



HCI Master's Degree Program Approved

The GVU Center has received approval to establish a Master of Science degree program in Human-Computer Interaction (HCI) beginning in Fall 1997. This interdisciplinary, collaborative program—encompassing the College of Computing; the School of Psychology; and the School of Literature, Communication, and Culture—will provide students with the practical skills and theoretical understanding they will need to become leaders in the design, implementation and evaluation of the computer interfaces of the future.

The existing need

The need for such a program is clear: computers are no longer used solely by technical professionals; they are an integral part of our everyday lives. Simple, intuitive user interfaces will be increasingly important if technology-based products are to be successful. It is no longer sufficient that a computer system perform a task without error—ease of usability and usefulness are as important as efficiency to today's computer user.

Because successful user interface design requires a broad knowledge of computer technology, human behavior, and the art of design, the HCI Master's program will include three specialization tracks: interface software and usability; cognitive and engineering psychology; and multimedia design, communication theory, and digital aesthetics.

The program was enthusiastically endorsed by the University and the Board of Regents for the State of Georgia. This will be the first such program in Georgia, and one of only a handful internationally.

Application and curriculum

Students will apply to the HCI Master's program through the GVU Center. Admission to the HCI program will be through one of the participating academic units, based upon the recommendations of a multidisciplinary GVU Committee consisting of representatives of each participating unit. The Master's degree in HCI will be granted by the participating unit which is the student's home department.

Each student will be required to take a set of core courses followed by a set of area specialization courses and participation in a team project. The core courses are divided into fixed and flexible groups; students are required to take all courses in the fixed core, and a subset of courses in the flexible core, as determined by the GVU Committee in consultation with the home unit. Courses in the area of specialization will be determined by the student's home academic unit.

Semester conversion

The campus-wide conversion to the semester system (effective Fall, 1999) has been factored into the planning process. The HCI degree program as currently outlined is 5 quarters or 54 quarter hours. It will convert to 3 semesters or 36 semester hours. With the enthusiastic support shown by all participating units for this degree program, we anticipate no problems with the semester conversion.

The Multidisciplinary Committee for the HCI Master's program is chaired by Al Badre, and includes Jay Bolter (LCC), and Richard Catrambone (Psychology). The GVU Center is grateful for the support and advice of our Industrial Affiliates throughout the planning process for the HCI degree program. ♦

FROM THE DIRECTOR

I spent my first weeks at GVU worrying about my shoe size (will I ever fill Jim Foley's ample shoes?) and reading everything ever written on herding cats (this is, I was told, akin to trying to steer faculty members). Then when the flood of email, phone calls, meetings, committees, recruiting and personnel issues, and finally teaching took 300% of my time, I stopped worrying. I always liked having large shoes anyway. I joined GVU because I believe that it has a unique opportunity to impact not only the technical community, but all of society. Our



Jarek Rossignac

mission goes beyond making computers easier to use; we must help computer hardware and software developers produce solutions that make humans more effective in every aspect of their lives. An admirable objective—one that requires the kind of talent, connections and infrastructure that I see here in our growing Center.

GVU's diverse talents continue to expand with the addition of faculty members from music (James Oliviero), engineering (David Rosen and Suresh Menon), and robotics (Ron Arkin); and our strength in 3D graphics, visualization, and animation has been significantly enhanced by the hiring last fall of two outstand-

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Acronyms

A key to Georgia TechTalk:

- CoC: College of Computing
- CRB: Centennial Research Building
- FCE: Future Computing Environments
- GTRI: Georgia Tech Research Institute
- IAP: Industrial Affiliates Program
- IDT: Information Design and Technology
- ISyE: School of Industrial and Systems Engineering
- LCC: School of Literature, Communication, and Culture
- OIT: Office of Information Technology

GVU in the Scientific Community

Our faculty and students make a strong showing in the technical community through participation in conference and professional societies:

Conference Chairs

- **Irfan Essa**—Program Chair, International Conference on Automated Face and Gesture Recognition '96; Program Co-chair, IEEE Workshop on Non-Rigid and Articulated Motion '97
- **Ashok Goel**—Vice-chair, 4th International Conference on Artificial Intelligence; Co-Chair, workshop on Functional Modelling in Design; Program Committee, Workshop on Machine Learning in Design
- **Larry Hodges**—Conference Chair, Virtual Reality Annual International Symposium (VRAIS '98); Program Co-Chair, VRAIS '97
- **Jarek Rossignac**—Conference Chair, TeamCAD: First GVU Workshop on Collaborative Design; Program Co-chair, Eurographics '96; Chair, Eurographics '97 Best Technical Paper Award Jury

Journal Editorships/Professional Committees

- **Jessica Hodgins**—IEEE Robotics and Automation Advisory Council; Editor, *Autonomous Robots*
- **Bill Ribarsky**—Chair, IEEE Technical Committee on Computer Graphics
- **Jarek Rossignac**—Editorial Board: *Computer-Aided Design*; *Visual Computer*; *Computer Graphics Forum*; and *Fundamentals and Applications of CAD/CAM and Modeling*; Guest Editor of special issues: "Solid Modeling," *IEEE Transactions on Visualization and Computer Graphics* (Mar '96); "Solid Modeling," *Computer-Aided Design* (Feb '97)

Conference Committees

- **Gregory Abowd**—Program Committee: Design, Specification & Verification of Interactive Systems '97; International Symposium on Wearable Computing (Oct '97)
- **Jessica Hodgins**—Program Committee: IEEE International Conference on Robotics and Automation 1997; 3d Interactive Symposium; Siggraph '97; Multimedia '97; Graphics Interface '98
- **Bill Ribarsky**—Program Committee: VRAIS '97; Visualization '97; and Pacific Graphics '97
- **Jarek Rossignac**—Program Committee: Theory and Practice of Geometric Modeling, Blaubeuren, Germany '96; ACM/Siggraph Symposium on Solid Modeling 1997; Eurographics '97; ACM Symposium on Computational Geometry 1997; Pacific Graphics '97; IMDSP Workshop on Signal Processing for 3D Image Analysis and Synthesis, 1998.
- **Larry Najjar**—Organizing Committee, First International Symposium on Wearable Computers
- **Jim Pitkow**—Organizing Committee, Frontiers in Distributed Operating Systems '97; ACM lecturer

Conference Papers & Presentations

CHI '97

- Making Computers Easier for Older Adults to Use: Area Cursors and Sticky Icons; **Aileen Worden, Neff Walker, Krishna Bharat, Scott Hudson**
- PaperLink: A Technique for Hyperlinking from Real Paper to Electronic Content; **Toshifumi Arai, Dietmar Aust, Scott Hudson**
- Life, Death and Lawfulness on the Electronic Frontier; **Jim Pitkow** and Peter Pirulli
- Age Group Differences in WWW Navigation (short paper); **Beth Meyer, Richard Sit, Victoria Spaulding, Sherry Mead, Neff Walker**
- Using a Wearable Computer to Improve the Performance of Quality Assurance Inspectors in a Food Processing Plant (workshop paper); **Larry Najjar, Jennifer Ockerman, Chris Thompson**
- Java-based User Interface Development and Web Application Deployment (tutorial); **Ian Smith**
- Supporting Knowledge Workers Beyond the Desktop with Palplates (tech note); **Jennifer Mankoff, Bill Schilit**
- CyberDesk: Automated Integration of Desktop and Network Services (tech note); Andrew Wood, **Anind Dey, Gregory Abowd**
- Interfaces for Learning from Modeling Problems (design briefing); **Noel Rappin, Mark Guzdial, Matthew Reaff, Pete Ludovice**
- Putting Visualization to Work: ProgramFinder for Youth Placement (design briefing); **Jason Ellis, Anne Rose, Catherine Plaisant**
- Supporting Student-Built Algorithm Animation as a Pedagogical Tool (demonstration); **John Stasko**
- Integrating Tools into the Classroom (poster); R. Hubscher, S. Puntembakar, **Mark Guzdial, Janet Kolodner**

