors profession. In fact, articles addressing driving simulation and simulated displays for vigilance monitoring began appearing in the pages of *Human Factors* in the early 1960s. Since then, more than 400 articles on simulation topics such as flight, air traffic control, command and control, driving, power plant operation, and simulator networking have appeared in *Human Factors*, *Ergonomics in Design*, and the annual meeting proceedings (see also Swezey & Andrews, 2001).

In the early 1970s, interest in medical issues also began to be reflected in the pages of *Human Factors*. A formal technical group called Medical Systems and Rehabilitation was formed in 1992 (now called the Health Care Technical Group). Today, more than 100 articles can be found in our literature addressing diagnoses, medical devices, errors, procedures, and patient safety.

Medical VR Simulators

Within the last 10 years, a new technology has emerged that bridges the areas of training simulators and medicine: medical virtual reality (VR) simulators. In this article, I will describe the development of medical VR simulators and current research issues, noting the absence of human factors/ergonomics input in their design.

Three factors converged in the 1990s to make this technology feasible. First, data from the National Library of Medicine's Visible Human project facilitated access to 3-D models of the human anatomy (Satava, 2001). Second, the rapid adoption of laparoscopic or minimally invasive procedures enabled surgeons to perform operations from outside the body and observe their actions on a video monitor. Thus, designers could utilize models of anatomy to create visualizations of the endoscopic perspective depicted on laparoscopic displays. Third, haptic force feedback-rendering systems that enable users to touch and manipulate objects in virtual space were developed and refined.

Collectively, these events helped usher in a new breed of medical VR simulators that incorporate facsimiles of laparoscopic instruments interfaced with force feedback systems to permit interaction with virtual organs. At present, a variety of medical VR simulators are commercially available that address procedures such as arthroscopy, upper and lower endoscopy including colonoscopy, and intravenous procedures.

Medical VR simulators offer numerous benefits (Scerbo, 2004). They provide the opportunity for students to acquire and refine their skills without putting patients at risk. They offer objective measures of performance and can provide immediate performance feedback. They allow students to encounter and interact with rare pathologies. Moreover, they decrease the need for animal and human cadaver labs.

Although medical VR simulators became commercially available in the late 1990s, data concerning their efficacy was lacking. In 2002, Seymour et al. published the results of the first double-blind experiment comparing training via the traditional apprenticeship approach and training with a VR simulator, the MIST® VR system, which uses abstract representations of laparoscopic tasks to train the fundamental psychomotor skills needed to perform the procedures. Their results showed that residents who trained on the simulator were able to perform a gall bladder removal on actual patients in 29% less time and were five times less likely to injure the gall bladder or burn nontarget tissue than were residents trained according to the traditional method.

More recently, Gallagher and Cates (2004a) reported their experience with a simulator for a surgical procedure used to treat patients with plaque buildup in the carotid artery. Because the risk of stroke is extremely high for patients with this condition, a procedure was developed in which a wire stent is placed in the artery to improve blood flow. This procedure is both complicated and risky, and very few cardiologists can perform it. Further, it is not reimbursable through insurance companies.

Researchers at the Center for Integration of Medicine and Innovative Technology developed the VIST® Vascular Interventional System for Training (now produced by Mentice AB of Gothenburg, Sweden) to provide training on the stent placement procedure. This VR system uses physical models of the catheters and the vascular system to simulate the appearance and physiological dynamics depicted on the cardiologist's X-ray display. The simulator also records a variety of performance metrics that can be used to assess skill acquisition and competency.

A Federal Requirement

In March 2004, Gallagher and Cates (2004b) met with officials at the U.S. Food and Drug Administration to present evidence that VR-based simulation is effective for skills training and skill

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Medical Virtual Reality Simulators

(continued from page 1)

assessment. In April 2004, the FDA voted to approve the carotid stent procedure, including the simulation-based training. In principle, physicians wishing to perform the procedure would have to meet the training criteria on the simulator established by an experienced normative group. Only after competency on the simulator had been demonstrated would they be permitted to perform the procedure on patients. A formal experimental trial comparing VR-trained and non-VR-trained physicians on the procedure is under way. Further, the Centers for Medicare & Medicaid Services announced in September 2004 that it would expand its coverage to include this procedure with the FDA-approved stent.

