



**UNIVERSITY OF  
SOUTHERN CALIFORNIA**

# **Image Processing and Informatics Laboratory**

Department of Radiology, Keck School of Medicine



## *RSNA 2009*



## **Education Exhibits & Presentations**

**November 29 – December 4, 2009  
McCormick Place,  
Chicago, Illinois**

**USC Viterbi**  
School of Engineering



**KECK**  
SCHOOL OF MEDICINE **USC**

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## WELCOME

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Dear Colleagues and Friends of IPI Lab,  
Welcome to another exciting year of IPI Lab's presentations and exhibits at RSNA 2009.



This year we are presenting:

Education Exhibits (Standalone Presentation)	4
Education Exhibits (Electronics Presentation)	1
Education Exhibits (Poster)	1
Scientific Posters (Electronics Presentation)	1

One large screen presentation:

**Monday, November 30th, 2009 - Scientific Poster**

12:15PM - 1:15PM ROOM Lakeside Learning Center 06

*Multi-Modality Electronic Patient Record (ePR) for Diagnostic Breast Imaging Centers*

**Kevin C Ma, MS**, Los Angeles, CA; P Moin, MD; X Hong, PhD; M Y Law, PhD; B J Liu, PhD; H K Huang, D.Sc.; et. al.

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## STAFF AND COLLABORATORS

Faculty and Administration	
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Graduate Student Assistants	

## IPI LAB NEW LOCATION & COLLABORATIONS

2250 Alcazar Street, CSC 105, Los Angeles, CA 90033



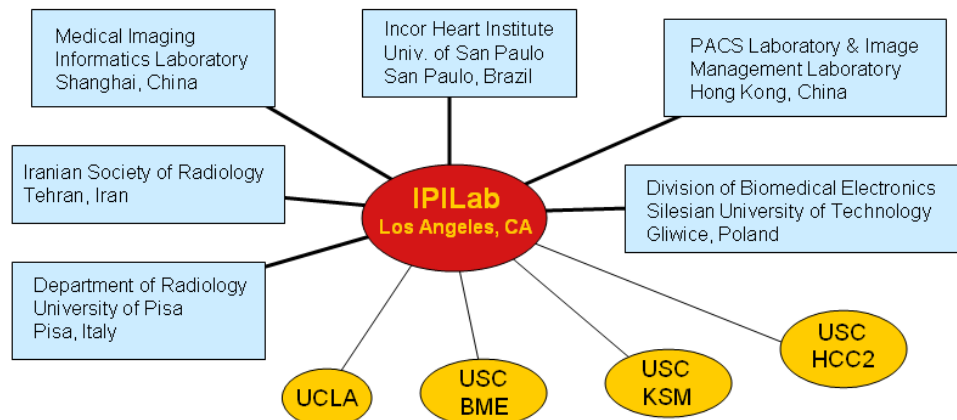
### IPI Lab Collaborations

International

National

#### ABBREVIATIONS

IPI: Image Processing and Informatics Laboratory, USC  
 KSM: Keck School of Medicine, USC  
 HCC2: Healthcare Consultation Center 2, USC  
 BME: Biomedical Engineering Department, USC  
 UCLA: Dept. of Radiological Sciences, UCLA



## EDUCATION EXHIBITS – STAND ALONE PRESENTATIONS

### LL- IN3538: Dynamic Digital MR Image Visual Templates for Grading White-Matter Lesions from Vascular Dementia in a PACS Environment

K C Ma, MS, Los Angeles, CA; C C Tsai, MD; P Moin, MD; J Lee, MD; B J Liu, PhD  
 (kevincma@usc.edu)

#### BACKGROUND

Age-related white matter degradation is a sign of vascular dementia. Dementia severity is often quantified by the degree of white matter degradation observed in brain MR images. Currently, grading vascular dementia involves subjective uses of a hardcopy template, and the grading method and scale are not standardized. In order to create a standardized grading of white matter changes in vascular dementia and a more convenient method in the digital imaging environment, we designed and implemented a digital and dynamic library of brain MR templates accessible from diagnostic workstations in an enterprise PACS environment.