VRAIS '97

- Evaluation of the Effects of Frame Time Variation on VR Task Performance; **Ben Watson, Victoria Spaulding, Neff Walker, Bill Ribarsky**
- Travel in Immersive Virtual Environments: An Evaluation of Viewpoint Motion Control Techniques; **Doug Bowman, David Koller, Larry Hodges**
- Gorillas in the Bits; **Don Allison, Brian Wills, Larry Hodges, Jean Wineman**
- Virtual Humans (panel); organized by **Jessica Hodgins**

Graphics Interface '97

- Simulation Levels of Detail for Real-Time Animation; **Jessica Hodgins, Deborah Carlson**
- Do Geometric Models Affect Judgments of Human Motion? **Jessica Hodgins, James O'Brien, Jack Tumblin**

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TeamCAD '97

The GVU Center will host TeamCAD, a NIST co-sponsored workshop on Collaborative Design, on May 12–13, 1997, immediately preceding the ACM Solid Modeling Symposium in Atlanta. By bringing together researchers, users, systems vendors and funding agencies involved with CAD/CAM, PDM, and collaborative design, the goal of TeamCAD is to better define the state of the art in collaborative CAD, identify research issues, explore collaboration between the different research and development teams, and justify a research charter on computer-assisted collaborative design of mechanical, architectural and construction models. The workshop will address such issues as:

- establishing precise task and performance models of traditional environments in order to provide guidelines for future research and yardsticks for measuring the results.
- collaborative CAD from such areas as shape manipulation, interactive graphics, user-interfaces and versioning, interface standards, decision support and documentation, multimedia communication and mark-up tools, product data management.
- the role of collaborative design in the overall product cycle and the interdependencies between the design activity and other business processes.

Registration for TeamCAD will remain open until May 12. For on-line registration see URL: <http://www.cc.gatech.edu/gvu/TeamCAD/> or call Tonya Dunson at 404/894-4488.

Special Demo Night

GVU hosted more than 350 computing enthusiasts from around the world for a special Demo Night and reception on Wednesday, March 26. Attendees of CHI (Conference on Human Factors in Computing Systems) in Atlanta, the visitors were treated to demonstrations of interdisciplinary research projects in animation, educational applications, future computing environments, information and scientific visualization, virtual environments, human factors, information design and technology, and architectural modeling.

The large turnout exceeded expectations; the labs were jammed late into the evening as GVUers demoed and discussed their work with visiting colleagues like Randy Pausch, a leading expert in HCI and VR, who backed off when “attacked” by the virtual female gorilla simulated by Larry Hodges’ students—never get too close to a gorilla, even in VR! Steve Mann, MIT’s inventor of the wearable computer, viewed GVU demos through his new display device built into ordinary sunglasses—he took them off to discuss with GVU Director Jarek Rossignac how GVU research will impact society in the near and distant future. Others discussed possible collaborations with GVU, or ways to enhance established relationships with the center.

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Web Growth Slowing; Privacy, Censorship Issues Emerge

After three years of explosive growth, the rapid expansion of the World Wide Web may be slowing. The sixth GVU WWW User Survey shows mostly minor changes in user demographics—age, gender, income, etc., and a significant decrease in the percentage of new users (36% of the respondents said they had been on-line for less than a year, compared to 60% in the fourth survey one year ago).

“The demographics of the Web are now showing stability,” says PhD student Jim Pitkow, who has conducted the surveys twice annually since 1994. “The trends are continuing, but the rate of change is much slower.”

New questions on the sixth survey focused on issues of cyberspace privacy, falsification of information provided on-line, censorship, and the sociological impact of the Web. More than 15,000 Web users responded to the survey, and some findings include:

- Web users, particularly women, expect to be able to control their personal demographic information on the Web. This runs counter to the interests of many Web information providers, who wish to obtain information about potential on-line customers for targeted marketing purposes.
- Mistrust of those asking for demographic information led many users to avoid Web sites that require registration, and caused a third of the respondents to provide false information. Nearly three quarters of the respondents said sites asking for information should specify how the data will be used and 57% said sites need to disclose that they are gathering information.
- The survey found strong beliefs that users should be able to have private communications on the Internet and use private payment systems. Significant numbers wanted laws to protect on-line privacy.
- Web commerce appears to be growing. Approximately 20% of respondents said they had purchased something on the Web, up from 11% a year ago. Computer hardware and software, books, music and travel were the items most likely to be purchased.
- Asked to name the most important issues facing the on-line community, 36% cited censorship as the top concern, while privacy was listed by 26%. Navigating the Web concerned 14% of respondents.

Complete results of the sixth survey, as well as all previous surveys, can be found at: http://www.cc.gatech.edu/gvu/user_surveys/ ♦

Next GVU WWW User Survey

April 10 through May 10, 1997.

URL: <http://www-survey.cc.gatech.edu>



Gorillas in the News

The Virtual Reality Gorilla Exhibit, a joint project between GVU and Zoo Atlanta, continues to draw media attention with recent articles in *Science and Children* (September, 1996), *R&D Magazine* (February, 1997), and *Discover Magazine* (April, 1997).

Grants

The Office of Naval Research has awarded \$125,000+ to **Larry Hodges** and **Bill Ribarsky** for research in interaction, collaboration and application building within a 3D virtual environment.

John Stasko received a 2 year grant for \$116,579 from NSF that will carry him through August of 1998. His research topic is understanding object-oriented systems through visualization.

Emory University/NIH have awarded \$50,000 to **Norberto Ezquerro** to study a unified approach to quantify and visualize cardiac imagery. This is the first year of a 4 year project.

Mark Guzdial is co-PI on a one year \$50,000 planning grant to EduTech from NSF's new CRLT (Collaborative Research on Learning Technologies) initiative to prepare a proposal for a center in design education—a multi-institute, multi-disciplinary, collaborative center to design, develop and evaluate curricula, curriculum guidelines, and classroom practices for learning, learning from and doing design. From the planning grants that were awarded, NSF will make awards for up to three centers.

Larry Hodges and **Bill Ribarsky** received \$46,186 from the National Science Foundation to support the sixth consecutive year of their Research Experiences for Undergraduates Program.

Richard Catrambone (PI) has received a 1997 grant for \$21,632 from Georgia Tech's Center for Education Integrating Science, Mathematics, and Computing (CEISMC) for development of a computerized laboratory for introductory psychology.

The Mobility Foundation has awarded a \$9000 grant to the Future Computing Environments Group for their use in continuing their work on Classroom 2000 and related activities. The award was presented to **Gregory Abowd** by Gerry Purdy, President of Mobile Insights, a consulting firm on mobile computing and sponsor of the Mobility Foundation.

Larry Hodges, Bill Ribarsky, Jarek Rossignac, Irfan Essa, Elizabeth Davis, Levien deBraal and **Norberto Ezquerro** received a Defense Universities Research Instrumentation Grant of \$126K from ONR and matching funds from J. L. Chameau, Vice Provost for Research at Georgia Tech, to purchase an SGI Reality Engine and Virtual Workbench display.

Larry Hodges and **Barbara Rothbaum** (Emory University) received a grant from NIMH to support the development of Virtual Environments to treat Post Traumatic Stress Disorder in Vietnam veterans.

Virtual Gorillas

The **VR Gorilla Exhibit**—an immersive virtual environment in which a child may assume the persona of an adolescent gorilla, enter into one of the gorilla habitats at Zoo Atlanta, and interact as part of a gorilla fam-

ily unit—combines a model of one of Zoo Atlanta's gorilla habitats with computer generated gorillas whose movements and interactions are designed to be accurate representations of gorilla behaviors. The goal of the VR Gorilla Exhibit is to create an experiential educational tool for kids to learn about gorillas' interactions, vocalizations, social structures and habitat. The project is a collaboration between GVU's Virtual Environments Group and Zoo Atlanta.