The action taken by the FDA is unprecedented and will represent the first time in the history of medicine that a performance-based competency measure will be used to determine who can and cannot perform a medical procedure. Further, it is the first time the FDA has specified how physicians must treat patients. These events have the governing boards of several medical specialties (e.g., the American College of Surgeons) considering the benefits of simulation-based training and competency assessment throughout their curricula (Healy, 2002).

There is a growing sense that the availability of medical VR simulators is now creating a paradigmatic shift in how medicine will be taught and practiced in the future (Gallagher et al., 2005). In May 2004, a group of leading surgeons, anesthesiologists, researchers, and developers of medical simulation technology gathered in Washington, D.C., for the first Advanced Initiatives in Medical Simulation (AIMS) meeting. The purpose was to raise awareness among congressional leaders of the need for additional support to help accelerate the development and adoption of medical simulation technology. The meeting concluded with a demonstration of medical simulation technology at the Dirksen Senate Building. A second AIMS meeting is planned for May 2005 and will be cohosted by Senators Tom Harkin (D-IA) and Arlen Specter (R-PA).

Where Is Human Factors?

There is no question that medical VR simulators are about to usher in a new age in medical training, and yet nearly all these developments have taken place with little or no human factors involvement. In fact, the human factors community seems largely

unaware of any activity regarding medical VR simulators. There were no human factors designers on the development teams for either the MIST[®] VR or VIST[®] VR simulator systems. A special issue of *Ergonomics in Design* on human factors and health care was published in summer 2004, and medical simulation was mentioned only once – in the lead article by Lucian Leape. Last October, the Federation of Behavioral, Psychological, and Cognitive Sciences and HFES cosponsored a forum on human factors and patient safety. The meeting brought together experts on home care, transportation/emergency care, and clinical environments and representatives from various funding agencies, including the FDA. Although many issues concerning patient safety were discussed, no one seemed to be aware of the AIMS initiative or even the existence of medical VR simulators.

In his 1999 HFES presidential address, David Woods argued that our profession is much like the street sweeper responsible for cleaning up at the end of a parade. That is, human factors often gets relegated the less popular activities at the end of the development cycle once the technology is fairly mature. Have we missed our opportunity where medical VR simulators are concerned? Are we to be left the job of suturing up incisions after the surgeons have performed the life-saving operations in the world of medical simulation? I think not. In fact, I argue that not only do we have much to offer, but we may have the rare opportunity to make an impact on medical VR simulators while the evolution of this technology is still in its infancy.

There are numerous areas in which designers of medical simulators could benefit from human factors expertise. Perhaps the most important issue faced by developers and users of medical VR systems is simulator fidelity. Many human factors researchers have studied simulator fidelity and performance issues in numerous contexts including aviation, air traffic control, and surface transportation.

Another issue concerns haptics. Many of the medical simulators that incorporate haptic feedback systems are based on an elementary understanding of haptic perception. There is a real need for guidance not only in the development and application of haptic models but in the psychophysical methods needed to establish difference thresholds between the feel of real and virtual tissue.

A third area concerns optimal training methods. Few developers of medical simulators are knowledgeable about principles of psychomotor skill acquisition, task sequencing, part- and whole-task training, overlearning and automaticity, hierarchical and integrative training methods, and transfer-of-training paradigms.

Finally, most of the medical simulators available today focus primarily on psychomotor skills. Few systems exercise the cognitive skills required for diagnoses, decision making, problem solving, and case management. Again, many human factors professionals have extensive experience in cognitive task analysis, cognitive engineering, intelligent interface design, and automated systems. The designers of medical VR systems will need to draw on this knowledge in order to create the next generation of simulators that benefit more advanced residents or practicing physicians.

