

Accomplishments

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A. Honors and Professional Recognition

I have received an NSF CAREER award from the Human Computer Interaction program in the Directorate for Computer and Information Science and Engineering. I am the PI or co-PI on two new NSF projects, and an ongoing Office of Naval Research (ONR) contract that encompasses three related research proposals.

Professionally, my UIST 2004 paper (B.2.2) was selected as one of the three papers to be presented in the “Best of UIST” session at SIGGRAPH2005. As recognition of my contributions to my research community, I have been selected to serve as co-Program Chair for the three major conferences in my research areas (ISMAR 2003, UIST 2004, and ISWC 2000), and am co-editor for a special issue of IEEE Computer Graphics and Applications on “Moving Mixed Reality into the Real World” that will be published in Nov/Dec 2005. I also serve on the four-person advisory board for the British EPSRC Equator Project (a £5 million, eight university Interdisciplinary Research Collaboration, started in 2000).

Within Georgia Tech, I was nominated for the “Outstanding use of Innovative Technologies in Teaching Award” in 2002 for my significant work integrating new technologies into the classes I teach. I was co-recipient of a the Raytheon E-Systems Faculty Fellowship, with Yannis Smaragdakis, to support our investigation of programming languages for ubiquitous computing.

As a graduate student, our work (with Steven Feiner and Anthony Webster) on using augmented reality for architectural visualization and inspection was awarded an Honorable Mention in the 1996 American Institute for Architectural Research/Architecture Awards for Architectural Research. When I finished my undergraduate degree, I was awarded a Natural Science and Engineering Research Council of Canada (NSERC) Post-Graduate Scholarship (from 1989–1991).

B. Funding

Since I have come to Georgia Tech, I have secured (or helped secure) approximately \$3 million in funding to support my research, as a combination of federal, industrial and internal Georgia Tech support.

Of this amount, over \$1.4 million was obtained as sole-PI contracts and grants. The two major sources of this funding are six and a half years of funding from the Office of Naval Research to support my work on error-adaptive augmented reality systems, and an NSF CAREER award to support my work on design tools to support AR as a new creative medium. This amount also includes industrial support for my work from Siemen’s and equipment donations from Sun Microsystems.

My research approach places a heavy emphasis on collaboration, and my funding reflects that. Over the past six years, I have helped secure over \$700,000 as co-PI on various NSF and internal Georgia Tech seed grants to support my collaborations with faculty in the College of Computing (CoC), the School of Psychology and the School of Literature, Communication and Culture (LCC). This includes NSF funding to support the Kimura project, jointly with Elizabeth Mynatt and Greg Corso (Psychology). Smaller grants have supported work with Yannis Smaradakis (CoC), Michael Mateas (LCC), Sha Xin Wei (LCC), and Jay Bolter (LCC). I helped secure almost \$600,000 in equipment and infrastructure grants, with over \$150,000 coming to me to support my teaching and research in mobile AR experience design.

I am also very interested in finding ways of having my research have real world impact, and helped

secure over \$200,000 to support work with the Food Processing Technology Division of GTRI to investigate how AR can improve poultry processing plants.

I would also call attention to the NASA H&RT proposal I submitted in October 2004 (H.3.1). After my letter of intent was accepted (10% acceptance rate), I coordinated and did most of the writing for a \$13 million proposal (\$6.5 million for Georgia Tech) that pulled together researchers in robotics, multi-modal interaction, ubiquitous computing and augmented reality from five institutions (CMU, UCSB, Georgia Tech, NASA Ames, and the Naval Research Lab). While this program was eventually cancelled by NASA, our proposal received the highest ranking and has generated considerable excitement among my co-PIs. This proposal shows my ability to apply my research results to new areas, and to assume a leadership role in organizing a large project proposal.

C. Research

The core focus of my research is on developing software tools and technologies to support the creation of augmented and mixed reality (AR/MR) experiences. I am interested in understanding the fundamental (and often subtle) problems that have made augmented reality systems difficult to design and deploy, and believe the best way to approach this problem is to form deep collaborations with people who are attempting to solve real problems using augmented reality and/or mixed reality. Therefore, I have developed long-term collaborations with researchers, theoreticians and practitioners in the military, industrial, design and artistic communities, and have leveraged these collaborative experiences to inform my own research. I have established two major lines of research in this thread over the past six years: support for *adapting to pose uncertainty in AR/MR systems*, and support for *designers exploring AR/MR as a new medium for creativity and communication*. The details of my research accomplishments in these areas are in my Research Plan, as are the details of other research projects in which I have taken part. Both of these lines of research were conceived of after I arrived at Georgia Tech, and represent a significant departure from my work as a graduate student.