Future Computing Environments

The Future Computing Environments group continues to build prototypes of mobile and ubiquitous computing systems for our everyday lives. The FCE group has grown tremendously in only two years, and it now includes three faculty members (Gregory Abowd, Chris Atkeson, Irfan Essa), seven PhD and three masters students, and dozens of undergrads.

Ongoing FCE projects include: **Classroom 2000**—ubiquitous computing in education. FCE now has its own purpose-built classroom in the College of Computing supporting a number of classes; **Cyberguide**—location-aware touring services for the Georgia Tech and Atlanta area. Cyberguide now provides camera support around Fulton County.

New this year: **CyberDesk**—automated support for integration of desktop and network services; **LlamaShare**—providing seamless support for access to mobile data; **Domisilica** (formerly CyberFridge)—the future of computing in the home (joint work with the Broadband Telecommunications Center); and **Savoir**—work on voice-only interaction with network-based information services.

FCE has received a good bit of Industrial Affiliates sponsorship in the last year from: NEC (including collaboration with visiting researcher Mikiya Tani), MERL, FX-PAL (donated touch panel for use in Domisilica and exchanged software built during summer internship), and Motorola (sponsored research with Colin Potts on voice-only interaction).

Educational Applications

Amnon Shabo is working with GT's Health and Performance Sciences Department and the Center for Education Integrating Science, Mathematics and Computing (CEISMC) on **HapTech**, a Web-based learning environment aimed at supporting the study of human anatomy and physiology. It consists of several modules: course notes; glossary; project facilitator (a collaborative tool to facilitate a paper project by a team of students); resources (an index of annotated links to external resources on the Web and elsewhere); and case studies (a list of case studies in human anatomy and physiology). The currently available case study is **WebDiagram**, which is based on HyperDiagram—a

RECENT PUBLICATIONS

Journal articles, books and book chapters in-press or published by GVU faculty and graduate students during 1996 and 1997 by general subject (conference proceedings not included):

Graphics, Animation, VR, Visualization, Modeling:

Banerjee, R., **J. Rossignac**. Topologically Exact Evaluation of Polyhedra Defined in CSG with Loose Primitives. *Computer Graphics Forum* 15(4): 205–17. 1996.

Brogan D. C., J. K. Hodgins. Group Behaviors for Systems with Significant Dynamics. *Journal of Autonomous Robots* 4:137–53. 1997.

Davis, E. T. Visual Requirements in HMDs: What Can We See and What Do We Need to See? In *Head Mounted Displays: Designing for the User*, edited by J. Melzer and K. Moffitt. New York: McGraw-Hill, 1997.

Ezquerro, N., S. Capell, L. Klein, P. Duijves. Knowledge-Guided Labeling of Arterial Structure Using Temporal Disambiguation. *IEEE Transactions on Medical Imaging* (in press).

Ezquerro, N., R. Mullick. Model-Guided Segmentation of 3D Imagery. *CVGIP: Graphical Models and Image Processing* 58(5): 510–23. November 1996.

Ezquerro, N., R. Mullick. Topological Goniometry: An Approach to 3D Pose Determination. *ACM Transactions on Graphics* 15(2): 99–120. April 1996.

Hodges, L. F., B. O. Rothbaum, B. A. Watson, G. A. Kessler, D. Opdyke. Virtually Conquering Fear of Flying. *IEEE Computer Graphics & Applications* 16(6): 42–49. 1996.

Hoffman, C., **J. Rossignac**. A Road Map to Solid Modeling. *IEEE Transactions on Visualization and Computer Graphics* 2(1): 3–10. 1996.

Reddy, M., **B. A. Watson, N. Walker, L. F. Hodges**. Managing Level of Detail in Virtual Environments: A Perceptual Framework. Accepted for publication in *Presence: Teleoperators and Virtual Environments*. 1997.

Rothbaum, B. O., **L. F. Hodges, R. Kooper**. Virtual Reality Exposure Therapy. To appear in *The Journal of Psychotherapy and Practice and Research*. 1997.

Rothbaum, B. O., **L. F. Hodges, B. A. Watson, G. D. Kessler, D. Opdyke**. Virtual Reality Exposure Therapy in the Treatment of Fear of Flying: A Case Report. *Behaviour Research and Therapy* 34(5/6): 477–81. 1996.

Surdick, R. T., E. T. Davis, R. A. King, and L. F. Hodges. The Perception of Distance in Simulated Visual Displays—A Comparison of the Effectiveness and Accuracy of Multiple Depth Cues Across Viewing Distances. To appear in *PRESENCE: Teleoperators and Virtual Environments*. 1997.

van Teylingen, R., **M. W. Ribarsky, C. van der Mast**. Virtual Data Visualizer. *IEEE Transactions on Visualization and Computer Graphics*. 1997 (in press)

Watson, B. A., N. Walker, L. F. Hodges, M. Reddy. An Evaluation of Level of Detail Degradation in Head-Mounted Display Peripheries. Accepted for publication in *Presence: Teleoperators and Virtual Environments*. 1997.

Wooten, W., J. K. Hodgins. Simulation of Human Diving. *Computer Graphics Forum*. 1996.

Human-Computer Interaction:

Abowd, G. D., C. G. Atkeson, A. Dey, J. Hong, S. Long, R. Kooper, M. Pinkerton. Cyberguide: A Mobile Context-aware Tour Guide. Accepted for publication in *ACM Wireless Networks*. January 1997.

Darrell, T., **I. Essa, A. Pentland**. Task-specific Gesture Modeling Using Interpolated Views. *IEEE Transactions on Pattern Analysis and Machine Intelligence* 8(12): 1236–42. 1996

Dix, A., **G. Abowd**. Modelling Status and Event Behaviour of Interactive Systems. *Software Engineering Journal* 11(6): 334–46. November 1996.

Essa, I., A. Pentland. Coding, Analysis, Interpretation and Recognition of Facial Expressions. *IEEE Transactions on Pattern Analysis and Machine Intelligence* (in press)

Rogers, W. A., E. F. Cabrera, **N. Walker, K. Gilbert, A. D. Fisk**. A Survey of Automatic Teller Machine Usage across the Adult Lifespan. *Human Factors* 38:156–66. 1996.

Rogers, W. A., **A. D. Fisk, S. E. Mead, N. Walker, E. F. Cabrera**. Training Older Adults to Use Automatic Teller Machines. *Human Factors* 38:425–33. 1996.



Fraunhofer Connection

The Fraunhofer Institute in Darmstadt presented Norberto Ezquerro with a plaque last fall commemorating past collaborations between Fraunhofer and GVU. Stefan Noll, Dr. Ezquerro's host in while in Darmstadt, visited GVU in April, gave a Brown Bag talk, and discussed with several GVU faculty ways to revive the collaboration and student exchange program.

electronic image

runner

Computer Animation (J. K. Hodgins, J. F. O'Brien)

Hodgins, J. K., J. F. O'Brien. Computer Animation. To appear in *The Encyclopedia of Computer Science* (fourth edition). 1998.

See 'Papers' on Page 6



Papers...

- Slamecka, V., H. Camp, D. Hall, **A. Badre**. A Knowledge System for Internal Medicine. *Journal of Information Processing and Management* 13:273-276.
- Walker, N.**, W. B. Fain, **A. D. Fisk**, C. L. McGuire. Aging and Decision Making: Driving-Related Problem Solving. *Human Factors* (in press).
- Walker, N.**, D. A. Philbin, **A. D. Fisk**. Age-related Differences in Movement Control: Adjusting Submovement Structure to Optimize Performance. *Journal of Gerontology: Psychological Sciences* 52(B): 40-52. 1997.
- Walker, N.**, D. Philbin, **A. Worden**, J. B. Smelcer. A Program for Parsing Mouse Movements into Component Submovements. *Behavior Research Methods, Instruments, & Computers* (in press).