Obviously, there are many other areas where human factors knowledge would be helpful. The important point is that there is a tremendous opportunity to bring the science and methods of our profession to an emerging technology. However, this parade has formed and is already marching. If we want to be leaders, we must



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be proactive and take our message to the medical community. They will not seek us. Now is the time to get involved, to open up new horizons for our discipline, and to forever change the way medical procedures are taught and practiced. Perhaps years from now, we will be able to look back on our role in the development of medical VR simulators and take pride that we were truly leaders of this parade.

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HFES BOOK DRIVE

HFES International Book Drive

The HFES International Book Drive continues its success in assisting universities and libraries around the world. The HFES University of Central Florida Student Chapter has been responsible for collecting, cataloging, and mailing donated references since January 2000. More than 3000 books, journals, and proceedings have been donated to more than 15 developing nations over the years. The 2004 book drive was a tremendous success. Books were sent to professors and universities in Colombia, Ukraine, and Thailand. At the HFES UCF Student Chapter, we continue to be extremely pleased with this effort and look forward to making this year as successful as previous years.

The chapter would also like to take this opportunity to thank

Raegan Hoefft for her work the last four years as book drive coordinator. Her hard work has ensured that the book drive has remained a successful undertaking. Please note that this year the book drive has a new coordinator and a new address. If you are interested in donating books or have any questions, please contact Michael Curtis, HFES Book Drive Coordinator, University of Central Florida, Team Performance Lab, 3100 Technology Pkwy., Ste. 100, Orlando, FL 32826, 407/921-3561, m_curtis@earthlink.net.



HFES 50TH

Contributions to HFES History

By P. A. Hancock, HFES Historian

It is one of the axioms of life that history is written by the winners. My request to the elder statespersons of our Society is an invitation to become one such winner by helping us to continue to write the evolving history of HFES.

As most members may be aware, we are rapidly approaching our half-century mark. In late 2006, we will meet in San Francisco to celebrate 50 years of experience. It is my belief that those who would look clearly into the future must look well into the past. In this respect, as a professional society, we are in the very fortunate position of still having with us many of our earliest members. There will be some in San Francisco who can recall that very first meeting in Tulsa, and we must capture this living history while we can.

To that end, as the official HFES historian, I am asking members for their early recollections of the Society. My aspiration here is not to constrain people's contributions, either as to content or as to format. Accounts of one to two pages would be simple and concise enough to be edited and generated as a collection. Further, all such accounts can act as an information database for myself and any future historian. To that end, please be as specific as possible as to dates and names and as charitable as possible in interpretation – after all, in the words of G. K. Chesterton, “the follies of our youth are, in retrospect, glorious compared to the follies of our old age.” Pictures for scanning – with as much detailed information as possible about date, location, and people – are especially encouraged.

To give an idea of potential contributions, perhaps this can be a story of how and why you first got into human factors. Given your role in the Society's inception, who were your academic and professional influences? Did you attend a particularly pivotal meeting, or were you influenced or inspired by a particular publication? Humorous stories are strongly encouraged.

Many of those to whom I am appealing may be retired and thankful that they have left all such concerns behind them. I hope this opportunity is one that many will wish to grasp. Please send e-mail contributions to Communications Director Lois Smith at lois@hfes.org and copy me at phancock@pegasus.cc.ucf.edu. Hard-copy contributions may be sent to HFES, P.O. Box 1369, Santa Monica, CA 90406-1369 or faxed to 310/394-2410. We will endeavor to have a selection of these accounts to greet you in the City by the Bay in just over one year's time.



What Makes HFES Succeed?

By Wendy A. Rogers, HFES President

HFES is a volunteer organization. What exactly does that mean? Don't we have a staff to support the organization? We do, but it is a very small, albeit excellent, one. In February, Secretary-Treasurer Dan Fisk (who is my usual traveling companion) and I visited the HFES central office in Santa Monica. We had always been impressed by the efficiency of the staff but came away from our meeting even more aware of how much gets accomplished with so few people. We have an executive director (Lynn Strother), a communications director (Lois Smith), a member services director (Carlos de Falla), and only three other people to support these activities. Stefanie Alexander is the member services coordinator, Jeremy Loudonback is an assistant editor, and Andrea Tomscanyi is our journal administrator. In addition, we hire temporary support as needed and an off-site copy editor whom many will remember from her days as a full-timer – Darcy Wilson (formerly Pettigrew). We also have an excellent relationship with Prestige Accommodations and Steve Marlin, who help make our annual meetings run smoothly.

