Undergraduate Research News

Check Out the Latest News and Updates from UROP (Page 6)

Student Profile: Allison Smith, INTA

In 1989 Poland took its first steps toward democracy after years of Soviet rule and upheaval during the world wars. Today Poland is a member of the European Union (EU). The people of Poland are still experiencing changes in their sense of identity, changes due to globalization and commerce, and working toward eradicating corruption. During Spring semester 2007, International Affairs (INTA) senior, Allison Smith, traveled to Poland as one of 24 volunteers from 13 countries taking part in the "PEACE – teaching tolerance" (People's Enthusiasm Acting for Cultural Education) Project. The project, sponsored by the United National (UN) Development Program was aimed, according to Smith, at "promoting cultural understanding, tolerance, and awareness of the Millennium Development Goals among secondary school students living in small and medium size towns of Poland". The goals include eradicating extreme poverty, improving primary education, promoting gender equality, reducing child mortality and improving maternal health, combating HIV/AIDS, malaria, and other diseases, ensuring environmental sustainability, and developing global partnerships for development.[1] During her work with PEACE, Smith traveled to five high schools in towns across Poland teaching lessons on the United Nations project, but also engaging students in conversations about the United States.

As an additional component to her time in Poland, Smith wanted to go further with her work by formally researching and measuring measuring underlying attitudes and perceptions of young Polish citizens. A survey questionnaire was designed with INTA faculty mentor, Dr. Vicki Birchfield, on "how Polish citizens see themselves with respect to their recent transitions and their place in a larger world, whether it be the EU, the UN, or a larger international society". Such attitudes and belief systems, according to Smith, play a critical role in the direction and shape of the country's future. Due to varying levels of English proficiency, the survey was translated into Polish for implementation. The project led to a final report, *Surveying Polish Attitudes: The Impact of Europeanization and Globalization on National Identity,* that describes her reflections on perceptions of Polish students

Allison Smith (in red shirt) educating high school students in Poland about the state of Georgia in the United States.

and presents the results from the survey questions answered by 191 students.

Smith described her experience as one which provided an opportunity to cap her undergraduate experience with a project that taught her "the importance and value of learning from direct experience and interaction." She mentioned that the project allowed her to use her academic knowledge gained during four years of undergraduate study combined with her experience from a previous study abroad trip to Poland to aid her research of the current situation in Poland. Because of this she was able to "further enrich [her] knowledge significantly, gaining a deeper level of proficiency and competency in understanding some of the big challenges and issues facing Poland today, as seen through the eyes of the youth."

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Student Interview: Jeffrey Schlosser, ME

U/G Research: What's the number one piece of advice you would give to fellow undergraduates who might be in interested in research?

JS: The best piece of advice I would give fellow undergraduates is to find an advisor who has an interest in your personal success as a student and a researcher. If you are particularly interested in a class you are taking, and the professor's teaching style matches well with the way you learn, take initiative and talk to the professor about research opportunities. If you find it easy to have a discussion with the professor, and if the professor sounds excited about working with you, ask them about joining their lab. You will know that the professor is interested in your success if they ask you questions about your future career plans, what classes you enjoy, or your academic interests. Finding a professor who is willing to spend time helping you learn is one of the most important aspects of a successful research experience.

U/G Research: Describe your role within your professor's research and research group.

JS: When I first started doing research with my professor, my objective was to develop an elec-

tric vehicle decision model to aid graduate students with decision-based design research. However, after finishing the model midway through my first semester, I became interested in the core research questions the graduate students in my lab were pursuing. Upon talking to my professor about my interests, he decided to assign me my own research project. My new role within my professor's research group was to seek answers to my own research questions and add knowledge to the decision-based design community (More detail in question #4). In addition to pursuing my own research project, I also participated in weekly group meetings with other members of my research group, in which we discussed papers related to the specific research topic of each lab member.

U/G Research: How key was your professional relationship with your mentor?