Software Environments and Solutions; Internet

- Abowd, G.** Software Engineering and Programming Language Considerations for Ubiquitous Computing. *Computing Surveys* 28A(4). 1996 (to appear).
- Abowd, G.**, J. Engelsma, L. Guadagno, O. Okon. Architectural Analysis of Object Request Brokers. *Object Magazine* (special issue on Distributed Systems), pp. 44-51. March 1996.
- Abowd, G.**, and **L. Ton**. Automated Verification of Temporal Dialogue Properties. *SIGCHI Bulletin* 28(2): 50-52. April 1996.
- Dix, A. and **G. Abowd**. Delays and Temporal Incoherence Due to Mediated Status-Status Mapping. *SIGCHI Bulletin* 28(2): 47-9. April 1996.
- Kazman, R., **G. Abowd**, L. Bass, P. Clements. Scenario-Based Analysis of Software Architecture. *IEEE Software* 13(6): 47-56. November 1996.
- C. M. Kehoe**, **J. E. Pitkow**. Surveying the Territory: GVU's Five WWW User Surveys. *The World Wide Web Journal* 1(3). 1996.
- J. E. Pitkow**, **C. M. Kehoe**. Emerging Trends in the WWW User Population. *Communications of the ACM*. 39(6). 1996.
- Recker, M. M., **J. E. Pitkow**. Predicting Document Access in Large, Multimedia Repositories: A WWW Case Study. *ACM Transactions on Computer Human Interaction* 3(4). 1996.

Communication, Collaboration, Psychology, Design

- Hettenbach, D., **C. Mitchell**, **T. Govindaraj**. Decision Making in Supervisory Control of a Flexible Manufacturing System. *Information and Decision Technologies*.
- Kirlik, A.**, **N. Walker**, **A. D. Fisk**. Supporting Perception in the Service of Dynamic Decision Making. *Human Factors* 38:288-99. 1996.
- Potts, C.**, **L. Catledge**. Collaborative Conceptual Design: A Large Software Project Case Study. Accepted

for publication in *Journal of Computer-Supported Cooperative Work*. Spring 1997 (to be published).

- Potts, C.**, **I. Hsi**. Abstraction and Context in Requirements Engineering: Toward a Synthesis. Accepted for publication in special issue on Requirements Engineering in *Annals of Software Engineering*. Summer 1997 (to appear).

Learning

- Catrambone, R.** Generalizing Solution Procedures Learned from Examples. *Journal of Experimental Psychology: Learning, Memory, and Cognition* 22(4): 1020-31. 1996.
- Catrambone, R.**, D. Beike, P. Niedenthal. Is the Self-Concept a Habitual Referent in Judgments of Similarity? *Psychological Science* 7(3): 158-63. 1996.
- Guzdial, M.** Technological Support for Project-Based Learning. To appear in *ASCD Yearbook*, edited by C. Dede & D. Palumbo. ASCD, 1997.
- Guzdial, M.**, J.L. Kolodner, C. Hmelo, H. Narayanan, D. Carlson, **N. Rappin**, R. Hübscher, J. Turns, W. Newstetter. Computer Support for Learning through Complex Problem-Solving. *Communications of the ACM*, 34(4). 1996.
- Harpold, T.** The Misfortunes of the Digital Text. *Readerly/Writerly Texts* 3(2): 95-114. 1996.
- Harpold, T.** Conclusions. In *Postmodern American Fiction: A Norton Anthology*, edited by P. Geyh, F. Leebron and A. Levy. New York, NY: W. W. Norton & Co., 1997 (forthcoming).
- Hmelo, C. E., **M. Guzdial**. Of Black and Glass Boxes: Scaffolding for Doing and Learning. In *International Conference of the Learning Sciences*, edited by D. Edelson and E. Domeshek, 128-34. Evanston, IL, 1996.
- Kolodner, J., **M. Guzdial**. Effects with and of CSCL: Tracking Learning in a New Paradigm. In *CSCL: Theory and Practices of an Emerging Paradigm*, edited by T. Koschmann, 307-20. Hillsdale, NJ: Lawrence Erlbaum and Associates, 1996.
- Mitchell, C.**, **T. Govindaraj**. Design and Effectiveness of Intelligent Tutors for Operators of Complex Dynamic Systems: A Tutor Implementation for Satellite System Operators. *Interactive Learning Environments*.
- Shabo, A.**, **M. Guzdial**, **J. Stasko**. An Apprenticeship-based Multimedia Courseware for Computer Graphics Studies Delivered on the World Wide Web. Accepted for *Computers and Education Journal*, special edition on Multimedia. 1997. ♦

Vision

- Davis, E. T.**, S. J. Bass, J. Sherman. The Flash Visual Evoked Potential (VEP) in Amblyopia and Optic Nerve Disease. *Optometry and Visual Science* (in press).

HackFest

FCE faculty Irfan Essa, Gregory Abowd and Chris Atkeson have initiated the HackFest Club on campus, a group of undergraduate and graduate students engaged in exploring hardware and software visions of the future. The group meets one night per week.



A New Column: Horizons

The horizon is the line where the earth meets the sky. Or is it the unreachable target of our scientific journey? Under 3D perspective projection, which brings points at infinity within our reach, the horizon—as the image of infinity—is the plane where all parallel lines meet. Thus, Horizons aims at providing non-expert readers with a GVU perspective on the current and future relationship between two or more “parallel” GVU focus areas. This time we discuss the intricate relationship between HCI and 3D graphics. We welcome your comments on this column (or other articles), your suggestions for future topics, or your own perspectives to <GVUhorizons@cc.gatech.edu>.

Jarek Rossignac, GVU Director

Horizons: 3D and HCI

by Al Badre and Jarek Rossignac

Numerous interactive 3D environments have been developed to help users understand and inspect complex datasets or structures that have a meaningful 3D interpretation. Although interactive 3D manipulation suggests a more natural—and hence easier to learn and to use—interface, the ease-of-use of many established commercial 3D systems is impeded by legacy software originally architected to provide trained designers with powerful shape construction or data visualization tools. This lack of user-focus is hurting these established systems in a market where professionals with many parallel responsibilities yearn for immediate productivity tools and where emerging market segments open opportunities for untrained, occasional users.

Recent advances in usability engineering science and in industrial practices may turn the situation around. Not only are most modern 3D systems user-centered and capable of improving the productivity of occasional users, but interactive 3D capabilities, recently made affordable by technical advances and standardization of consumer 3D hardware and software, will fuel a new era of human-computer interaction (HCI), expanding the horizons of 3D graphics applications from computer aided design (CAD) and scientific visualization to innovative 3D paradigms for desktop metaphors, entertainment, socializing, teaching, Internet browsing, electronic commerce, or interacting with a hand-held or wearable computer.

We will first present a brief introduction to HCI and 3D graphics and then propose a perspective—which projects the convergence of these areas on a foreseeable horizon—and outline a symbiosis where advances in HCI improve the effectiveness of 3D graphics applications and as advances in 3D graphics support in consumer products leads to innovative 3D paradigms for more effective user interfaces.

What is HCI? The field of HCI combines scientific principles, experimental techniques, and innovative technologies aimed at producing software tools that are easier to master and learn and that make users more effective in their daily tasks.

HCI includes usability engineering (methodologies for evaluating and testing human-computer interfaces),

which instantiates the recent computer focus of the traditionally broader human factors and ergonomic disciplines. It also involves techniques for modeling and predicting human computer interaction performance, and the invention of new paradigms that support the interaction between people and specific functions.

Teaching HCI. HCI involves a deep understanding of human psycho-physiological capabilities and limitations, a global understanding of the target application area and of the user’s objectives, an understanding of the current state and possible evolution of the various software engineering, multimedia, and user-interface technologies, and the mastery of methodologies for usability engineering. It is therefore best to teach HCI in a programmatic way such as a dedicated Master’s program combining courses and real world interface design projects. Courses in such a program would cover quantitative methods, cognitive psychology, computer graphics, multimedia, software development, and human factors. (See our feature article on GVU’s new Master’s program in HCI on page 1).