That's it – that is the entire staff. How then does this nearly 5000-member organization carry out so many activities? Through the dedicated, hard work of many, many volunteers. As I write this, we are preparing for the midyear meeting of the Executive Council. In advance of this meeting, we ask the chair of every task force, subcommittee, committee, and subcouncil to prepare a report to Council. I was amazed to learn that this work amounted to 48 reports! HFES is a vibrant, active organization involved in local activities, student support, outreach, education, and more.

Organizational Structure of HFES

Below is the organizational structure of our Society. Over the years, the structure has evolved (and is still evolving) to enable efficient communication and operation. The Executive Council is divided into subcouncils that serve as the liaisons between Council and the various committees and task forces. What is the difference between a committee and a task force? A committee is permanent, whereas a task force is convened for a specific purpose and is disbanded when that task is accomplished. Each subcouncil is organized according to a theme, and there are six: Communications & Publications, Corporate Activities, External Relations, HFES Institute, Membership & Internal Relations, and Professionalism.

Why am I telling you all this? To illustrate the variety of activities that the Society is involved in, to give you a sense of the sheer number of people who are active volunteers, and to provide you with some ideas about how you might get involved. I can almost guarantee that there is an HFES committee, task force, technical group, publication, or chapter that would match your interests.

Getting Involved

Think about what you like to do and what you are good at doing. Are you a whiz at putting together Web sites? Volunteer to be the Webmaster for a local chapter, a student chapter, or a technical

group. Do you enjoy speaking to groups of people? Become active in National Ergonomics Month, and list yourself in the Speakers Bureau. Do you want to contribute to the technical program of the annual meeting? Start by serving as a reviewer for a technical group, and then volunteer to be nominated for program chair. You might then wish to become involved in the Technical Program Committee.

Do you like to review papers and get involved with the editorial process? Volunteer to serve as a reviewer for one of our publications (and, of course, submit your best work to be published in those publications).

There are many opportunities to be active in our Society at the level of local chapters, student chapters, and technical groups. There is also the need for involvement at the level of committees and task forces. Our publications succeed because of the volunteer efforts of reviewers, associate editors, and editors. And it is critically important to have energetic and experienced individuals participating at the level of the Executive Council. One activity that all Full Members should participate in is the election process – when you receive your ballot in June, be sure to vote. (Ballots are due June 25.)

What Makes HFES Succeed?

The title of this column is “What Makes HFES Succeed?” The answer: “You!” When I started to write this column, I wanted to thank people by name. But there are so many people who work so hard – I was afraid I would offend by omission. Suffice it to say, the members appreciate your service, and as president, I have been awed by your efforts.

To say that HFES is a volunteer organization means that the vast majority of our activities are carried out by dedicated volunteers who recognize the important contributions that an organized society can make, who are willing to share their knowledge and expertise, who give up their personal time for HFES, and who appreciate the importance of advancing and supporting the discipline of human factors and ergonomics.

To those of you who have volunteered in the past or who are currently volunteering, I say, “Thank you!” To those of you who have not yet volunteered, I look forward to working with you in the future. The success of HFES is dependent upon you (with a little help – a lot of help – from our friends in the Central Office).

Organizational Structure

Listed below is the current HFES organizational structure.

