UI researchers develop lensless camera that captures 3-D images

By James E. Kloeppel

Using principles gleaned from radio astronomy and medical X-ray tomography, researchers at the UI have assembled an optical system that produces three-dimensional reconstructions of objects without using a lens.

“One big advantage of designing a lensless 3-D camera is that the resulting optical system has an infinite depth of field,” said Ronald Stack, a research engineer in the UI’s Beckman Institute for Advanced Science and Technology. “That means the object will always be in focus, which simplifies the amount of data processing that is required.”

Instead of a lens, the camera system uses a series of beam splitters and folding mirrors to capture a sequence of “snapshots” as an object is slowly rotated in front of the aperture. The images are detected with a CCD (charge-coupled device).

“The snapshots are not like ordinary photographs, however,” said David Munson Jr., a professor of electrical and computer engineering and a researcher at the Beckman Institute. “The camera collects data on interference patterns in much the same way as does a radio telescope. These two-dimensional data frames are then processed to form a 3-D representation of the object, which can be displayed on a computer screen or in a virtual reality environment.”

To produce the 3-D image, the researchers rely on a reconstruction algorithm used in cone-beam tomography — a relatively new medical X-ray photography technique that produces 3-D images of a patient, instead of the more familiar cross-sectional slices.

“With our camera, we can reconstruct 3-D objects purely from physical principles, field analysis and number crunching,” Munson said. “Because our system is not based on conventional computer vision and image processing techniques, we incorporate no tricks, heuristics or data manipulation.”

Such physical optics techniques may ultimately benefit areas such as microcopy and machine vision by providing 3-D reconstructions of superior resolution.

“In a lot of current 3-D visualization activities, people need a quick and reliable way to capture 3-D information about the optical world to put into their database,” Stack said. “Our camera system can also help do that.”

The researchers described the lensless imaging system in the June 25 issue of the journal Science.


Aeronautical and Astronautical Engineering. Assistant to the head. Bachelor’s degree in business administration, accountancy or a related field with five or more years’ experience preferred. Requires knowledge of accounting and budgeting principles and use of personal computers for financial applications. Available immediately to Michael B. Bragg, 333-2651. Closing date: Sept. 3. Available: Sept. 1.

Coil and Structural Biology. Research specialist in cell biology. Master’s degree preferred. Required: Ph.D. degree in cell biology, environmental professional experience, or experience in teaching. Available immediately. Contact Joyce Woodworth, 244-6358.

Coll and Structural Biology. Research specialist in cell biology. Bachelor’s degree. Required: good organizational skills and experience in cell biology, biochemistry and molecular biology or related field. Bachelor’s degree or equivalent and excellent academic record. Available immediately. Contact Joyce Woodworth, 244-6358.

Chemical Sciences, School of. Research specialist in chemistry (mass spectroscopy). Bachelor’s in chemistry or related field required. Some previous experience in operating mass spectrometers and gas chromatography equipment or related instruments desired. Available: Nov. 22. Contact Renee Schum, 333-6730. Closing date: Aug. 28.

Coordinated Science Laboratory. Principal research scientist. Ph.D. in computer science and two to three years’ experience conducting research in the develop. 2000, required. Should demonstrate truly exceptional potential in their field. Available immediately. Contact Melissa Mitchell, arts, international offices, 333-2895 or e-mail to d-dahl2@uiuc.edu.

East Asia and Pacific Studies, Center for. Program assistant. Bachelor’s degree required, major in international studies or East Asian studies, interest in K-12 and higher education, and the use of audiovisual media in teaching and learning. Knowledge of East Asia preferred. Minimum of two years related work experience. Available: Sept. 15. Contact Melissa Mitchell, arts, international offices, 333-2895 or e-mail to d-dahl2@uiuc.edu.


Microbiology. Research specialist in life sciences. Bachelor’s degree required; master’s in biology, biochemistry or related field and prior experience with nucleic acids, protein purification and analysis. Experience with cell and tissue culture. Available: September. Contact Diane Combs, 333-4818.