The impact of HCI research on society. Usability concerns, competitive pressure, and the cost of user-interface development and support has raised the industry’s concern for HCI issues and tools, and we expect the fundamental principles of “design for usability” to become common practice in software development:

- user-centered design, which starts by asking questions about the user, instead of focusing on the new technology
- task-environment analysis and design which employs the process of decomposition and takes into account all aspects of the user’s task-environment including physical, social, aesthetic, etc..
- input from human factors at the early design stages
- a design cycle based on continuous prototyping and usability testing

The application of these principles will yield software solutions that address the generic issues important for humans, such as interpersonal communication, collaborative design, data mining, or lifelong learning.

Intel Master’s Award Program

The Intel Foundation has initiated an annual Master’s-level award to a GVU student. The Center has earmarked this award for students entering the new HCI Master’s Program, which will begin in the fall of 1997. All eligible students will be considered. Through this award, Intel seeks to support science and engineering education and encourage the entrance of under-represented minority students into technical careers.

See ‘Horizons’ on Page 8



Horizons...

Optimal HCI technologies will enable users to focus their full attention on the task and on interactions with other humans, instead of on the intricacies and obstacles of the human-computer interface.

Key research issues in HCI. While we do not foresee a change in usability principles and methods as outlined above, we feel the emergence of 3D technologies will foster a change in focus for HCI studies to include multimodalities in interaction, the social interface, ecologically-valid interactions, and flexibility/adaptability in interaction styles. HCI innovations cover a large territory: better usability methodologies, better models of the user's capabilities, new software tools and library architectures, and sometimes ideas for paradigm shifts, which may be hampered by market pressures and widely distributed legacy systems or may be accelerated by industrial competition or by new market opportunities, such as the Internet or the portable computer.

What is 3D graphics? 3D graphics applications are based on a shape or scene representation and on the associated tools for capturing, designing, exporting, viewing and animating the represented scenes. Although electronic 3D models have been successfully exploited for design, data mining, manufacturing automation, and as a reference for coordinating the various product-cycle activities in the manufacturing industry, 3D graphics serves primarily as a communication technology between humans. Emerging applications may be found in areas as diverse as therapy, marketing, electronic commerce, Internet socialization, video-games, video-production, education, and art.

Teaching 3D graphics. Understanding the geometric nature of the models and of the rendering process require specific skills in geometry and mathematics. To develop efficient and correct datastructures and algorithms for 3D modeling, one must first acquire familiarity with general datastructures and algorithmic techniques and knowledge of specific aspects of computational geometry and topology. Developing effective interaction techniques may involve HCI principles and usability studies. A practitioner must be able to leverage the constantly evolving hardware capabilities and trends, and, of course, he must have an understanding of the application area and of the user's tasks.

How does 3D graphics impact society? Interactive 3D graphics has become the cornerstone of the \$12B CAD/CAM/CAE industry and is rapidly invading the consumer video-games and entertainment industries (estimated at \$32B). It also drives many applications in the geosciences, medicine, and datamining. Most personal computers come equipped with 3D graphics acceleration hardware and graphics standards are being put in place for developing portable 3D systems and for exchanging 3D datasets over the Internet.

Key research issues in 3D graphics. The challenges of general purpose 3D graphics lie essentially in content creation (the most expensive component of the applications), rendering performance, image quality,

data exchange, and ease of use—given that the complexity of datasets useful for most applications considerably exceeds what can be downloaded in reasonable time and displayed at interactive rates using personal computers and standard network or phone connections.

Automatic fitting algorithms, powerful design tools, and libraries of reusable 3D components may in many cases reduce the data acquisition bottleneck. Rendering performance problems are being addressed by dedicated 3D graphics chips, by algorithms for constructing and exploiting multi-resolution geometric models, and by novel techniques for reusing images instead of creating them at each frame from a geometric description. Image quality may benefit from algorithmic advances in photo-realistic rendering techniques and from the partial support of anti-aliasing, transparency, shadows, radiosity, and image warping in hardware. Data access issues are addressed by the convergence standards for 3D data exchange and by 3D compression techniques. Ease-of-use may benefit from 3D input and output devices and from various navigation and manipulation metaphors, leading naturally to specific virtual environment metaphors, as they become practical for the various application domains.

The convergence of HCI and 3D graphics. The personal productivity applications support user interactions with their distinctive slant, although competitive pressure reduces the differences in functionality and even in the look and feel. We anticipate that a standardization of horizontal functions (such as searching, browsing, design, communication) will impose the interface metaphor and even the look and feel to the vertical application components. The web browser standardization of data access and information sharing is a good example of this tendency.

Applying usability principles to the design of 3D environments should yield a new generation of 3D user interfaces for specific application domains. For example, the productivity of stylists and of mechanical designers will benefit from recent experiments with 2-hand design interfaces, where both hands may be used to rescale, position, and orient a 2D or 3D shape; or where one hand manipulates a color selection palette or a French curve, while the other hand is used to trace curves or to apply colors to selected areas. Controlled usability experiments during the early stages of the development of such innovative interfaces are fundamental to their success, because the best idea will not be endorsed by professional users, unless engineered to increase their productivity without a any major up-front investment or learning curve.

We anticipate that interactive 3D presentations will replace 2D desktop organizations and will support intuitive navigation, selection, and organization of data and applications. Perspective views of 3D scenes unify in an easy to control manner a global view of the context at reduced resolution ("Where am I?") with a de-

HCI Search is On

Jarek Rossignac has formed a special GVU faculty search committee to recruit the most promising, internationally respected candidates to fill two HCI positions. The committee will be chaired by Al Badre and will initially include: Gregory Abowd, Jay Bolter, Richard Catrambone, Irfan Essa, Mark Guzdial, and John Stasko. Please contact Al Badre at <badre@cc.gatech.edu> for more information.

Visitors to GUV

A group of Japanese visitors from the National Federation of Universities Cooperative Association spent time with Larry Hodges and Gregory Abowd in September. . . **Graham Cosier** and **Pat Hughes** of British Telecom Research Labs visited with Irfan Essa in October. . . Jessica Hodgins hosted **Dinesh K. Pai** (University of British Columbia), who gave a talk entitled "Real Simulation for Virtual Reality: Sound, Touch, and Motion" in November. . . **Martin Brady** and colleagues from Intel Corporation visited with Larry Hodges, Jarek Rossignac and others on December 5. . . **Thad Starner** of the MIT Media Lab gave a talk on "Wearable Computing and Augmented Reality" while visiting Gregory Abowd and the Future Computing Environments group in December. After his talk Starner helped assemble a wearable computer from parts he brought with him from the Media Lab. . . **Sing Bing Kang** of Digital Equipment Corporation visited with Jessica Hodgins in January and gave a talk entitled "3D Scene Data Recovery from Multiple Panoramic Images." . . Mark Guzdial and Gregory Abowd co-hosted a visit by **Jim Spohrer** of Apple Research Labs. . . A group from Lockheed (**Ken Johnson, Paul Cole, Starr Goetschalckx, Don Meadows**) visited GUV to talk about design and manufacturing technologies; graphics and collaborative design review; applications of VR, intranet, and multimedia; and computer assisted training in industrial settings. . . **Kodak Entertainment Imaging** visited campus and GUV in March to explore possible research collaboration in the area of digital imagery. . . **Stefan Noll**, head of the CSCW group at the Fraunhofer Institute in Darmstadt, Germany, is giving the GUV Brown Bag lecture on April 24—he will be meeting with Norberto Ezquerro and Scott Hudson during his visit.