#### EVALUATION

A web-based user interface of digital brain MR templates has been designed. The digital template contains multiple MR studies showing various degrees of white matter change. Each image set is carefully selected and evaluated by radiologists at USC; subjects contain both genders with varying age groups. The digital template has been integrated with PACS review workstations in a healthcare enterprise, accessible directly from the PACS application. Radiologists can compare the template images from the web-based GUI with images from PACS. The GUI enables dynamic image manipulation, such as zooming, window/level, pan, and scrolling. Evaluations of the digital template are completed by two radiologists, comparing the printed hardcopy templates with the digital template.

#### DISCUSSION

The web-based digital template has been successfully designed and implemented in the lab setting, which includes a simulation of the PACS environment. The evaluation workflow has been demonstrated. The performance of the web-based templates is evaluated, and the successful results show that the dynamic digital template improves accessibility and convenience as compared to hardcopy paper templates.

#### CONCLUSION

The digital template is a comprehensive and useful tool to assist radiologists in grading white matter changes relating to vascular dementia. It addresses the need to have a reliable and a more systematic approach to the evaluation. Future works include implementation in a clinical setting and automatic quantification of white matter in relation to brain matter for an objective approach.

## ***LL-IN3550: An Image-Intensive Breast Cancer Data Grid Infrastructure for Data Mining and Outcomes Research***

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*B J Liu, PhD, Los Angeles, CA; J Documet, PhD; M Y Law, PhD; J Lee, MS; X Hong, PhD; P Moin, MD; K Ma, MS; H K Huang, DSc (brentliu@usc.edu)*

### **PURPOSE/AIM**

The utilization of breast MRI is increasing in the diagnostic evaluation of suspicious breast findings. As more imaging centers implement dedicated breast MR, the need for managing data on a large-scale is apparent. We propose an overall solution utilizing data grid and ePR system technologies as an infrastructure for data mining and research.

### **CONTENT ORGANIZATION**

Present the data grid for DICOM images and DICOM-SR data and the image-intensive web-based ePR system technologies. Present the current three-site dedicated breast MR outpatient centers as the clinical application. Show how the implementation of the two technologies can provide a global solution that is portable for the Breast Cancer patient including aggregation of Mammo, US, MR, CAD, BI-RADS, and clinical related reports data to form a powerful platform for data mining and outcomes research.

### **SUMMARY**

The data grid implemented with a web-based ePR system can provide a robust platform for managing Breast Cancer Patient's globally and providing an infrastructure for imaging informatics data that provides future outcomes and data mining research. Specifically we showed a data mining and outcomes example where Mammo studies with dense breasts and corresponding MRI studies with findings of BIRADS 3-5 and correlated biopsy/pathology results were queried/retrieved and compared the findings of both.

## ***LL-IN3551-R: Mind Over Matter: Using a Neuroheadset to Interact with a PACS Workstation***

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*P Moin, MD, Los Angeles, CA; R Deshpande, BE (pmoin@usc.edu)*

### **BACKGROUND**

Evolving modalities and the demands of efficient interpretation are increasingly at odds with each other necessitating a revisit of the image interpretation process.

### **EVALUATION**

The Emotiv neuroheadset is adapted for use with a clinical PACS system in an effort to replicate basic functions. Objectives are to reduce repetitive motions, increase productivity, and eventually allow complex commands to be initiated in a single step. In addition, the reduction of repetitive motions using a mouse will reduce the prevalence of associated musculoskeletal fatigue/injuries that may result.

### **DISCUSSION**

We seek to participate in the development of next-generation of human-machine interface tools. The eventual endpoint of interaction between humans and electronic devices is a direct neural-machine interface. We hope this is the start to that process in radiology. In addition, advancement of such functionality could allow more efficient image viewing in other situations such as in the operating room where a surgeon could review and manipulate relevant images intraoperatively while maintaining a sterile field.

### **CONCLUSION**

Continued development of the Emotiv neuroheadset functionality could eventually make the use of a mouse obsolete, increase image interpretation efficiency and allow the proliferation of image intensive medical applications outside of the radiology reading room.

***LL-IN3559: Imaging Informatics Beyond Radiology: Clinical experiences from a 6-month Implementation of a DICOM Multimedia Electronic Patient Record (ePR) System for Image-Assisted Minimally Invasive Spinal Surgery***

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*J Documet, PhD, Los Angeles, CA; B J Liu, PhD, A Le, MS, J Chiu, MD, H K Huang, DSc (documet@usc.edu)*

**PURPOSE/AIM**

To present an image and data intensive Electronic Patient Record (ePR) tailored to improve the efficiency of clinical procedures for Image-Assisted Minimally Invasive Spinal Surgery, which is a new frontier in imaging informatics. Conclusions from a clinical implementation of the ePR that has been in place for over six months will be presented.

