



Tutorial: Image-Based Empirical Information Acquisition, Scientific Reliability, and Long-Term Digital Preservation for the Natural Sciences and Cultural Heritage

Date: Tuesday, April 14th

Time: 09:00 – 12:30 & 14:00 - 17:30 (Full-day Tutorial)

Presenters:

Mark Mudge, President, Cultural Heritage Imaging, Mark@c-h-i.org

Tom Malzbender, senior research scientist, Media and Mobile Systems Lab, Hewlett-Packard Laboratories, malzbend@hpl.hp.com,

Alan Chalmers, Professor of Visualisation, Warwick Digital Laboratory University of Warwick, UK, alan.chalmers@warwick.ac.uk

Roberto Scopigno, Research Director at CNR-ISTI, an Institute of the Italian National Research Council (CNR), Pisa, Roberto.Scopigno@isti.cnr.it

James Davis, Assistant Professor, University of California Santa Cruz, davis@cs.ucsc.edu

Oliver Wang, 4th Year PhD. Student, University of California, Santa Cruz, Department of Computer Science, owang@soe.ucsc.edu

Prabath Gunawardane, Graduate Student, University of California, Santa Cruz, Department of Computer Science, prabath@soe.ucsc.edu

Michael Ashley, Digital Conservation Architect for the Office of the Chief Information Officer at the University of California Berkeley, mashley@berkeley.edu

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Abstract: The tools and standards of best practice adopted by natural science and cultural heritage (CH) professionals will determine the digital future of natural science and CH digital imaging work. This tutorial discusses emerging digital technologies and explores issues influencing widespread adoption of digital practices for CH and the natural sciences. The tutorial explores a possible digital future for natural science and CH through key principles: adoption of digital surrogates, empirical (Scientific) provenance, perpetual digital conservation, and the democratization of technology.

The tutorial discusses multiple image based technologies along with current research including; Reflectance Transformation Imaging (RTI), Photometric Stereo, and new research in the next generation of multi-view RTI. This research involves decomposition of the reflectance function into view dependent and view independent components, extending stereo correspondence methods. These technologies are then used to produce digital surrogates that can serve as trusted representations of “real world” content in digital form. The tutorial also explores how empirical provenance can contribute to the authenticity and reliability of digital surrogates, while perpetual digital conservation can ensure that digital surrogates will be archived and available for future generations.

The tutorial investigates the role of semantically based knowledge management strategies and their role in simplifying ease of use by natural science and CH professionals as well as long term preservation activities. The tutorial also investigates these emerging technologies’ potential to democratize digital technology, making digital workflows easy to adopt and make natural science and CH materials widely available to diverse audiences. The tutorial concludes with hands-on demonstrations of image-based

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Presenters (continued):

Martin Doerr, Principal Researcher in the Information Systems Laboratory and the head of the Centre for Cultural Informatics of the Institute of Computer Science, FORTH, martin@ics.forth.gr

Alberto Proenca, Professor of Computer Engineering, University of Minho, aproenca@di.uminho.pt,

João Barbosa, Graduate Student, University of Minho, jbarbosa@di.uminho.pt

capture and processing methods and a practical problem solving Q&A with the audience.

Keywords: Reflectance transformation imaging, polynomial texture mapping, empirical provenance, photometric stereo, stereo correspondence, photogrammetry, structured light, digital preservation, archiving, cultural heritage

Mark Mudge received his BA in Philosophy from New College of Florida (1979). He has worked as a professional sculptor and has been involved in photography and 3D imaging for over 20 years. He has published 10 articles related to cultural heritage imaging and serves on several international committees. In 2002, Mark founded Cultural Heritage Imaging, a non-profit corporation, in which he serves as President. He is a co-inventor of Highlight RTI.

Mark's recent work involves improving the ease of adoption of digital imaging techniques by cultural heritage professionals, trustworthiness of "born digital" images, the semantic richness of metadata records about digital representations, and easing the burdens of sustainable, long term digital archiving. His efforts focus on the ease of use, cost effectiveness, and self-documentation of digital imaging techniques through new equipment designs and methodology enhancements.

Tom Malzbender is a Senior Research Scientist in the Mobile and Media Systems Lab within Hewlett-Packard Laboratories. Tom developed the capacitive sensing technology that allowed HP to penetrate the consumer graphics tablet market. At HP, he also designed several early CMOS imaging I.C.'s used in an optical mouse design. In 1986 he joined HP Labs, working in the area of parallel processing and neural approaches to computer vision. Since then he has focused on 3D computer graphics and computer vision, specifically the intersection between the two, as well as applying signal processing methods to both. Tom Co-Chair for the visualization track of the International Symposium on Visual Computing, and on the program committee for Volume Graphics 2007. He is known for his work in applying Fourier methods to volume rendering and image based relighting of artifacts. His work on reflectance imaging of the Antikythera Mechanism contributed to a breakthrough understanding of the functioning of this artifact. Tom's current research interests are photorealistic avatars for teleconferencing, image based relighting for conveying shape information and image based surface detailing. He also works in 3D model reconstruction from multiple handheld images and texture synthesis.