And GUVers Go Visiting

Gregory Abowd gave an invited lecture at IBM T. J. Watson Labs in January; he was hosted by research scientist Parviz Kermani. Former GUV director Jim Foley hosted Gregory for a distinguished lecture at Mitsubishi Electric Research Lab in January; and Gregory visited with Proxima Corporation in San Diego in March.

Jarek Rossignac and Peter Freeman, Dean of the College of Computing, made a whirlwind trip through the Silicon Valley last fall shortly after Jarek took the reins as GUV Director. They visited Intel, Apple, Xerox PARC, SGI, Sun, NTT, Interval Research and Hewlett-Packard. ♦

Welcome to New Members

We are pleased to welcome three companies to the Industrial Affiliates Program (IAP). **IBM Corporation** will be working with GUV Center Director Jarek Rossignac (formerly a Senior Manager at IBM's T. J. Watson Research Center). They joined the program with a donation of \$300,000 in equipment—this is a two year membership commitment.

Motorola Cellular Infrastructure Group (CIG) signed a research agreement with Gregory Abowd and Colin Potts for \$100,000+, and also donated a PC to GUV, with another machine to come later in the year. Students Lara Catledge and Anind Dey will also be working with Motorola.

NCR is back with us as an Industrial Affiliate. They re-joined the IAP in January and plan to work with Colleen Kehoe, Jim Pitkow, Bill Read (Public Policy) and Jarek Rossignac on creating an industrial consortium to support the GUV WWW User Surveys.

Intel Donation

Intel has donated 31 dual processor machines valued at \$490,000 for research and education in 3D graphics. Dave Sprague and his team will be working with Larry Hodges, Bill Ribarsky, Jessica Hodgins, Norberto Ezquerro, Greg Turk and Jarek Rossignac.

Industrial Advisory Board

There have been numerous changes on the Industrial Advisory Board, which is composed of one representative from each of our full IAP members. **Paul Borrel** (IBM), **Tom MacTavish** (NCR HITC) and **Allan Willey** (Motorola CIG) represent our newest IAP members. **Richard Waters** has replaced Les Belady as the representative from MERL, **Wolfgang Friedrich** succeeds Matthias Schneider-Hufschmidt as the representative from Siemens AG, and **Gary Cantwell** has just taken the place of Dorothy Redner from Digital Equipment Corporation. For all of the Industrial Advisory Board members, see the list at right. The Board meets annually in February, in conjunction with Research Review Day.

Industrial Visitor

In January, GUV welcomed **Akira Kobayashi** from Hitachi for a one year term as a visiting researcher. Mr. Kobayashi is working with Larry Hodges on virtual environments projects. For more information see Personnel Briefs on page 13. ♦



GUV Industrial Affiliates & Advisory Board Members

- Digital Equipment Corporation
Gary Cantwell
- Fuji-Xerox
Palo Alto Laboratory
Joseph Sullivan
- Hewlett-Packard
Research Labs
Tom Christian
- Hitachi Research Laboratory
Yoshiaki Takahashi
- IBM Corporation
Paul Borrel
- Intel Corporation
Roger Ray
- Mitsubishi Electric Research Labs
Richard Waters
- Motorola Cellular Infrastructure Group
Allan Willey
- NCR Human Interaction Technology Center
Tom MacTavish
- Siemens AG
Wolfgang Friedrich
- Silicon Graphics, Inc.
Forest Baskett
- Sun Microsystems
Bob Glass

Associate Members

- Bentley Systems, Inc.
- ERDAS, Inc.



Community...

Siggraph'97

- Physically Realistic Morphing; **Jessica Hodgins, Nancy Pollard**
- Design Galleries: A General Approach to Setting Parameters for Computer Graphics and Animation; **Jessica Hodgins** and others. (This paper represents joint work with Industrial Affiliate MERL.)
- Geometric Simplification; **Jarek Rossignac**; Siggraph '97.

Human Factors (1966):

- Stereoscopic Depth Perception in Simulated Displays: What Helps and What Hurts? **John Akers, Beth Davis, Bob King**.
- Single and Combined Distance Cues: Is the Whole Less than the Sum of the Parts? **Kelly Elliott, Beth Davis, Bob King** and **Greg Fujawa**.
- The Ponzo Illusion in Virtual Environments: Correct Applied-size Constancy; **Bob King, Greg Fujawa, Kelly Elliott**.

Psychonomic Society (1996):

- Access and Application of Analogies in Problem Solving; **Richard Catrambone**.
- Is There a Stereo Aperture Problem in Vision? **Beth Davis, John Akers, Bob King**.

American Educational Research Assoc. (1997):

- Computer-Support for Collaborative Learning: Learning to Make it Work; Cindy Hmelo, **Mark Guzdial, Jennifer Turns**.
- A Scaffolded Learning Environment Supporting Learning and Design Activities; Roland Hübscher, S. Puntebakar, **Mark Guzdial, Janet Kolodner**.

Others:

- An Evaluation of Techniques for Grabbing and Manipulating Remote Objects in Immersive Virtual Environments; **Doug Bowman, Larry F. Hodges**; Interactive 3D Graphics Symposium.
- The Role of Structural and Surface Features of Stories in Analogical Access; **Richard Catrambone**, 8th Annual Winter Text Conference.
- An Adaptive Short List for Documents on the World Wide Web (poster); Matjaz Debevc, **Beth Meyer** and **Rajko Sveciko**; International Conference on Intelligent User Interfaces.
- Design Explanations in Interactive Design Environments; **Ashok Goel, Andres Gomez, Nathalie Grue, William Murdock, Margaret Recker** and **T. Govindaraj**; 4th International Conference on Artificial Intelligence in Design.
- The 3D Revolution: CAD Access for All! (invited paper); **Jarek Rossignac**; The International Conference on Shape Modeling and Applications '97.
- Structured Topological Complexes: A Feature-based API for Non-manifold Topologies; **Jarek Rossignac**; ACM Symposium on Solid Modeling.

- Simplification and Compression of 3D Scenes, (tutorial) and Multi-resolution Models for 3D Graphics (keynote lecture); **Jarek Rossignac**, Eurographics '97.
- In Search of Reliable Usage Data on the WWW; **Jim Pitkow**, 6th Annual International WWW Conference (Santa Clara, April).
- Teaching and Learning as Multimedia Authoring: The Classroom 2000 Project; **Gregory Abowd, Chris Atkeson, Ami Feinstein, Cindy Hmelo, Rob Kooper, Sue Long, Nick Sawhney, Mikiya Tani**; Multimedia '96.
- Rapid Prototyping of Mobile Context-Aware Applications; **Sue Long, Rob Kooper, Gregory Abowd, Chris Atkeson**; 2nd Annual International Conference on Mobile Computing and Networking.
- Head-tracked Orbital Viewing: An Interaction Technique for Immersive Virtual Environments; **David Koller, Mark Mine, Scott Hudson**; UIST '96.
- DEVICE - Dynamic Environment for Visualization in Chemical Engineering; Matthew Realf, Pete Ludovice, **Noel Rappin, Mark Guzdial**; American Society for Engineering Education, 1997.
- Visualizing Usability Log Data; **Mark Gray, Al Badre, Mark Guzdial**; IEEE Visualization '96.
- Poetics and the Graphical User Interface: Rethinking the Substance of Hypertexts; **Terry Harpold**; 1996 Convention of the Modern Languages Association of America.
- Visualizing Interactions in Program Executions; **Dean Jerding, John Stasko, Thomas Ball**; International Conference on Software Engineering '97.
- The Dual Timestamping Methodology for Visualizing Distributed Application Behavior; **Brad Topol, John Stasko, Vaidy Sunderam**; IASTED International Conference on Parallel and Distributed Systems (Euro-PDS '97).
- "Technology Enhanced and Extended Learning," **Mark Guzdial**; invited plenary address, Chairs of Departments of Psychology Group Annual Meeting. ♦

Starchild Broadcast

"StarChild" was taped for public television, and a special big-screen premiere of the one hour broadcast version was held Wednesday April 23, 1997 at the Robert Ferst Theater as part of the 1997 Georgia Tech Arts in the Village Festival. Included in this evening of music and multimedia were several new works by Oliverio's graduate students, as well as a short documentary by Dystar Television on the making of the opera. For more information see: <http://www.gatech.edu/starchild>

FACULTY PROFILE



One of GVU's newest members has brought a decidedly different perspective to the work of the Center. He is **James Oliverio**, Georgia Tech's Composer-in-Residence and Associate Professor in the Music Department/College of Architecture. Before coming to Georgia Tech, he spent 15 years working in the audio industry, producing music and sound design for IBM, Hewlett-Packard, HBO, CitiBank, CNN, Delta Airlines and others. He has created more than 400 film and television soundtracks, working at a number of facilities including LucasFilm's Skywalker Ranch. "I have two main instruments," says Oliverio, "the orchestra and the recording studio."