JS: My professional relationship with my mentor was essential for my success as an undergraduate researcher. Excited about being the only freshman in my Numerical Methods course, I decided to ask my professor, Dr. Chris Paredis, about research opportunities in mechanical engineering. He sparked my interest in simulation-based design and invited me to join the Systems Realization Laboratory (SRL) the following fall. Throughout my five semesters of research, Dr. Paredis and I met weekly to discuss my research progress and to map out a plan for future work. Dr. Paredis guided me through the entire research process of proposing a research question and hypothesis, testing the hypothesis, and writing a publication to communicate our results. I feel that our professional relationship was one of the key factors for my success throughout the research process. I felt very comfortable working with Dr.

Paredis, and his teaching style matched well with the way in which I learn. In addition, Dr. Paredis helped review my graduate school and fellowship essays, and wrote excellent recommendations for me. Not only did a positive relationship with my mentor help me achieve my undergraduate research goals, it also helped me successfully get into graduate school and win the NSF fellowship.

U/G Research: Describe your research project and what you learned from your experience.

JS: Before joining the SRL, I had little experience with the formal research process. After my research experience with Dr. Paredis, I feel confident that I can take the lessons learned in each step of the process and apply them to new research problems as a graduate student and professional researcher.

Detailed steps in my research project included:

Familiarization with Decision-Based Design: To enhance my knowledge about decision making in engineering design, I formulated a decision problem in the context of Environmentally Benign Design and Manufacture (EBDM). Using Matlab, I worked with graduate student Jay Ling to develop an EBDM electric vehicle (EV) decision model for determining how many batteries the EV should contain to maximize performance and minimize environmental impact. After experimenting with the model, I gained a better understanding of how engineering design decisions are made and was ready to move forward in the research process.

What I learned: Working with Jay, I learned the value of teamwork in a research environment. Our discussions gave me a different perspective on many of the EV model problems I had battled and helped me approach the issues with a new mindset, saving time and effort. I also learned about the difficulties of interpreting and extending the work

of other researchers. My EV decision model was based on a limited model developed previously by other SRL researchers, but many of the variables and equations were ambiguous, unavailable, or did not make physical sense. I learned how to use the foundations of their work and add my own ideas to the model.

Developing a Research Question: The second step in my research process was to work directly with Dr. Paredis and propose a research question in the context of decision-based design. I began reading conference papers, journal articles, and book chapters devoted to decision making, utility theory, probability bounds analysis, computational simulation, uncertainty, and information economics. After reading a recent paper on model selection, it became clear to me that several research questions were still open in the area of information management. Since previous research in the SRL focused on information collection from only a single source of uncertainty, Dr. Paredis and I decided that a framework was needed for managing information collection from multiple sources of uncertainty, and proposed the research question stated above.

What I Learned: The search for a research question taught me the important difference between research and design: research results in the *creation of new knowledge*, while design is the *application of existing knowledge to a new concept*. I learned how to separate ideas into these two categories and zero in on questions whose answers would create new knowledge and add value in the design community.

Proposing a Hypothesis: Dr. Paredis originally hypothesized that sensitivity analysis could be used to identify the most significant uncertain quantities in a

Faculty Corner

Resources and Tips for Faculty mentors of undergraduate researchers will be presented in this section of each newsletter.

Mentoring Workshop

Due to popular demand in January of this year, UROP and CETL will be offering a regular workshop on Mentoring of Undergraduates in Research that is geared toward faculty, research scientists, and graduate students. This fall's workshop will be held Tuesday, September 18, 2007, from 11am-1pm, in the Student Success Center, Suites C&D. Lunch will be served. Watch for additional information on how to register by visiting: http://www.cetl.gatech.edu/services/faculty/mentoring.htm

UROP Library

Several books and resources on mentoring undergraduates in research are available for check-out from UROP. A selected list of titles can be found below, others are also available that relate the Research Option's "Writing an Undergraduate Thesis" course.

How to Mentor Undergraduate Researchers, **Council on Undergraduate Research, 2002**

This guide, available free of charge from the UROP office, offers a brief coverage of practical information regarding mentoring and expectations. This is a great resource for first-time mentors or as a book to be discussed by a research group.

Advisor, Teacher, Role Model, Friend, **National Academy Press, 1997**

This guide, produced by a subgroup of the Committee on Science, Engineering, and Public Policy, offers advice on the improvement of mentoring skills. The book discusses the various hats that mentors likely wear and provides various examples to back up points in the text. Topics such as advising research projects, career advising, assistance with skills development, and the need for role models are discussed. Additional resources related to gender, cultural, and disability issues are also listed. The guide also contains a well-organizes bibliography of resources. Limited copies are available upon request from the UROP office.