Natural History Survey, Illinois, Plant Chair, Search Committee, c/o Research and UI Research Park and Incubator. Prefer business, engineering or related field. Experience with increasing responsibility in budget management and development and/or data analysis. Experience required with increasing experience with computer literacy in database management, programming, systems analysis and design and other computer systems. Knowledge of Novell and NT preferred. Previous experience writing SQL queries and SQL programming desired. Available immediately. Contact Chairperson, Consultant Committee, 244-2254. Closing date: Aug. 20.

Supercomputing Application, National Center for. Software developer (one or more positions). Bachelor’s degree, preferably in computer science or systematics are required. Experience required; master’s preferred. Has working knowledge of C or Java and training with workstations and application programming on UNIX, or Windows NT. Training in efficient programming skills and development methodologies required. Available immediately. Contact NCSA Human Resources, 333-6085, carol@ncsa.uiuc.edu. Search #402. Closing date: Aug. 17.

Veterinary Medicine, College of. Zoo and wildlife pathology. DVM or equivalent degree and eligibility for certification by the American College of Veterinary Pathologists required. Available: June. Contact Michael Brown, 216-2135. Closing date: Sept. 13.


Assistant/associate professor (international studies). PhD in computer science and two to three years’ experience in cell biology, biochemistry and molecular biology or related field. Bachelor’s degree. Good organizational skills and ability to work effectively as a collaborative team. Available immediately. Contact Joyce Woodworth, 244-6358.

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David Thiel, program director for WILL-Channel 12, is frequently seen by the public during the campaign drives when he appears on camera to make pitches for public support. Behind-the-scenes, he scans thousands of potential shows each year, and in his free time treats himself to science fiction movies and TV shows, such as "Star Trek" and "Buffy the Vampire Slayer.

Thiel even has one room in his Champaign home lined with bookshelves that display his large collection of science fiction action figures, ranging from Captain Kirk to the Hulk and the Incredible Hulk.

What does the WILL-TV program director do?

That’s the person who decides what airs. We always try to pick up some new things and also to bring back some old ones. I respond – or someone in my department will – to anyone who calls in with a comment about programming. People have a lot of opinions about what they’ve seen, want to see or don’t want to see on our station, and so we try to listen to those comments.

Do you like to do the pledge drives? Are you comfortable being on air?

Oh yeah, I’ve been doing it a long time now. It can be fun. We try to keep it light.

What do you like to do away from the job?

I’ve been working with the Champaign-Urbana Theater Co. this summer. We’re rehearsing the next play, “You Can’t Take It With You.” It’s a funny show, a real funny script. My character’s name is Mr. DePinna. I did the “Wizard of Oz” this summer too. I was essentially in the chorus. Also the C-U Theater Co. does murder mystery dinners, and I’ve been doing those since about last November.

When did you get started collecting science fiction characters?

About 22 years ago. It really starts with the first “Star Wars” film. I would have been probably 12 or 13 at that time, so I was initially getting them as toys. And then later, I started getting a little more into the collector mode, and I started thinking wouldn’t it be fun to have all and set them up in some sort of display?

How do you acquire them?

I scour the stores and try to find new things as they come out. But it’s just not “Star Wars” characters, it’s other things too. The Godzilla stuff is harder to get because the things I go after are all Japanese imports. I’ve done some wheeling and dealing on the Internet to get things. I’ve found people I can trade things with and some folks who will even just pick up something for you – if it’s available at a store near them but not locally.

Every once in a while my friends and I do what we euphemistically call the toy run, where we drive out to other communities – like Bloomington – and just hit all the stores just to keep an eye on things.

Do you have some characters that you feel are valuable?

I do. But I try not to worry about value much. A sizable number of folks will buy things and never take them out of the package, correctly believing they’re more valuable that way. But I prefer to take them out and mess with them. I think that’s more fun. So yes, I’ve got some things that are fairly valuable but on the other hand that’s not really why I have them. I did sell some things off last year – an original set of “Star Wars” figures from the ‘70s and ‘80s. Some of them were getting really high up in value.

How many do you have?