So what does an electronic musician have to do with GVU? Oliverio's research interests lie in sonification and the integration of sound design into computing environments, as well as the creation of large-scale multimedia events. Recently, as audio has become a hot topic at GVU, doors are opening to new alliances and collaborations. Oliverio is a proponent of both teaching and research in this area within GVU, and is involved in planning courses that will provide students with a broad spectrum of audio-related skill sets.



James Oliverio at work

Last year Oliverio served as Principal Investigator for the LYRICOS Project, which built upon basic research in sinusoidal modeling and synthesis so that

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Rossignac...

ing new faculty members—Irfan Essa and Greg Turk. Our recruiting focus has now shifted toward expanding GVU's leadership position in the field of human-computer interaction; we hope to hire at least two HCI experts in the next two years.

Industrial support is growing rapidly and the number and quality of graduate students, who are at the heart of GVU's reputation, keep increasing. With new faculty, more students, and the many generous equipment donations we have received from our industrial partners, GVU has outgrown its lab space in the College of Computing. We will be expanding this summer into 4000+ square feet of beautifully renovated office and laboratory space in the Centennial Research Building (CRB), just a short walk from the College of Computing. This splintering of the computing group will exacerbate our already urgent need for real and virtual social spaces where GVU members can meet to imagine and design the future. We plan to provide such physical spaces in CoC and CRB and to experiment with a variety of computer-assisted communication and tele-presence technologies. We also will create more opportunities and incentives for faculty and students from our various units to join forces in fulfilling GVU's mission and inventing the solutions that will be needed as we enter the next century.

GVU is also creating new opportunities for joint research efforts in several areas. For instance, personal computers, electronic commerce, mobile computing, and computer-based entertainment create unprecedented opportunities for research and education in audio technologies. GVU is pulling together representatives from a number of our member units to create an Audiolab in the GCATT building as a central resource for faculty, students, and visitors. We envision that the Audiolab will host artistic explorations in drama and music, among other activities. To strengthen its ties with manufacturing and architecture, GVU will host in May its first TeamCAD workshop on Collaborative Design (co-sponsored by NIST) and will welcome attendees of the ACM Solid Modeling Symposium for an evening of demos. Finally, we are collaborating with NCR to create an industrial consortium that will help GVU look into the future of electronic commerce through future extensions of its semi-annual World Wide Web user survey.

—Jarek Rossignac

Kudos

GVU student Kelly Elliott (PhD student in Psych) was awarded the Georgia Tech President's Award to the Outstanding College of Science Graduate Student. She received her M.S. in Psychology in December 1996.



Research Updates...

program developed by Dr. Shabo at the Hebrew University of Jerusalem. This case study applies general knowledge in endocrinology to actual clinical cases using both multiple-choice questions and diagram construction. URL: <http://www.gatech.edu/anatomy/>.

Graphica update: Last quarter, Graphica (a computer graphics apprenticeship program) was used in a special way by Norberto Ezquerro's Advanced Computer Graphics course. Students used Graphica first as learners, then composed new exercises—each on a topic of his/her choice—and finally reviewed their peers' work. Some students focused on developing a visualization applet with interactive features to enhance the learning use of the visualization while others concentrated on developing comprehension and application exercises with a variety of scaffolding features. Graphica was developed by Mark Guzdial, John Stasko, and Amnon Shabo. URL: <http://www-int.cc.gatech.edu/gvu/multimedia/nsfmmedia/graphics/edulib/CSA.html>.

CaMILE update: A new version of CaMILE is being trialed in CS2390 (Modeling and Design) this quarter with 89 students. This version is interesting because it ties into the course Web pages and the grading system, creating a cohesive learning and teaching environment. The original CaMILE has now been used by over 800 students at Georgia Tech and more than 100 people have downloaded it from the Web. URL: <http://www.cc.gatech.edu/gvu/edtech/CaMILE.html>.

IDT Projects

Annie Archbold is developing a prototype Web site for International Public Health that will involve distance learning and an on-line journal. Annie and **Aida Najarian** have created a shared Web site for two organizations that serve persons with disabilities in Georgia. They have designed the site and supporting documentation with ease of use and maintenance in mind.

Learning

Engineering psychology student **John Akers** is currently running his Master's experiment, which looks at improving instructions for learning new material through goal-directed guided exploration. Guided exploration is based on constructivist learning theory which holds that learning will be more effective if it is based on learners' intrinsic motivation to learn, on their prior knowledge, and the way that knowledge is organized. Exploration-based learning allows learners to actively and continuously apply what they are learning to solve problems they devise on their own. Guided exploration instruction attempts to provide learners with enough guidance and feedback to help them avoid making serious errors or devising practice that is inappropriate to the domain being explored. However, a fair amount of confusion exists in the literature as to what constitutes an appropriate amount of "guidance"

in a guided exploration environment. John's experiment will teach participants how to create basic Web pages with hand-typed HTML. It will attempt to show that, at a minimum, effective guided exploration instruction requires helping learners set an overall learning goal at the outset of instruction, allowing them to learn underlying principles by discovering them rather than by explicit instruction, and providing effective error recognition and recovery information. It will also attempt to show that the benefit of guided exploration learning is not simply due to an improved motivation to learn, but to a difference in the way information is cognitively processed. ♦

Web Experts

GVU graduate student **Colleen Kehoe** was interviewed on CNN's "FutureWatch" regarding "information overload" as it applies to using the Web. Colleen gave a user's perspective of the pros and cons of the various search engines available. The story aired at 3:30pm on Sunday, April 6. Colleen and **Jim Pitkow**, authors of the semi-annual GVU WWW User Surveys have been interviewed numerous times in conjunction with their Web activities.

Oliverio...

end-users can play melodies and type words into a MIDI sequencer program and the computer will "musically" sing them back. A key component of this project was the ability of the synthesized melodies to retain the perceived identity of the original singer. According to Texas Instruments sponsor Dr. Bryan George, the general chair of a research conference described LYRICOS as "the most impressive demonstration of digital signal processing technology he'd ever seen at TI."

Oliverio has consulted for Denon/Nippon Columbia in the development and usability of "Figure Mobile," a software environment that permits MIDI files to be visualized and graphics files to be sonified. Currently a project is under development with Denon that will provide real-time synthesis of complex and musically useful sounds on the desktop.

Oliverio's interest in the combination of acoustic ensembles and electronic multimedia has culminated in several large-scale works, including "Wall of Hope" (1994) at the High Museum of Art, "The Science of Imagination" (1995) at the Fox Theater and the "Information Symphony" (1995) at Atlanta Symphony Hall, commissioned by the Equifax Corporation.

"StarChild," Oliverio's multimedia opera, capped the Arts in the Village Festival here at Georgia Tech immediately prior to the 1996 Summer Games. It was subsequently featured internationally on CNN's "FutureWatch," and was the subject of a paper presented at the International Computer Music Conference in Hong Kong. It is believed to be the first opera to incorporate computer animation, surround sound and a digital orchestra with live singers. ♦

Horizons...