I have been successful at publishing results from these new projects, documenting contributions to both the collaborative experience domains and the advancement of tools and technologies. This complementary set of contributions is significant; it demonstrates that I am seriously pursuing these projects and having an impact on these domains, rather than simply looking for stories on which to hang my technology research. For example, Jay Bolter and I are together defining new forms of drama and storytelling using the medium of MR, and are inspiring others to following in our footsteps; the technology I am developing as a result this collaboration (DART, the Designer's AR Toolkit) is allowing designer's and artists to join us in exploring the potential of these new media¹. The contributions of our experience projects have been published and presented widely in domain-specific outlets, ranging from new media journals and conferences (e.g. B.1.2, E.1.8, E.1.11, E.3.11) through technical journals and archival CS publications (e.g., B.1.4, B.1.5) to HCI books and conferences (e.g., C.1.3, E.1.3, E.1.6) and discipline-specific conferences on agricultural engineering (E.2.2) and history (E.3.5).

Within my own research community, I have focused on publishing in the two conferences most closely aligned with my research, the ACM Symposium on User Interface Software and Technology (UIST) and the ACM/IEEE International Symposium on Mixed and Augmented Reality (ISMAR). I have had four full papers at these highly selective conferences² (B.2.2, B.2.3, B.2.1, E.1.5), as well as numerous posters, demos and and short paper presentations. I am pleased that these projects are sufficiently well respected that I have recently been invited to publish two chapters in an upcoming book on Augmented Reality, one on each of my major AR projects (most chapters were not invited, but selected by reviewing proposals).

In an experimental field such as human-computer interaction technology, conference papers are often more important (i.e. more timely, more influential) than journal publications. Additionally, now

¹DART has been downloaded by over 500 unique individuals, and is in use around the world.

²Rigorous reviewing, and acceptance rates below 20%

that conferences papers are available in online digital libraries (and are often more accessible to researchers than individual journal publications), my preferred method of work is to publish conference papers while the work is still on-going and most timely, and to publish journal papers as historical summaries of multi-year projects. I have published 14 papers in peer reviewed conferences on my work at Georgia Tech, including high-quality and highly competitive conferences such as IEEE ISMAR and ACM UIST. I have also published journal articles on more mature work in the journals such as Presence, VR and IJHCI, as well as other archival publications such as IEEE Pervasive Computing and IEEE Computer Graphics and Applications. I am currently working on two journal articles for ACM TOG, and will be submitting additional journal papers in coming years on my more mature Georgia Tech projects.

D. Teaching, Education and Curriculum Development

I have played a key role in the design and development of three courses in the Graphics and HCI areas since coming to Georgia Tech. I was responsible for the semester conversion of the undergraduate Computer Graphics class (CS4451), significantly updating the curriculum to modernize the class and shift the focus to interactive graphics techniques. I revived the graduate “User Interface Software” (CS6456) class that had not been taught since Scott Hudson left, updated it to discuss post-WIMP interfaces, and created an undergraduate version of the class (CS4470). With Jay Bolter in LCC, I co-designed and co-teach a class on “Mixed Reality Experience Design” that brings together CS and New Media students to explore the creation of MR experiences from the joint perspectives of technology, HCI, media theory, cultural theory, and location-based entertainment. We have taught MR Design as a special topics class for 5 years, and recently proposed this class as an official course, cross-listed for graduates and undergraduates in CS and LCC. Finally, I helped to design the computing courses and requirements for our new HCC PhD program.

Over the past two years, I have shifted my teaching focus, handing the Graphics and UI Software classes to other faculty. Instead, I now regularly teach “Introduction to Media Computation” (CS 1315), the introductory CS class for non-CS and non-Engineering majors. My interest in this class reflects a larger interest in undergraduate CS education, especially CS education beyond traditional computer science. It is this interest that lead me to take the lead role in the College of Computing in the design and implementation of the Computational Media (CM) degree, Georgia Tech’s first cross-unit undergraduate degree (between CoC and LCC). The CM program starts it’s first full year this fall, and already has over 100 majors, reflecting the significant excitement the degree has generated among undergraduates. The goal of CM is to allow students to combine a first-class education in CS with a similarly deep education in new media practice and theory, equipping students to not only think deeply about technology, art, media and communication, but to also be able to implement and experiment with their ideas. I am currently the CoC faculty advisor for the CM program, and co-direct the CM steering committee.

In 2002, I was nominated for the Georgia Tech “Outstanding Use of Educational Technology” award for my integration of advance technology in all my classes. My goal is to have students really use this advanced technology, rather than simply reading about it. Over the course of three years, I acquired a significant amount of novel technology (approximately \$150,000 worth of laptops, handhelds, trackers, head-worn displays, GPS units and sensor/actuator prototyping kits) to enable the students to explore location-aware computing and tangible interfaces in CS4470/6456, and augmented and mixed reality in the MR Design class.

Aside from curriculum development, I work to involve graduate and undergraduate students in my research. I have supervised over 30 undergraduates, over a dozen Master’s students, and seven PhD students since arriving at Georgia Tech. The undergraduates I work with have gone on to graduate school at places like Georgia Tech, the MIT Media lab, CMU and UC Irvine. My students have been recruited for summer internships by premier research organizations including Xerox PARC, Intel Research, Microsoft, and the Naval Research Lab. I currently supervise five PhD students, one of whom

will defend his dissertation in fall 2005.