Executive Council

President
Past President
President-Elect
Secretary-Treasurer
Past Secretary-Treasurer
Secretary-Treasurer-Elect
At-Large Members (3)
Parliamentarian

Communications & Publications Subcouncil

Bulletin Features Editor

Compensation Task Force
Ergonomics in Design Editor
 Historian
Human Factors Editor
JCEDM Editor
 Monograph Series Editors
 Pioneers in HF&E Editor
 Reviews of Human Factors/Ergonomics Editor
 Web Site News Editor

Corporate Activities Subcouncil

Annual Meeting Policy Committee
 Finance & Budget Committee
 Nominations & Elections Committee
 Policy & Planning Committee
 Technical Advisory Group
 Technical Program Committee
 50th Anniversary Task Force
 2005 Annual Meeting Host Committee

External Relations Subcouncil

IEA Representatives Committee
 Liaison to the Federation of Behavioral, Psychological, and
 Cognitive Sciences
 Media Relations Advisory Committee
 National Ergonomics Month Committee
 Outreach Programs Task Force

Internal Relations & Member Services Subcouncil

Chapter Affairs Committee
 Council of Technical Groups
 Diversity Committee
 Membership Admissions
 Student Affairs Committee
 Volunteerism Committee

Professionalism Subcouncil

Accreditation Reviewers Panel
 Awards Committee
 Education & Training Committee
 Fellows Selection
 Professional Standards Committee
 Undergraduate Program Recognition Committee

HFES Institute Subcouncil

International Organization for Standardization (ISO) Standards
 Chair
 US TAG to ISO/TC159 Committee
 SC1 Committee
 SC3 Committee
 SC4 Committee
 SC5 Committee
 Liaisons to Department of Defense Human Factors Engineering
 Technical Advisory Group (DoD HFE TAG)
 U.S. Standards & Best Practices Chair
 Best Practices
 HFES 100 Committee
 HFES 200 Committee

2005 Cross-Society Development Report

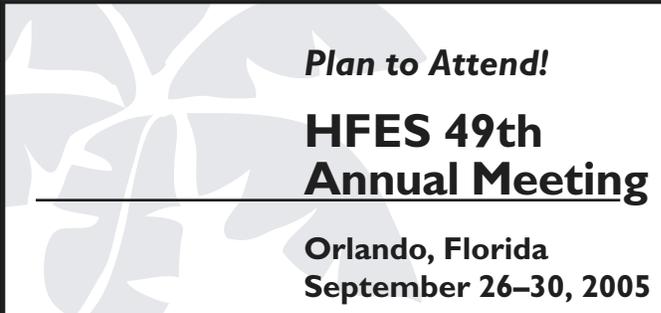
By *Arnold M. Lund & Lynn Strother*

At the recent Association for Computing Machinery Special Interest Group in Computer-Human Interaction conference in Portland, Oregon, a variety of professional societies whose members are active in creating user experiences gathered to talk about the needs of professionals and the needs of the societies that support them. These societies represent human factors professionals, visual and industrial designers, interaction designers and information architects, technical communicators, usability professionals, and professionals in other related areas. An HFES contribution written by Wendy A. Rogers, Lynn Strother, and Arnold (Arnie) M. Lund was presented at the meeting by Strother and Lund.

Day one began with a quick overview of the evolution of the user experience field and the growing number of cross-society activities already occurring. Participants then went on to talk about the missions of their societies and the ways they support their members. These societies make different decisions based on whether they are publication- and discipline-oriented versus networking- and job-oriented, or balance between the two. The fundamental genetics of most associations also were revealed to be different – for example, as to whether they sought to be more of an engineering organization versus more of a creative community. Interestingly, societies that had more of a technical or special interest group orientation seemed to have a greater built-in capability for handling the changing needs of the field and their members.

Day two began with a discussion of the pain points that societies were experiencing. The heart of many of these pain points is that there is simply too much that one needs to know for a complete understanding of user experience, and even if people can find such an understanding, they don't have the time and resources to participate in everything. Personas and scenarios were defined concerning these pain points in order to identify potential solutions. Solutions ranged from a cross-society calendar to joint conferences and workshops.

Next steps include continuing to refine the proposals and then formally presenting these proposals to the boards of the various societies. 



Plan to Attend!