Alan Chalmers is working to create the 'Mother of All Virtual Environments' at Warwick Digital Lab. An expert in high fidelity graphics, Professor Chalmers is using extremely novel techniques to render 'as there' virtual reality environments in order to make traditionally slow and expensive technology attainable for normal markets. Using understanding of the human eye, Prof Chalmers and his team are able to substantially reduce the amount of computing power needed to render a wide range of complex images.



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Roberto Scopigno is a Research Director at CNR-ISTI, an Institute of the Italian National Research Council (CNR). He is part of the Visual Computer Lab. He is currently engaged in research projects concerned with multi-resolution data modeling and rendering, 3D scanning, surface reconstruction, scientific visualization, volume rendering, and applications to Cultural Heritage. He published more than one hundred twenty papers in international refereed journals/conferences and gave invited lectures or courses on visualization at several international conferences. Since 2001 he is Chief Editor of the Computer Graphics Forum Journal (with David Duke); Roberto is Member of the Editorial Board of the ACM Journal on Computers and Cultural Heritage and of the Int. Journal of Image and Graphics. At the national level, CNR has recently nominated Roberto the coordinator of a national research line on Cultural Heritage & ICT ("Fruizione e Valorizzazione del Patrimonio Culturale"), that is one of the research lines of the newly constituted CNR Dept. on Cultural Heritage.

James Davis is an Assistant Professor in Computer Science at the University of California, Santa Cruz. His research expertise is in computer graphics, machine vision, and sensing systems for building digital models of the real world. In addition, he is interested in applying technology to address global social issues. His research has resulted in over 25 patents and peer-reviewed publications, as well as commercialization by companies including Sony, Prentice Hall, and Apple Computer. His teaching was recognized with an award given to fewer than 2% of faculty. He was previously a senior research scientist at Honda Research Institute, and received his PhD from Stanford University in 2002.

Oliver Wang is a fourth year PhD student at UC Santa Cruz in the Department of Computer Science. He is working on research related to computational photography, specifically relighting and understanding reflectance functions approximations.

Prabath Gunawardane is a fourth year PhD Student at the University of California, Santa Cruz, Department of Computer Science. He is doing research in the areas of computer vision and computational photography, focusing on 3D shape extraction and relighting.

Michael Ashley is Digital Conservation Architect for the Office of the Chief Information Officer at UC Berkeley. In this capacity, he has co-lead several efforts focusing on open digital heritage, including Open Knowledge and the Public Interest (Okapi), Remixing Çatalhöyük and the Digital Nineveh Archives. Currently, he is developing the Media Vault Program, a campus-wide experiment to develop robust digital archiving solutions for scholarship. Michael co-founded and serves as the Executive Director of the Multimedia Authoring Center for Teaching in Anthropology, where students and faculty develop digital literacy through inquiry-based learning. He continues to remain engaged in the cultural heritage field, serving as the Chair of Global Communications for the World Archaeological Congress, and on the boards of Cultural Heritage Imaging and the CyArk High Definition Heritage Network. Michael received his Ph.D. in archaeology from Berkeley in 2004.

Martin Doerr is a Principal Researcher in the Information Systems Laboratory and the head of the Centre for Cultural Informatics of the Institute of Computer Science, FORTH. He is involved in the following projects: CIDOC CRM Special Interest Group; CHIOS Cultural Heritage Interchange Ontology Standardization; SCHOLNET : A Digital Library Test bed to Support Networked Scholarly Communities; CRISTAL - Conservation & Restoration Institutions for Scientific Terminology dedicated to Art Learning Network; TERM-IT - Multilingual Support for Multimedia Services; HYPERTOUR - a Hypermedia Platform Combining an Organizational Framework and a Methodology for the Exploitation & Promotion of Tourism in Europe of 2000

Alberto Proenca is a Professor of Computer Engineering at the University of Minho, where he leads the University Computer Center and the Computer Science and Technology R&D Centre. He received international awards for innovative projects. His main interests lie in applied HPC and grid computing and the use of imaging techniques to increase awareness of cultural heritage.

João Barbosa is a graduate student at University of Minho pursuing research in high-performance and gpGPU computing and their application to computer vision algorithms. He has worked as a Senior IT/SI International Project Consultant, with expertise in information systems integration.