On Being A Scientist: Responsible Conduct in Research, **National Academy Press, 1995.**

This booklet "makes the point that scientific knowledge is defined collectively through discussion and debate." The best use of the booklet is to form the basis or jumping off point for group-based discussion, whether in seminars, research groups, journal clubs, or informal settings. Several case studies can be found in the appendix to help guide discussions on ethical and responsible research conduct. Limited copies are available upon request from the UROP office.

Additional titles are available and will be highlighted in future newsletters. Please contact Karen Harwell if interested.

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Jeffrey Schlosser ...cont'd from page 2

decision problem, and information collection could be restricted to those quantities only. I programmed an implementation of a sensitivity analysis algorithm known as the Morris Method and applied it to the EV model. Dr. Paredis and I soon realized that this approach was limited because it did not consider the cost of gathering information or the amount of uncertainty that the information could eliminate.

We next hypothesized that by maximizing a quantity known as the *expected net value of information*, defined as the value gained by using the information minus the cost of acquiring the information, a decision maker would be able to choose the most valuable combination of uncertainty reductions. Extending the derivations in Jay Ling's M.S thesis, Dr. Paredis and I mathematically defined the expected net value of information and decided to further pursue this hypothesis.

What I Learned: The most important lesson I learned in this

research stage was to not get overly attached to one particular hypothesis. I spent many hours experimenting with the Morris Method, so it was difficult to leave this work behind. However, I realized that exploring the Morris method gave me a better understanding of our research question and ultimately gave me a broader perspective of engineering decision-making approaches.

Testing Hypothesis: My next task was to test our new hypothesis by applying it to the EV decision model I created. I programmed the mathematical framework for the expected net value of information using Matlab, then ran computational simulations and extracted results. I found that for every dollar spent acquiring information, over ten dollars in risk reduction for the EV design decision could be obtained by maximizing the expected net value of information.

What I Learned: I largely worked independently during this phase of my research,

sometimes going several weeks without input from Dr. Paredis. I learned how to set weekly objectives and to assess my own progress as I tested our hypothesis.

Communicating Results and Enhancing Technical Understanding: The next step in my research process was to communicate our findings by writing a paper for the 2007 SAE World Congress. The final step was to increase awareness of our results by giving a presentation at the SAE conference. Since both academic researchers and practitioners from the automotive industry attended the conference, I was able to disseminate my knowledge to both communities.

What I Learned: Through the seemingly endless cycles of revisions and modifications to my paper, I feel like I significantly improved my ability to clearly and concisely communicate ideas. I learned how to put many of my ideas into a mathematical context that others could understand, and I learned how to organize my thoughts logically.

U/G Research: What are your future plans after Tech?

JS: I will attend Stanford University starting in fall 2007 and pursue both M.S. and Ph.D. degrees in mechanical engineering. I am specifically interested in mechanical engineering fields which have a strong emphasis on mathematical concepts. I was an strong math student in high school, taking both Calculus II and Calculus III courses at college campuses. At Georgia Tech, I was especially engaged in engineering courses such as Fluid Mechanics, Heat Transfer, Internal Combustion Engines, Computing Techniques, and System Dynamics and Controls, which relied heavily on the application of differential equations, linear algebra, and numerical methods to physical design guidelines. Furthermore, the principles of statistics and interval mathematics played a critical role

Allison Smith ...cont'd from page 1

When asked what her number one piece of advice was for undergraduate students interested in pursuing research, she quickly and strongly says, "Go for it!" Smith believes that "research as an undergraduate creates exceptional opportunities to apply many things you've already learned, educate yourself further in a chosen subject area, and simply have the experience of conducting research and gaining new skills."

Smith hopes to continue to work internationally in some capacity following graduation, whether that be through international development work or other means. During her time at Georgia Tech, Smith was also a member of the rowing team, provided volunteer work for the AIDS Awareness Week Planning Committee in Spring

2006, and was a member of the International Association of Students in Economic and Commercial Sciences (AIESEC).

