

World Archaeological Congress

Held every four years, the 7th World Archaeological Congress (WAC-7) took place January 13-18 2013 at a palatial convention center at the Dead Sea in Jordan, featuring more than 800 researchers from roughly 70 different countries. CISA3's work on Cultural Heritage Diagnostics, Engineering, and Analytics -- applied to Cyber-Archaeology -- was well-represented at the meeting.

Over the course of two days, CISA3 Associate Director Tom Levy and long-time collaborator Mohammad Najjar co-chaired a session on "Deep-time perspectives on culture change in Jordan: Cyber-archaeology, production and exchange." Levy led off the series of talks with a presentation on Jordan as a model for world cultural heritage research and conservation. He noted that since 1999, UC San Diego and Jordan's Department of Antiquities decided to 'go digital' and abandoned paper recording methods in their work in the Faynan copper ore district of southern Jordan. "Beginning in 2010, with the help of a five-year National Science Foundation IGERT grant, interdisciplinary students have been involved with faculty using UCSD field research as a testbed for cyber-archaeology," said Levy, whose overview presented an "integrated system that includes data capture, storage, analytical frameworks, scientific visualization, and cyberinfrastructures for on-site and global data sharing."

Levy and IGERT Trainee Matthew Vincent delivered a paper, "From the copper mines to the data mines: OpenDig and the data avalanche in southern Jordan." OpenDig is an in-field data acquisition tool for the descriptive metadata of field archaeology -- providing new ways of accessing and organizing the data through the use of NoSQL databases that allow for "seamless replication and easy access through standard HTTP protocols."

On Day Two, IGERT Trainee Ian W.N. Jones talked about "Technological narratives, nrand and small: Where do we currently stand?" Fellow IGERT Trainees David Vanoni and Vid Petrovic, working with CISA3 director Falko Kuester, presented papers on "ARtifact in Jordan: Augmented reality for on-site scientific visualization and digital tourism," and on "Capturing and visualizing excavations in 3D: Lessons from fieldwork in Jordan," referring to case studies carried out with Ashley Richter from excavations in Faynan and Petra. The World Heritage Site at Petra was also the subject of a paper by IGERT Trainee Matthew Howland, Matt Vincent, Tom Levy and Christopher Tuttle (the latter from the American Center of Oriental Research). Their topic: "Ballooning in Petra: Utilizing low-altitude aerial photography and structure-from-motion for archaeological conservation."



Pictured top: Program for the 7th World Archaeological Congress; (above) Balloon used to capture aerial footage at Petra; (below) ARtifact augmented reality app running on Android tablet in Petra church; and (bottom) Balloon photo of the Temple of the Winged Lions taken from approximately 120 meters.



WAC-7



Letter from the Director

May 2013

Dear CISA3 supporters and colleagues,

Last month marked the mid-point between our annual field expedition seasons. That's when we take our research from the laboratory into the "wild" (as some would say), putting the underlying theory to the test under field conditions.

In 2012, our CISA3 team of faculty and graduate students funded through our NSF IGERT Training, Research and Education in Engineering for Cultural Heritage Diagnostics (TEECH) project were active in Italy, Cyprus, Saudi Arabia, Jordan and Mongolia. They worked on a broad range of research opportunities with the unifying vision of developing the cultural heritage diagnostics and analytics approach needed to create a future for the past. We call this our cultural heritage engineering methodology, and it creates the underlying approach, techniques and tools for data acquisition, curation, analysis and dissemination that we now apply to cultural analytics, digital archaeology and cyber-archaeology, among other fields. The goal: to solve specific domain challenges.



In this special issue of the CISA3 Newsletter, we highlight the field of cyber-archaeology – a field that is swiftly transforming archaeology as we know it – and a field that our research is re-shaping at a fundamental level.

Through IGERT-TEECH, a remarkable team of young minds keeps evolving, taking on grand challenges in disruptive and refreshing new ways. We invite you to experience some of our latest research during two upcoming events: the May 24 Open House (10am-3pm) to celebrate the naming of Calit2's Qualcomm Institute (where we are based); and the next CISA3 Open Lab Night on June 4 (5:30pm-7:30pm), when visitors will also get the opportunity to take in our CISA3 exhibition, *EX3: Exodus, Cyber-Archaeology and the Future* (see below), which will be on display through June 9 in Atkinson Hall. We look forward to seeing you at one or all of these upcoming events.