**HFES 49th
Annual Meeting**

**Orlando, Florida
September 26–30, 2005**

O. Keith Hansen (1929–2004)

The profession and the Society lost one of our strongest advocates when Oliver Keith Hansen died in June 2004. Those who worked alongside Keith marveled at his combination of raw intelligence and a tutorial manner that was gentle and unpretentious.

Keith's efforts on behalf of HFES were constant. He loved the profession and saw the Society as being pivotal in making the discipline known to the general public, other professions, and agency administrators. Indeed, his many activities to "spread the word" resulted in the establishment of the O. Keith Hansen Outreach Award in 2003. Fortunately, he was still living when it was created; unfortunately, he died without ever knowing that he was also its first recipient.

Keith's activities for HFES were extensive. Perhaps many of us associate him with his role as chair of the Public Relations Committee for many years. He expanded HFES exhibit operations and managed booth activities at more than 50 events with exposure to more than 150,000 attendees. He produced and directed a video promoting the profession and the Society. He enjoyed working behind the scenes and served on three annual meeting committees, each time introducing unique program topics. He quietly arranged press interviews for HFES leaders. He also served as president of the HFES Los Angeles and Orange County Chapters.

Keith's professional experience began in 1958 as a research psychologist at the U.S. Air Force Aeromedical Lab at Wright-Patterson Air Force Base after receiving his M.S. in industrial

and personnel psychology. A National Institutes of Health predoctoral fellow in sensory physiology, he maintained a strong research orientation. In spite of that, Keith was able to perform quick studies for practical applications at North American Rockwell, Northrup Nortronics, and Hughes Aircraft. His outstanding knowledge of display systems and human visual processes made him a valuable contributor to the design of advanced avionics, shipboard displays, command and control functions, and air traffic control systems. He authored more than 60 technical papers, research reports, and book chapters.

Keith served on committees and planning boards for color display technology, intelligent vehicle systems, technology transfer, VDT ergonomics, and speech recognition technology. In 1980, he established HEDCON, Inc., to provide consulting services to industry and government.

People who got to know Keith realized that there seemed to be nothing that he had not done or did not have deep knowledge about. Bring up a topic, and Keith would provide you with a fascinating learning experience – from anthropology to zoology. Perhaps some of that came from his many jobs before and during college: mail carrier, auto mechanic, roofer, railroad switchman, surveyor, truck driver, cook, and even a stint as a bartender.

His personal activities were equally extensive in his later years. He was an avid skier and a caring family man and had just completed a book of highly creative poetry prior to his death. It will be published by one of his sons.

He will be deeply missed by all whom he touched.

—R. J. Hornick

Design of Complex and Joint Systems Submissions Sought

The *Journal of Cognitive Engineering and Decision Making*, HFES's new journal, invites submissions for the Design of Complex and Joint Systems track.

This track focuses on the process and products of innovative design. It seeks to provide a vehicle for the presentation of creative design research that has not traditionally had natural outlets within the human factors/ergonomics field and related communities. Toward this end, papers are encouraged that include URLs of Web sites featuring companion electronic media that present material that is not well suited for inclusion in traditional papers (e.g., dynamic depictions of design concepts, video clips of user interactions that motivate the design or illustrate its evaluation).

The Design of Complex and Joint Systems track seeks research papers that are broadly relevant to the design of innovative systems. These would include theories, methods, and studies

of design that contribute to the understanding of how systems that more effectively foster cognitive and collaborative work of individuals, teams, and organizations can be designed. Papers that present innovative design concepts and their theoretical rationale are also sought. The focus of these papers should be on the description of the design concepts, support rationale, and design principles. Formal evaluation studies of the design concepts are not required. Authors are encouraged to include URLs of Web sites where an electronic companion is available to display dynamic illustrations of the design concept.

Papers that examine the role of cognitive engineering in the wider systems design enterprise are also encouraged, including the role of analysis, envisioning, and evaluation within the broader context of design. Papers on topical themes such as the role of scenarios in design and the role of cognitive metrics in design and evaluation are particularly desired. The objective is to publish papers that can provide the focal point for additional shorter commentary papers that reflect on the core theme.