E. Service

At Georgia Tech, my service has been dominated by College of Computing activities. I served on the CoC Ph.D. admissions committee in AY2000, was the Graphics area representative to the Graduate Committee in AY2001, and served on the CNS advisory committee for AY2002. I served on the Dean's Advisory Committee (DAC) for three years, from AY2002 to AY2004, including chairing the committee in AY2004. I also served on the committee that designed the computing courses for our new HCC PhD program.

My recent service has focused on undergraduate education, including the design and implementation of the CM degree discussed above (AY2004), and being the CoC Faculty Advisor to CM through the present. In the Spring of 2004, I was asked to be the first ICD (Interface Computing Division) undergraduate coordinator; this role was expanded to include coordination of all CoC undergraduate programs in Spring 2005 (jointly with Milena Mihail from CCD, the Core Computing Division). The intent of this position is to have faculty members who understand and oversee the curriculum and undergraduate educational mission of the College, and can also act a bridge between the faculty, students, staff and the various committees handling undergraduate issues. As part of this job, I sit on all committees dealing with undergraduate issues.

Beyond Georgia Tech, I am on the editorial board for the International Journal of Human-Computer Studies, and have served as program chair for three major ACM/IEEE symposia (UIST, ISMAR, ISWC). I have served on many program committees, the external review board of the British EP-SRC Equator project, an NSF grant review panel, and have reviewed grant proposals for the British, Canadian, Korean and Singapore governments.

F. Leadership

In summary, I am recognized as a leader in the field of human-computer interaction, especially in user-interface software architectures, tools and technologies for augmented and mixed reality. My research is particularly noteworthy for introducing the idea of adapting to uncertainty into AR interfaces, for breaking new ground (and supporting others) in the use of augmented and mixed reality as a creative medium. Key indications of my leadership (summarizing some of the above):

- Numerous speaking requests at conferences, workshops and lecture series.
- Requests by outside researchers to come work in my laboratory (with little to no financial compensation), including Professors Dongyi Chen and Kang Bo (from Chongqing University, China), Klaus Hansen (a Ph.D. student from Aarhus University, Denmark), Marco Lohse (a Masters student from Universität des Saarlandes, Saarbrücken, Germany), and Tobias Lang (a Masters student from Ludwig-Maximilians-Universität München, Germany). Recently, Dr. Jong-Hyoun Kim, a professor in the Department of Gameware, Kaywon School of Art and Design, Korea, has contacted me to visit for a year to work on AR games (at his own expense).
- A consistent and influential presence at the premier conferences in my field, ACM UIST and ACM/IEEE ISMAR.
- Membership on the editorial board for the International Journal of Human-Computer Studies, the oldest HCI journal (started in the 1960s by Brian Gaines, as the International Journal of Man-Machine Studies).
- My approach to dealing with uncertainty in AR interfaces has changed the way many researchers think about AR, with the assumption no longer being that perfect tracking/registration must be achieved to create usable AR systems.

- My approach to working with designers and artists on AR experiences, by enhancing the tools they use (Macromedia Director) to support AR, has changed the way researchers working on AR tools think about the tools they create.
- By designing, building and distributing DART, our freely available tools for working with AR with Macromedia Director, we are putting the necessary tools in the hands of creative individuals who would otherwise be shut out from using it. The history of media has shown that a medium does not reach its potential until creative professionals begin using it; we hope to enable radical advances in AR by facilitating this process.
- Creating new kinds of AR experiences for historic sites and for entertainment, and having an impact on how historians and new media thinkers view the potential of AR, by speaking at history conferences and publishing in new media conferences and journals.
- As PI, took the lead on defining and writing a \$13 million NASA proposal in collaboration with robotics and perceptual interface researchers from five institutions, based on applying our ideas about adapting to uncertainty in AR interfaces to human-robot interaction and perceptive/gestural interaction. While the proposal was unfunded, we are now beginning to look for other avenues of funding and believe that we will be able to push the are of HRI forward in exciting ways.
- The only CS person, and one of two academics, invited (along with architects and theme park/experience designers) invited (by Bob Weis, of DesignIsland Associates) to take part in a two-day design charrette to come up with a conceptual design for an experience museum for Project Exploration on the Chicago Pier.
- In collaboration with researchers in the Food Processing Technology Division of GTRI, demonstrated how AR can be used for communication with automated inspection systems in poultry processing plants.
- Pushing the boundaries of cross-disciplinary education, by demonstrating how to teach an AR experience design class in a multidisciplinary context, to design and CS students having extremely different backgrounds, without having the students stay within their own discipline.
- Defining a new approach to CS education by leading the design and implementation of Georgia Tech's Computational Media program.