**CONTENT ORGANIZATION**

The main stages of clinical procedures for Minimally Invasive Spinal Surgery will be presented including Pre, Intra and Post Operative phases, which provide a variety of data types, such as images (e.g. C-Arm, Endoscopic images, MRI, CR), patient information, videos, waveform data points and pain assessment forms. All these data are acquired and stored on a fault-tolerant and reliable ePR system. Clinical implementation of this ePR system including pitfalls and challenges will also be addressed.

**SUMMARY**

A novel ePR system tailored to collect and integrate relevant imaging and informatics data from patients who undergo Minimally Invasive Spinal Surgery is presented. The collection of the different data types during the span of the entire clinical procedure opens a rich new area of research opportunities and improving overall workflow efficiency. Similarities between PACS and ePR system clinical implementations were highlighted.

**EDUCATION EXHIBITS – ELECTRONIC PRESENTATIONS**

***LL-UR4738: A Benchmark Study to Measure Native Client-side Image Manipulation Performance Utilizing Firefox 3.5, Safari 4, Chrome 2, and Internet Explorer 8***

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*J Documet, PhD, Los Angeles, CA; R Lee, MD, K Ma, MS; B Liu, PhD (documet@usc.edu)*

**PURPOSE/AIM:**

Viewing medical imaging studies via a web browser has become predominant in the past years and is usually done using a thin client or AJAX (Asynchronous JavaScript and XML) technologies. With significant improvements in Javascript engines by most of current web browser vendors, we explore how well they perform medical imaging manipulation natively.

**CONTENT ORGANIZATION:**

A cross-platform and stand-alone methodology to measure image manipulation performance utilizing a set of web browsers will be presented with a specific number of tests that are performed. These tests include: zoom, pan, window/level and inverting an image. A set of a 5 jpeg images for each CT, MRI, US and CR will be utilized during the performance evaluation. A virtual machine with Windows XP Home will host all the different web browsers. A final performance evaluation will be presented.

**SUMMARY:**

This unique benchmark methodology will provide quantitative information about the performance of the latest versions of most used web browsers when performing medical image manipulation which will ultimately allow developers and users to make better decisions on which technology to choose for web-based image viewing. The image manipulation will be performed on the jpeg format instead of native DICOM due to the lack of natively rendering DICOM images on web browsers.

## EDUCATION EXHIBITS – POSTER

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### **LL-IN3052:** Pre-clinical Implementation and Disaster Recovery Evaluation of a Medical Imaging Informatics Data Grid Used as a Tier 2 Enterprise PACS Back-up Solution at the USC Academic Medical Center

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*J Lee, MS, Los Angeles, CA; K Wang; B J Liu, PhD (jasperle@usc.edu)*

#### **PURPOSE/AIM**

To address clinical challenges and performance concerns of a Data Grid based on the Globus Toolkit used as a tier 2 enterprise PACS back-up solution. Topics include methods to integrate with a thin-client PACS, HIPAA-compliance within the enterprise PACS, and disaster recovery performance.

#### **CONTENT ORGANIZATION**

1. Introduce design and requirements of the IPILab's Medical Imaging Informatics Data Grid
2. Overview the enterprise PACS infrastructure at the USC Academic Medical Center, consisting of four facilities and two thin-client PACS
3. Discuss system integration methods of the Data Grid with the two PACS
4. Discuss HIPAA concerns and data access-control using the Data Grid's distributive technology
5. Evaluate workflow and performance of the Data Grid in two PACS down-time scenarios

#### **SUMMARY**

The Data Grid utilizing the Globus Toolkit is a novel design for an enterprise PACS environment looking for a tier 2 backup solution. It can be integrated into an existing PACS and maximizes the SAN infrastructure. Challenges are realized, however, during pre-clinical implementation of the Data Grid and disaster recovery scenarios at the USC Academic Medical Center. System integration, HIPAA-compliance, and disaster recovery workflow and performance are some major challenges to be addressed.