[1] A copy of the *Millennium Development Goals Report* produced by the UN can be found at: http://www.un.org/millenniumgoals/pdf/mdg2007.pdf.

Wayfinding and Design in Public Parks

by Stephanie Radbill (ID) and Jessica Wood (ID)

Both of us (Jessica and Stephanie) started our fourth and final year at Georgia Tech with the personal goal of completing an intensive design research project. Traditionally, every student in the Industrial Design program at Tech participated in a "Senior Thesis" studio that is completed in the final semester of the Industrial Design curriculum, but the program changed this year, leaving us with greater flexibility to carry out independent study projects in addition to the new senior studio program. After doing a lot of searching and finally developing a project that we both had interest in pursuing, we had the incredible opportunity to work on an undergraduate research project supported by the Presidential Undergraduate Research Award. We applied for this program through writing a proposal that was ultimately accepted.

Our research project, like many others, involved narrowing our topics to specifics and then applying our findings to a more general issue. This specific project we worked with was the Lionel Hampton / Beecher Hills Nature Preserve. This development is located in the West End district of southeast Atlanta. Park Pride, a local non-profit park planning organization, had already designed the general outlay of the park when we joined the project in January. While park design and development is a huge field, we wanted to look specifically at product installations in public spaces based on our background in Industrial Design.

We decided to organize our project into three sections: literature review, field research, and data synthesis/results. The first area focused largely on acquainting ourselves with the fundamentals of the design of public space. Industrial Design, the discipline we have received our degrees in, focuses largely on the design of products or systems that are contained and are associated with some form of personal ownership. Ap-proaching the design of product installations that are accessed by everyone, and therefore must cater to everyone, required a paradigm change in our thought as we approached not only design solutions, but also the very manner in which we conducted research.

Jeff Schlosser ...cont'd from page 4

in my research project at the SRL, particularly when analyzing decisions under uncertainty. In graduate school, I would like to continue pursuing fields in which I can take advantage of my ability to apply mathematical frameworks in the context of solving engineering problems. Such fields include system dynamics, computer-aided design, energy and propulsion, fluid mechanics, robotics, and controls. I am currently leaning towards research in robotics and controls, although I have not yet made a final decision.

U/G Research: Provide insight on how you were able to work on a conference presentation and the experience of presenting at the SAE World Congress.

JS: To prepare for the conference presentation, I made slides based on my paper and practiced them until the presentation was approximately 20 minutes. I gave my presentation in front of several professors and graduate students at a SRL meeting about a week before the conference. I took the feedback from the SRL meeting, improved the slides and presentation, and was then ready for the final conference presentation. During my time at the conference I was able to attend numerous research presentations by automotive researchers and make valuable industry contacts in the exposition area. Being one of the only undergraduates at the conference, I was a little intimidated at first, but quickly became comfortable talking to experienced engineers and professors. I learned a great deal about current trends in the automotive industry, as well as what areas are likely to receive research attention in the future (alternative energies, control systems, materials, etc). My presentation went very smoothly, and several audience members asked questions at the conclusion of the presentation. My presentation was given a very high score in the peer rankings, and my paper was recommended for publication in the SAE Transactions journal. I feel that presenting at the SAE World Congress gave me a valuable experience few undergraduates get to experience. I feel much more confident about presenting in front of an audience of professionals than I did before the conference. Given my positive experience, I plan to attend many more research conferences in the future.

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UROP News & Updates

Fall 2007

New UROP Resource Library

A small library of resources related to undergraduate research, writing theses, mentoring undergraduate researchers, and preparing excellent posters and oral presentations, can be found in the new UROP Resource Library. All texts used by Research Option students in the LCC4700 Thesis Writing Course can be found in the library and be previewed before the course begins. Copies of the CUR Quarterly and other publications are also available. Many books can be checked out for 2 weeks by signing them out from UROP staff.

New Initiative: Undergraduate Research Journal: The Tower

Pending final approval of the Student Publications Board and the Student Activities Committee of the Student Government Association, Georgia Tech will be starting an on-line Undergraduate Research Journal, *The Tower*. For additional information on the initiative, visit: http://www.GTTower.org/ or attend one of two information sessions:

> Thursday, Sept 6th
> 11am-12noon *or* 4-5pm
> Wilby Room, Library

We will be looking for student, faculty, senior-level graduate student, and research scientist involvement in the start-up of the journal, so please indicate your interest in being involved in a journal at the above website or by e-mailing Karen Harwell (karen.harwell@carnegie.gatech.edu). Pizza will be served at both information sessions.