Prof. Falko Kuester
Director, CISA3



(Above) IGERT demos for CENIC workshop attendees in March 2013; (below) CISA3 Open Lab Night in February 2013 [more on page 4]



SAVE THE DATE CISA3 OPEN LAB NIGHT

AND SPECIAL EVENT IN CONNECTION WITH THE EXHIBITION

EX3

Exodus, Cyber-Archaeology and the Future

5:30PM - 7:30PM

TUESDAY, JUNE 4, 2013

ATKINSON HALL, UC SAN DIEGO

VISIT THE EXHIBITION AND CISA3 LABS, AND HEAR UPDATES FROM GRADUATE STUDENTS AND FACULTY ON THEIR LATEST PROJECTS AT CALIT2'S QUALCOMM INSTITUTE. EXHIBITION CO-SPONSORED WITH UC SAN DIEGO JUDAIC STUDIES. EXHIBITION OPEN TO THE PUBLIC FROM JUNE 1-9. FOR DAILY HOURS, VISIT <http://bit.ly/ZnqIn3> RSVP: VPOOL@UCSD.EDU



IGERT Updates

CISA3 Looks to the Sea for New Challenges in Cyber-Archaeology

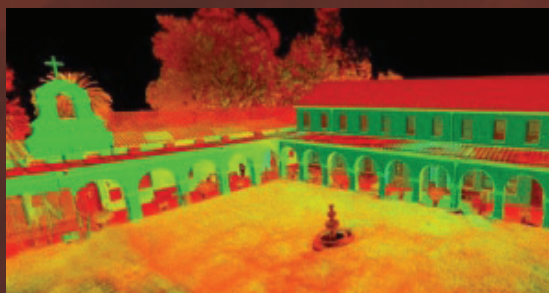


IGERT Trainees got a closeup look at the challenges of underwater archaeology when CISA2 staged its first underwater archaeology workshop February 4-7.

University of Southampton Prof. Jon Adams (above center), a maritime archaeologist; Justin Dix, a senior lecturer in geophysics and geoarchaeology; Graeme Earl, senior lecturer in archaeology; and Filippo Fazi, a lecturer in the Institute of Sound and Vibration Research, all joined Falko Kuester, Tom Levy, Jules Jaffe, Tom DeFanti, Peter Otto, and Dominique Rissolo, as well as IGERT students, for a series of working meetings to talk about how to broaden CISA3's terrestrial cultural heritage diagnostic approach and methodologies to maritime applications. Some of the outcomes included plans to install a CAVE environment at the University of Southampton for collaborative visualization; submission of joint proposals; and participation in each other's field expeditions.

San Luis Rey

A team from CISA3 joined with CyArk, a non-profit group documenting historic sites, to scan the Mission San Luis Rey in the city of Oceanside. Their goal: to create a 3D record of the huge compound in less than four days -- to help in the Mission's ongoing preservation and modifications. The UCSD team brought CISA3's terrestrial laser scanner (which will also be used as the primary scanning device for a Balboa Park digitization project). The CISA3 team also deployed their octocopter with on-board cameras for aerial imaging. IGERT Trainees Ashley M. Richter (see story at right) and Tom Wypych represented CISA3 on the expedition.



Interdisciplinary Research Award

IGERT Trainee Ashley Richter was honored for her efforts to understand the past by using high-tech, 3D data visualization tools to analyze artifacts and excavation sites.

Richter is a Ph.D. candidate in archaeological anthropology, and received the Interdisciplinary Research Award from UC San Diego's Office of Graduate Studies and Graduate Student Association. She was one of three students selected for the award in what the Dean of Graduate Studies called "an intense competition."



Richter, who is a descendant of the Danish antiquarian and 'Renaissance man' Ole Worm, said she was especially honored to win the award because it recognizes the interdisciplinary nature of her research. Her approach incorporates principles of computer science and engineering (such as using a LiDAR scanner to create digital 'point clouds' of archaeological sites) as well as traditional archaeological methods.

"Too often in the field of archaeology, moving the knowledge forward is broken down by the politics of departments, who don't want to 'share' researchers," Richter said. At least at UC San Diego, she added, that is changing.

Events

EVENTS

Cyber-Archaeology and World Cultural Heritage

In January, CISA3's Tom Levy (above left) headlined a meeting on cyber-archaeology for the American Academy of Arts & Sciences. UCSD Chancellor Pradeep K. Khosla (above right) welcomed the American Academy members to the campus, before Charles Stanish introduced Levy. Stanish directs UCLA's Cotsen Institute of Archaeology. Levy's keynote talk is available for viewing on-demand at <http://bit.ly/15CGf6d>. His talk was followed by tours of CISA3 labs and demos by IGERT graduate students (below right and left). See photo gallery at <http://bit.ly/X3sUhO>.