I just counted yesterday, and I had 700 on display. And there are probably a couple more hundred put away.

What are your three favorite science fiction movies?

Definitely the original “Star Wars” is one of them. One of my other favorites is “Forbidden Planet” from the 1950s. It was the first real big-budget science fiction film. And another favorite is “Aliens,” “the sequel to “Alien."

Does your wife share your interest in the collection?

Vicky has helped out and she frequently buys me things. And she’s always been very supportive of this insanity.
The UI has received a $350,000 grant from the Ford Foundation to support an innovative, multi-dimensional educational program focusing on “Area Studies, Identity and the Arts” over the next three years.

The grant was awarded as part of the foundation’s “Crossing Borders: Revitalizing Area Studies” initiative, which provided multi-year grants to 10 of 30 colleges and universities that competed for the award nationwide.

The grant will provide resources for faculty and students to develop a learning-research seminar that combines close faculty-student interactions, teaching by faculty from other cultures and countries, and study abroad experiences with university and international faculty.

The program will be administered by the UI Office of Institutional and Faculty International Collaboration, with matching funding provided by International Programs and Studies, Office of the Provost, and colleges of Liberal Arts and Sciences, and Fine and Applied Arts.

Kellogg, associate provost for international affairs, credited individual proposals from those units for unifying to develop this program that seeks to move area studies in some entirely new academic directions.

The grant proposal was written by an interdisciplinary team of faculty members led by UI Germanist Kerstin Ekman, “Gie mig Jesu! Jesu! Jesu!” from Marty Yeakel at 333-1085. The online UIUC Events Bureau, 807 S. Wright St., Suite 520 East, Champaign, MC 61801, or to insideill@uiuc.edu. More information is available in the Office of Instructional Resources. Memorials: to the UI department of Spanish, Italian and Portuguese to fund the Paul Borgeson Memorial Scholarship for Undergraduate Study in Latin America, Paul Borgeson Jr., 8 a.m. Levis Pharmacology Building.

The newly funded program expands upon a more limited project, also funded by Ford, undertaken during the 1997-98 academic year. Wong said that like the previous project, the new effort also will focus on the broad topic of “Area Studies, Identity and the Arts,” but each year will have a different theme. This year it will be “Gendering Area Studies: Arts and the Boundaries of Identities;” themes planned for the second and third years, respectively, are “Local Identities and the Transnational Culture Industry” and “Arts of the Sacred: Crossing the Boundaries of Place and Perception.”

During each year of the program, two fall-semester seminars will be offered—one for undergraduates, one for graduate students. During subsequent spring semesters, students continuing in the program will get hands-on experience working with visiting international artists and scholars. Students may choose from two learning tracks: an arts-practicum in which they will perform or practice under the tutelage of visiting artists-in-residence, or directed research projects in which a small group of students will work on relevant independent research, supervised by a visiting scholar-in-residence.

Kertu Gedye Asnawa, a Balinese gamelan musician, has been invited to participate as an artist-in-residence for the first year of the program. The scholar-in-residence for the same period will be Estrella de Diego, an artist historian and critic on the faculty of Universidad Complutense, Madrid.

For many students participating in the program, their course of study won’t stop after the academic year. During the summer, participants in the arts-practicum track will travel to the home country of the visiting artists with whom they studied the previous semester. Wong said that this will continue their study and practice of the artistic tradition in its native milieu, and will conduct hands-on ethnological fieldwork through interactions with native artists and audiences.

Likewise, participants in the research track will travel to the home country of the visiting scholar with whom they worked during the previous semester to continue to develop the research projects using the unique resources and materials available in the scholar’s home institution.

Join both groups of students traveling abroad will be accompanied by one of two UI faculty program coordinators. The first year’s coordinators are Capwell and art history professor Jordana Mendelson. Capwell will oversee the graduate seminar. Mendelson, the undergraduate seminar.

The coordinators are seeking qualified undergraduates and graduate students interested in participating in the seminars. Faculty members and advisers are asked to direct nominations to Tim Barnes at 333-1990, or tbarne@uiuc.edu, as soon as possible.