Sigma Xi 2007 Annual Meeting & Student Research Conference

On November 2nd and 3rd, students from North America and abroad will join distinguished scientific researchers at the Sigma Xi Annual Meeting and Student Research Conference for a celebration of research accomplishments. Undergraduate and graduate students will present research, attend career development workshops, participate in mentoring and networking activities, panel discussions, and other events. Monetary awards will be presented for outstanding research. Members and non-members of Sigma Xi may participate in the conference. For additional information and application instructions, visit: http://www.sigmaxi.org/meetings/annual/src.shtml . Application deadline is September 30, 2007.

Have a student that you'd like to see recognized for their work?

Nominate an undergraduate student to be "Georgia Tech's Undergraduate Researcher of the Month". Each student chosen will be highlighted in a new section of the UROP website (coming in October) and will receive a certificate. To nominate students, just send an email to urop@gatech.edu, with the Subject: U/G Researcher of the Month, including the student's name, project title, and a short write-up about why they should be recognized. A subcommittee of Student Advisory Board for Undergraduate Research (SABUR) members will choose a new student to honor each month.

Visit us at : http://www.undergradresearch.gatech.edu

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Stephanie Radbill and Jessica Wood ...cont'd from page 5

Determining the scope of the problem was one of the most challenging parts of the project. In hindsight, defining our research problem with more clarity would have been extremely beneficial for us throughout the rest of the process. The ultimate problem statement we developed stated that an opportunity exists to research, develop, and construct a series of products that explore navigation in public spaces with a particular emphasis on multiculturalism and green design. In the end, while the research portion of this statement was thoroughly completed, the project would have been stronger if we had spent more time on the development and construction of a final product based on our research.

As previously stated, our project research was organized in three parts. In the literature review phase, we sought not only to review scholarly articles on park design, but also to understand the specific park we were researching. We looked at everything from local vegetation to census information for the neighborhoods surrounding the park. After establishing a strong background and knowledge based on both park development and the particulars of the area at hand, we then conducted field research within the Atlanta community, interviewing people connected with the Lionel Hampton / Beecher Hills project, as well as individuals who were in some way involved in the design, development, or maintenance of public spaces.

After exhausting our resources in Atlanta and still feeling unfulfilled with the data we were gathering, we began to look elsewhere for information and inspiration. This led to one of the most exciting and educationally fulfilling experiences of our undergraduate career!

After writing a proposal outlining our goals and plan of action, we received funding from Georgia Tech's Undergraduate Research program to travel to New York City, a world leader in the development of public space, to conduct research for our project. We chose New York based on the diversity of its public spaces and the number of excellent public space agencies that reside in New York. Not to be underestimated or overlooked, the success of New York's public spaces as being perceived as *necessities* to everyday existence by New Yorkers was another crucial factor fueling the need to travel to New York.

To prepare for the trip, we planned interviews with key people and developed a list of public spaces to visit and analyze. After establishing a schedule, we developed an interview questionnaire and a park evaluation and analysis spreadsheet. We also designed our own data archiving system including a file naming convention that ended up being extremely helpful in organizing our information when we got back from our trip.

Experiencing the public spaces of New York first-hand was invaluable. The insight we gained into how all the elements of public spaces come together to create both a physical and a social community was very eye-opening for both of us. Interviewing professionals working in the field of public spaces was also enlightening, not only because of knowledge gained from discussion but also as a result our experience of interacting with these individuals within a specialized setting. Neither of us had done anything like a research interview previously. The individuals we interviewed came from different backgrounds and held a variety of positions within organizations dealing with public space development, maintenance, and activism. While the specifics of their occupations differed from their counterparts in Atlanta, so did the parks we analyzed in two cities we studied. In both cases, however, the guiding principles between the two were the same.