Clockwise from top left: CISA3 director Falko Kuester, visiting Jordan in the StarCAVE VR environment; TourCAVE system; and John Mangan displays MPF app.



Open Lab Night

In early February 2013, CISA3 organized its latest Open Lab Night and invited patrons and the public at large to walk through its labs at UC San Diego and witness more than 20 high-technology demos staged by graduate students funded through CISA3's NSF IGERT program. MediaCommons, developed in Calit2, was demonstrated by computer scientist John Mangan. It is a Multi-Purpose Framework (MPF) application that allows various types of data (including video images, panoramic images and flat images) to be viewed remotely, and simultaneously, on multiple displays. "So it's possible," explained Mangan, "for collaborators to view the exact same data, at the exact same time, in the exact same spot on their screens, no matter what type of screen they're using."

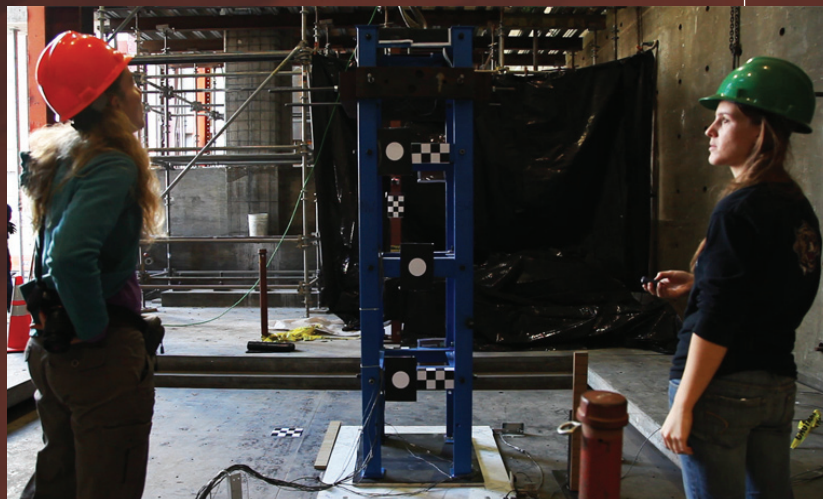


Research Highlights

Seismic Testing of Statues

Christine Wittich, a grad student from Structural Engineering who is part of Calit2/CISA3's NSF IGERT program in cultural heritage diagnostics, won a Best Use of Literature award from the Science & Engineering Library at UCSD in April 2013. She received one of the two awards given by the S&E Library at the Jacobs School's annual ResearchExpo on April 18, selected from among over 200 posters. Wittich's prize-winning poster on "Shake Table Testing of Stiff Model Statue Structures Considering Mass Eccentricity" will be displayed in the library through the summer.

Wittich and her advisor, Prof. Tara Hutchinson (pictured above at left, with Wittich prior to the first shake) undertook shake table experiments to understand the seismic response of culturally important statues. The tests were conducted at the UCSD Powell Laboratory through an IGERT mini-grant. A stiff, steel specimen was designed with movable weight plates and a marble base to represent 85 percent of statues surveyed during Wittich's 2011 field experience in Florence, Italy. Planned configurations of this specimen systematically vary the theoretical governing geometric parameters. The experimental setup included specimen and



shake table, which were subjected to both recorded earthquake motions as well as simulated earthquakes. The intent was to monitor the response of the statue with respect to the input motion in terms of rocking, sliding, and vibration. Typical structural engineering displacement and acceleration sensors were used in combination with computer vision techniques and high-definition cameras to track the complicated motion of a statue.

The results of this experiment will be used for the calibration of predictive numerical models and to understand which types of statues are most vulnerable during an earthquake.

CISA3: Aerospace, Disaster Response + Pattern Recognition

In March 2013, CISA3 and IGERT fielded a strong presence at **IEEE Aerospace**, which took place in Montana this year. Tom Wypych, Andrew Huynh (pictured below) and Jason Kimball all gave talks to the assembled aerospace engineers, scientists and managers from industry, NASA, government labs, the military and academe. Wypych's paper spelled out a "System for Interactive Management of Aerial Imaging Campaigns," offering a framework for real-time management of interchangeable image sensor payloads on unmanned aerial vehicles. The goal: to streamline the data acquisition pipeline during aerial imaging campaigns while providing a high degree of interactivity. Kimball spoke about "Interactive Visualization of Large-Scale Atomistic and Cosmological Particle Simulations," while Huynh's talk focused on "Visual Analytics of Inherently Noisy, Crowdsourced Data on Ultra High Resolution Displays."