Prospective authors are encouraged to submit brief descriptions

JCEDM, cont.

of proposed papers as well as preliminary draft materials for review and comment by the editors. For more information about the Design of Complex and Joint Systems track of the *Journal of Cognitive Engineering and Decision Making*, contact David D. Woods at woods.2@osu.edu. All manuscripts should be submitted electronically to Editor in Chief Mica R. Endsley at cedm.journal@satechnologies.com.

A future issue of the *HFES Bulletin* will feature a call for submissions to the Studies in Simulations and Synthetic Environments track. The call for papers for the Cognition in Context track was published in the April issue. Cognition in Context track editor Robert R. Hoffman may be reached at rhoffman@ihmc.us. David B. Kaber, editor of the Studies in Simulations and Synthetic Environments track, may be contacted at dbkaber@unity.ncsu.edu. ☒

★ **6th Australian Industrial and Organisational Conference**, June 30–July 3, 2005, Gold Coast, Queensland, Australia. Anna Bolkas, +61-3-8662-3300, a.bolkas@psychsociety.com.au, <http://www.iopconference.com.au>.

★ **Third Annual Cognitive Systems: Human Cognitive Models in System Design Workshop**, July 6–8, 2005, Santa Fe, New Mexico. Sidney Holman, 505/844-7854, spholma@sandia.gov, http://www.sandia.gov/cog.systems/cognitive_workshop/index.htm.

Human Factors and Ergonomics Society 49th Annual Meeting, September 26–30, 2005, Orlando, FL. info@hfes.org, <http://hfes.org/Meetings/05annualmeeting.html>.

★ **HFES Europe Chapter 2005 Annual Meeting**, Turin, Italy. Dick De Waard, d.de.waard@hfes-europe.org, <http://conference.hfes-europe.org>. *Deadline to submit abstracts: July 1.*

★ *Indicates new listing.*



STANDARDS

Comments Invited on HFES 100 Canvass Draft

Consensus review of BSR/HFES 100, Human Factors Engineering of Computer Workstations, announced in *Standards Action* on January 21, 2005 and in the *HFES Bulletin* in February 2005, has begun. The canvass committee has been formed and is reviewing the document. The document has been revised based on comments received during the trial use period.

Public comment regarding the canvass document is invited. A copy of the revised document is available for \$50 for HFES members (\$85 nonmembers), plus \$10 shipping/handling. Orders and payment (check, MasterCard, VISA, AMEX) may be sent to HFES at the address below (fax 310/394-2410).

Please send all comments regarding the document to Tom Albin, c/o Human Factors and Ergonomics Society, P.O. Box 1369, Santa Monica, CA 90406-1369. All comments must be received by June 30, 2005. ☒

CALENDAR

Announcement deadlines: 1st day of the month prior to the desired issue; for events or deadlines within the first 3 weeks of a month, send information at least 2 months in advance. Items are published according to space availability.

★ **Organizational Design and Management Symposium**, June 22–25, 2005, Maui, HI. odam2005@cqpi.engr.wisc.edu, <http://cqpi2.engr.wisc.edu/odam2005/>.

★ **XIX Annual International Occupational Ergonomics and Safety Conference 2005**, June 26–29, 2005, Las Vegas, NV. <http://www.iso.es.info>.

★ **3rd International Driving Symposium on Human Factors in Driver Assessment**, June 27–30, 2005, Rockport, ME. Kathy Holeyton, U. of Iowa/PPC, 223 South Quadrangle, Iowa City, IA 52242, 319/335-6804, fax 319/335-6801, kathy-holeton@uiowa.edu, <http://driving-assessment.org/>.

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FLASH!

Graduate Directory Update

*The HFES Directory of Human Factors/
Ergonomics Graduate Programs is up-
dated regularly. If you have not sent
updated information about your grad-
uate programs lately, please contact
Assistant Editor Jeremy Loudenback at
310/394-1811 or jeremy@hfes.org.*



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