New Faculty

GVU has welcomed several new faculty members since last fall. **Suresh Menon** is a Professor in the School of Aerospace Engineering. After receiving his PhD from the University of Maryland in 1984, Prof. Menon was a senior scientist at Flow Research Inc. (now Quest Integrated Inc.), then joined GT in 1992. He is a world-renowned expert in large-eddy simulation of turbulent reacting and non-reacting flows and has developed unique parallel simulation capabilities that are being used to study pollutant formation, ozone depletion in high altitude aircraft jet plumes and combustion phenomena in gas turbine and ramjet engines.

Ron Arkin is an Associate Professor in the College of Computing and Director of the Mobile Robot Laboratory. He received his PhD from the University of Massachusetts, Amherst, in 1987 shortly before joining Georgia Tech. Dr. Arkin's research interests include reactive control and action-oriented perception for the navigation of mobile robots and unmanned aerial vehicles, robot survivability, multi-agent robotic systems, and learning in autonomous systems. "We're the only group in autonomous robotic systems that I know of that does usability studies," says Arkin. "I'd like to contribute to GVU's mission in that regard." Dr. Arkin is an Associate Editor for the IEEE Expert and a member of the editorial board of *Autonomous Robots*. He is a Senior Member of the IEEE, and a member of AAAI and ACM.

James Oliverio is Georgia Tech's Composer-in-Residence and an Associate Professor in the Music Department within the College of Architecture. He is involved with electronic music and multimedia, and will be instrumental in the creation of the new GVU Audiolab. Oliverio is the winner of four Emmy Awards and a Telly award for broadcast music composition. His work is profiled on page 11.

Visiting Researcher

We are happy to welcome another Hitachi researcher to GVU for a year-long collaboration. He is **Akira Kobayashi**, an engineer with Hitachi's Information System Development Department, a unit of the Omika Works in Hitachi City, Japan. Their latest product, "SPHERIX," accelerates OpenGL graphics in Graphics Accelerator for Windows/NT. Mr. Kobayashi has played a major role in software driver development and software interface design of Hitachi's LSIs.

At GVU, he will be working with Larry Hodges and the VE group on projects which need strong graphics power and use sophisticated graphics techniques. He hopes these collaboration will result in a new design concept for Hitachi's new graphics accelerator and a new business concept which uses the VE techniques.

Mr. Kobayashi enjoys traveling, photography and video. He is married and has a 3 year old daughter. His family will be joining him in Atlanta in April. ♦

tailed high-resolution view of a particular item ("What am I looking at?"). These principles may benefit desktop computing, but will be most important for handheld or wearable environments, where the virtual workspace (3D version of the desktop itself) will be explored and manipulated interactively through a small physical display. Consider, for instance, the process of browsing through a real newspaper. Switching back and forth between a global view of a page, where only the headlines and images are visible and a close-up view of a potentially interesting passage takes no more than half a second, if we exploit our hand-eye coordination perfected by years of practice. Current 2D desktop metaphors are still far from providing comparable efficiency, but several interesting attempts have been reported recently. We believe that properly engineered 3D input devices combined with real-time multi-resolution anti-aliased graphics capabilities and implemented along the fundamental usability principles will soon transform horizontal functions, such as browsing large amounts of multimedia information. Most importantly, they will elevate the mobile user of a portable or wearable computer to new levels of productivity. ♦

Demos...

It was a very successful and enjoyable evening for GVU and for the CHI visitors, some of whom expressed surprise at the wide variety and highly interdisciplinary nature of the projects they saw. GVU units that participated in the Demo Night included Architecture; Computing; Psychology; and Literature, Communication, and Culture.

We look forward to hosting a similar evening of demos for attendees of the Solid Modeling Symposium on May 14, featuring research from Computing, Architecture and Mechanical Engineering. ♦

electronic image
CHI Demo Night

Colleagues, friends and alumni visited the GVU Lab for a special night of demos for attendees of the CHI conference.



Mark your Calendars

1996-97
Distinguished
Lecture Series

October 24, 1996—
*Artificial Animals:
Creation and Applications*
Demetri Terzopoulos
University of Toronto

January 16, 1997—
*Why Don't They Know
What Designers Do?*
S. Joy Mountford
Interval Research

May 1, 1997—
*The Promise and Practice
of HCI Design*
Bruce Tognazzini
Healthcon Corporation

Time:
12:00 noon
(reception 11:30 am)

Place:
Room 102
Pettit Building

Need more info?
elaine@gvu.gatech.edu
404/894-9392



GRAD STUDENT NOTES

Graduating soon...

G. Drew Kessler (PhD, CS, Summer '97). Dissertation: "A Flexible Framework for the Development of Distributed, Multi-user Virtual Environment Applications; advisor: Larry Hodges; research interests: distributed virtual environments, computer graphics, HCI, CSCW.

Jim Pitkow (PhD, CS, Spring '97). Advisor: Jim Foley; research area: HCI, WWW and user modeling. Jim will become a Research Scientist at Xerox PARC after graduation.

Wayne Wooten (PhD, CS) Advisor: Jessica Hodgins, research interest: computer animation. Wayne plans to pursue a career in academia.

Ben Watson (PhD, CS, Summer '97). Dissertation: Level of Detail Management; advisor: Larry Hodges. Ben is leaning toward a career in academia.

Annie Archbold (MS, IDT, Summer '97). Thesis: International Public Health Integrated Web Project; advisor: Anne Balsamo.

Hamish Caldwell (MS, CS, Winter '97) Research: user interfaces for interactive multimedia applications

Mark Johnson (MS, IDT, Spring '97). Thesis: 24 Hours: An Experiment in Re-mediation; advisor: Terry Harpold; research interests: multimedia and Web development, specifically webcasting and design of interactivity.

Arthur Murphy (MS, IDT, Winter '97) Thesis: Web-based information resource for teachers, parents, and students to increase accessibility to education for students with disabilities.

Mike Pinkerton (MS, CS, Spring '97). Thesis: Ubiquitous Computing: Extending Access to Mobile

Data; advisor: Gregory Abowd; research interests: mobile and ubiquitous computing. Mike wishes to pursue a career in software development in the S.F. Bay area.

Jun "Jay" Yan (M.S., C.S., Spring '97). Research interests: Human computer interaction. He is interested in a career as a software engineer.

Invited Talks

Jim Pitkow has given a number of invited talks on the WWW and the user surveys that he has been instrumental in initiating and maintaining, including:

- "Internet Demographics," 1996 Int'l Resumix User's Conference (San Diego, November).
- "Extracting Useful Structures from the WWW," NEC Research Institute (Princeton, NJ, November).
- "WWW Demographics," The Internet: What's Fact/What's Fiction (Anderson School, UCLA, Feb.)
- "GVU's WWW User Survey," UCEA's 5th Annual Market Seminar (New Orleans, February).
- "The History of of Demographic and Usage Collection on the Web" 6th International WWW Conference (Santa Clara, April).

In the Community at Large

Marcia Crosland served as Research Staff on the Mayor's Task Force to study Atlanta's 911 Emergency Communications System. Marcia analyzed system usability and display, among other factors. Her completed report was submitted to the Mayor and the press in January. The task force review was prompted in part by crucial communication delays relating to the Centennial Olympic Park bombing in July. ♦

GVU Info:

Eye on GVU is published twice annually by the Graphics, Visualization & Usability Center at Georgia Tech.



Send inquiries to:
GVU Center
Georgia Institute of
Technology
Atlanta, GA 30332-0280

PHONE: 404-894-4488
FAX: 404-894-0673
EMAIL:
gvu-info@cc.gatech.edu

To learn more about us via
the Web, here's our URL:
<http://www.cc.gatech.edu/gvu>

GVU Center
Georgia Institute of Technology
Atlanta, GA 30332-0280
USA