IGERT Trainee Huynh (right) also presented his work at two meetings in Japan. Last fall, he spoke on the limitations of using crowdsourcing for damage assessment at the **10th International Workshop on Remote Sensing for Disaster**



Response, held in Tohoku. After the workshop, researchers went on a two-day field trip visiting sites that were damaged by the 2011 tsunami. The workshop resulted in a call for better metrics of damage assessment in remote sensing. Then in mid-November, Andrew was back in Japan to present his work on the application of triadic clustering to map dirt roads in northern Mongolia. The venue was the **21st International Conference on Pattern Recognition**, in Tsukuba. Huynh's oral presentation went over the difficulties of working with noisy, crowdsourced data, capturing human perception, and the use of methods such as triadic clustering to make more sense of the data.

Internships

With summer approaching, CISA3 at UCSD becomes home for undergrads interested in cultural heritage.

Calit2 Scholars

The Calit2 Summer Undergraduate Research Scholars program kicks off in June, with two of the 30 Calit2 Scholars slated to work on CISA3 projects. Lillian Wakefield, who is studying environmental chemistry, will focus on the “Development of Analytical Methodologies for the Characterization of Lead White Pigments in Microsamples from Renaissance Paintings,” with Maurizio Seracini as her advisor. Separately, undergraduate Aliya Hoff will explore “Diagnostic Visualization Systems and Methodologies for Underwater Archaeology.” Hoff is interested in biological anthropology, and she will work with advisor Jules Jaffe at the Scripps Institution of Oceanography. <http://bit.ly/xTJfRM>

UCSD-NGS Engineers for Exploration

2013 is the inaugural year for a new summer program funded through a \$380,000 NSF grant under its Research Experiences for Undergraduates (REU) program in the CISE directorate. The grant went to CSE professor Ryan Kastner, Calit2 research scientist Albert Yu-Min Lin and Calit2 wireless functional manager Curt Schurgers, who run the UCSD-National Geographic Engineers for Exploration program. Engineers for Exploration is continually seeking new ways to break down barriers in the world of exploration with UC San Diego’s partners in the program, including National Geographic, Hubbs SeaWorld Research Institute, and San Diego Zoo Global. The eight undergrads in the inaugural class – some from UCSD, some from other institutions – will spend their summer in San Diego tackling real-world engineering challenges in exploration and scientific discovery.

As with the UCSD-National Geographic program, the REU grants will match upper-division undergrads to a variety of high-tech research projects overseen by scientists, engineers, and explorers from the university and program partners. “This NSF funding will allow us to expand the Engineers for Exploration program to invite enthusiastic engineering and computer science majors from across the U.S. to come to San Diego to design and test their own research projects in the field,” said PI Kastner. “The undergrads will benefit from the guidance of existing undergraduate leaders



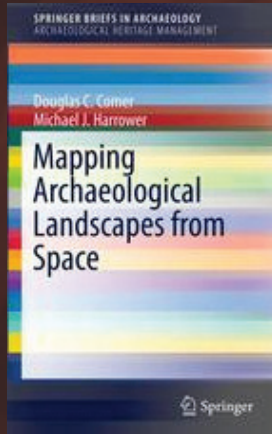
in the program, graduate students, professors, and scientific mentors from our partner institutes.” Check back in January re: summer 2014: <http://bit.ly/Zjuez1>.

CISA3 Undergraduate Research Internships

The CISA3 Undergraduate Research Internship (CURI) program offers academic credit to students interested in the interdisciplinary application of science and technology to cultural heritage diagnostics and preservation. The CURI internship is a four-unit independent study course listed as a choice of CSE 199 or Structural Engineering 199, which may serve as a technical elective towards the student’s degree. Positions are available for all levels of experience, and each project will be crafted to suit and develop the student’s personal skill set. Current undergraduate research projects include:

- Digital archaeological illustration techniques and metadata recording applications
- Educational outreach about archaeology and technology
- Digital documentation (laser scanning, photogrammetry, structure from motion, GIS) of Balboa Park and Old Town
- X-Ray Fluorescence and multispectral techniques for cultural heritage diagnostics of artwork and artifacts
- 3D printing for cultural heritage analysis
- Creating Diagnostic Point Cloud Maps of Mosaics for conservation
- Design of cognitively ergonomic user interfaces for augmented reality and visualization in the immersive CAVE systems; efficient systems of visual and “tactile” navigation IN virtual space
- Diagnostic imaging techniques and data capture methodologies for underwater archaeology; designing underwater panoramic stereo photography, structure from motion, and LiDAR.