Based on our conducted research, we developed a set of design criteria for public space product development. This set of criteria ultimately resulted in a defined process for the evolution of a product suitable for public spaces. Our system is based on a hierarchy of design factors that deal with human perception and experience. In this system, the designer starts by examining the human senses on a basic level, and from there, moves through societal and cultural influences, and usage analyses to create meaning and flow in her design. Because we were able to look at such a diverse array of public spaces, the system we developed is universal to all public spaces, whether it is located in a city or a rural area, whether it is large or small, etc. The system places particular emphasis on having a fundamental understanding of the physical, social, and cultural character of any given piece of land within an existing community.

While we were able to accomplish a lot during the course of the semester, there is still much to be done with this project, particularly in applying what we learned and the system we developed to the Lionel Hampton / Beecher Hills project. One of the most exciting aspects of this project is that we have been able to pass our research on to another Industrial Design student interested in researching public spaces. He now has an immediate connection with all of the people we communicated with over the course of the semester, and he will continue to research and develop the project.

Having the opportunity and experience to perform undergraduate research was extremely enriching. At the time this article was written, we are reaching the three-month mark of having left school and started careers in the design field. Stephanie is working in Peachtree City, Georgia as a Prototype Designer/Fabricator for 3-D Solutions, Incorporated. Jessica is working in Huntsville, Alabama as a Human Factors Engineer for Jacobs Engineering, a NASA subcontractor. The Lionel Hampton / Beecher Hills Nature Preserve project was very important to us on a personal level. However, the experience of developing and carrying out an intensive research project will benefit us throughout the course of our professional careers as designers. The fact that this was a group project, tying together academic and professional organizations, particularly contributed to the educational value of the overall experience. We look forward to the results of the next group of students' work in designing products for public spaces!

Undergraduate Research Opportunities Program (UROP)

Undergraduate Research Opportunities
Program (UROP)
Georgia Institute of Technology
MC 0740
Atlanta, GA 30332-0740
Phone: 404-385-7325
Fax: 404-385-6940
E-mail: urop@gatech.edu
www.undergradresearch.gatech.edu

News from the Director

Welcome Back to Campus! I am glad to see the increased presence of students on campus and the increased activity that brings with it. I am also happy to report that Undergraduate Research at Georgia Tech is growing. Last year 1790 students enrolled in one of over 100 undergraduate research courses on campus, an increase of over 34% from the previous year. We also awarded 18 students Research Option degrees in 4 discipline areas. For additional information on last year's activities and progress towards the program's goals, please refer to the Institute's Quality Enhancement Plan Annual Impact Report. Please contact me if you're interested in obtaining a copy of this report.

This fall our office will be hosting two information sessions on undergraduate research, a session on the President's Undergraduate Research Award (PURA), and a mentoring workshop. Other workshops will be scheduled later in the semester. Check the website's news page periodically for updates. Mark your calendars now for our annual Spring Symposium to be held April 3, 2008 *(tentative date)*.

If you are a student interested in helping other know of your research experiences, apply to be a part of the Student Advisory Board for Undergraduate Research (SABUR), by emailing a resume and a statement on why you'd like to be involved, to urop@gatech.edu. We are looking for a group of new students to continue the excellent work began by our charter group of members last year, including an annual awards ceremony, library talks, and other publicity (including participating in FASET and other information sessions).

Best,
Karen Harwell

Let Your Voice Be Heard!!

Student Advisory Board for Undergraduate Research (SABUR)

The newly formed Student Advisory Board for Undergraduate Research (SABUR) works toward implementing new ideas for programs and resources for students interested in research. If you're interested in serving on this board, please contact Dr. Karen Harwell, Director, Undergraduate Research at Karen.harwell@carnegie.gatech.edu. *Freshman, sophomores, and juniors are particularly encouraged to become involved!*

WE WANT TO HEAR FROM YOU!!!

We are always looking for subject matter for our newsletter, including suggestions of students and faculty to profile and good news to share about student achievements, publications, and presentations. If you are interested in writing for the newsletter or have suggestions for future profiles, please contact us at urop@gatech.edu.

Listserv

To receive information and announcements from Georgia Tech's Undergraduate Research Opportunities Program (UROP), join the **urop-news** listserv. To join: Send an e-mail to sympa@lists.gatech.edu with a subject of "subscribe urop-news"