Publications



At right are some of the latest journal articles, conference papers, books or book chapters authored by CISA3-affiliated faculty and students:

“Interactive Visualization of Large-Scale Atomistic and Cosmological Particle Simulations,” J. Kimball, M. Duchaineau, F. Kuester, *IEEE Aerospace*, March 2013.

“Archaeological Remote Sensing in Jordan’s Faynan Copper Mining District with Hyperspectral Imagery,” S.H. Savage, T.E. Levy, I.W.N. Jones, *Mapping Archaeological Landscapes from Space* (Springer), pp. 97-110, February 2013 (pictured) <http://bit.ly/Z1xtfO>

“The 2012 Petra Cyber-Archaeology Cultural Conservation Expedition: Temple of the Winged Lions and Environs, Jordan,” T.E. Levy, C.A. Tuttle, M.L. Vincent, M. Howland, A.M. Richter, V. Petrovic, D. Vanoni, *Antiquity*, February 2013. <http://bit.ly/13r2TKK>

“Technological Narratives, Grand and Small: Where Do We Currently Stand?” *7th World Archaeological Congress*, January 2013.

“Capturing and Visualizing Excavations in 3D: Lessons from Fieldwork in Jordan,” V. Petrovic, A. Richter, T.E. Levy, F. Kuester, *7th World Archaeological Congress*, January 2013.

“The Leonardo Project and the Futures of the Field,” S. Stout, *Clark/CLIR Colloquium on Preservation and its Intellectual Framework*, January 2013.

“Cyber-Archaeology in the Holy Land: The Future of the Past,” T.E. Levy, N.G. Smith, F. Kuester, T.A. DeFanti, A.Y-M. Lin, M. Najjar, *Biblical Archaeology Society*, December 2012. <http://bit.ly/ZI8Cy0>

“ARtifact: Tablet-based Augmented Reality for Interactive Analysis of Cultural Artifacts,” David Vanoni, Maurizio Seracini and Falko Kuester, *2012 IEEE International Symposium on Multimedia (ISM)*, pp. 44-49, December 2012. <http://bit.ly/17ekeJ4>

“Terrestrial laser scanning (LiDAR) as a means of digital documentation in rescue archaeology: Two examples from the Faynan of Jordan,” A. Richter, F. Kuester, T.E. Levy, M. Najjar, *International Conference on Virtual Systems and Multimedia*, December 2012. <http://bit.ly/USSu82>

“Islamic Metallurgy in Faynan: Surveys of Wadi al-Ghuwayb and Wadi al-Jariya in Faynan, Southern Jordan,” I.W.N. Jones, T.E. Levy, M. Najjar, *American Schools of Oriental Research*, November 2012. <http://bit.ly/17ekNIZ>

Invest in CISA3!

Research universities are critical to the growth of our economy. Your investment in innovative centers like CISA3 helps new methods of discovery and in this case, preservation of our cultural heritage for future generations. With your gift, you become part of the World Cultural Heritage Society, and enjoy special benefits and exclusive access to world-renowned explorers, emerging innovators, and bright young minds. Your gift at any level is meaningful, please consider the following opportunities to invest in CISA3:

- Support students through graduate and exploration fellowships.
- Create opportunities for field work and hands-on experience with travel grants.
- Provide flexible funding to meet the greatest needs for innovation and discovery.



Give Online:

To contribute via the Web, click on this link:

<http://culturalheritage.calit2.net/cisa3/patrons.php>

and click on “Give Now” to be directed to the UC San Diego Giving site.

For more information about ways to support the World Cultural Heritage Society and CISA3, please contact Sarah Beckman, Director of Development, at sbeckman@ucsd.edu or call (858) 534-7320.

World Cultural Heritage Society

To provide the vital support necessary for innovative research, international expeditions, and unique global partnerships, the World Cultural Heritage Society (WCHS) for CISA3 was formed. With ever increasing competition for public funding, private support from individuals, foundations, and corporations is critical to the growth and sustainability of CISA3. We are grateful for the passionate donors and volunteers who have invested their time and resources to support exploration and discovery, and helped position CISA3 as a global leader in the field of cyber-archaeology and cultural heritage preservation.

Pictured (l-r) Patrons Norma Kershaw, Thad and Arelene Wolinski, being briefed by IGERT Trainee Aaron Gidding on his research in Jordan.



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