## SCIENTIFIC POSTERS – ELECTRONICS

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### **LL-IN2121-D06:** Multi-Modality Electronic Patient Record (ePR) for Diagnostic Breast Imaging Centers

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**Mon Nov 30 2009 12:15PM - 1:15PM ROOM Lakeside Learning Center**

*K C Ma, MS, Los Angeles, CA; P Moin, MD; X Hong, PhD; M Y Law, PhD; B J Liu, PhD; H K Huang, DSc; et al.(kevincma@usc.edu)*

#### **BACKGROUND**

Diagnostic breast imaging is often completed at outpatient imaging centers. To eliminate the hassle of patients carrying hard-copy image and clinical data, provide a remotely-accessible and comprehensive database, and reduce cost, a web-based electronic patient record (ePR) system for multi-modality breast imaging has been developed. The system combines patient information, history, and medical images as a total informatics solution. It allows patients to be mobile without carrying or having to coordinate retrieving their entire history and allows radiologists to easily access patient history to aid diagnosis.

#### **EVALUATION**

The breast imaging ePR system features a patient record database, a multi-modality image database, a BI-RADS report database, and a web-based GUI that can be accessed securely and remotely within the ePR network. The GUI is designed to display dynamically MR, mammography, and ultrasound images in a web browser with zooming, panning, and scrolling. Image-guided biopsies and biopsy reports are stored. A search function is for image data mining through both patient information and BI-RADS reports. The system has been implemented and evaluated in a laboratory environment, where a workflow simulates the ePR network involving three outpatient breast imaging centers.

#### **DISCUSSION**

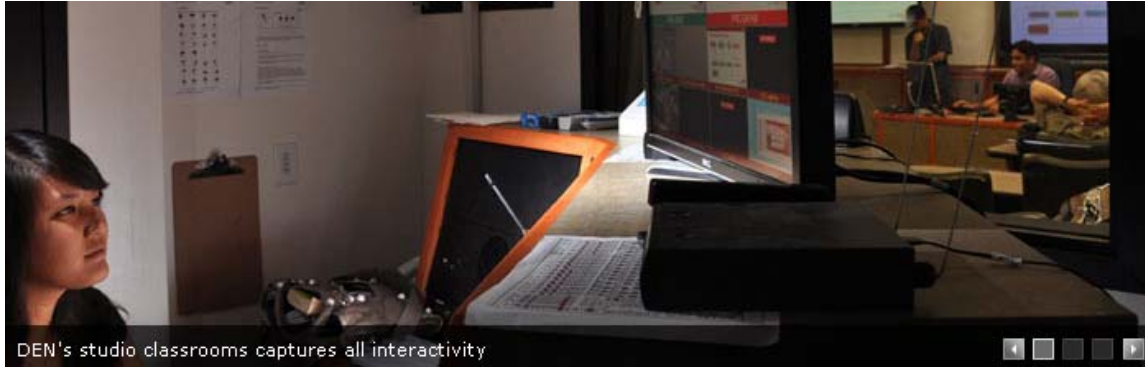
The infrastructure of patient information and image database has been completed and set up in the lab environment. The GUI is able to display patient information, multiple images, and their diagnostic and/or biopsy reports. The workflow simulation with three outpatient breast imaging centers includes image querying and retrieving, creating new patients, remote access of patient information, report look-up and data search from BI-RADS scores.

#### **CONCLUSION**

This study proves that a multi-modality ePR system is a robust information and image archive and retrieval solution for outpatient breast imaging centers. A successful workflow simulation shows the potential in clinical implementations. Future works include evaluations with radiologists and subsequent clinical implementations. The results can be utilized to expand the breast-imaging ePR system for other clinical uses.

## TECHNICAL EXHIBIT: DEN @ USC

**Booth 7237 (North Building Hall B):** USC Viterbi's School of Engineering Master's Programs and the Distance Education Network (DEN)



The USC Viterbi School of Engineering is consistently ranked among the top ten graduate engineering schools in the United States by U.S. News & World Report. Over 50 Master of Science programs are available in broad disciplines and niche areas, including biomedical imaging and imaging informatics, smart oilfield technologies, medical device & diagnostic engineering, and game development.

Whether you are seeking to pursue your M.S. full time or part time, the Viterbi School has options to enable you to advance your degree. We also offer our M.S. programs online via the Distance Education Network (DEN). DEN enables students to continue their education 100% online. DEN caters to the professional engineer by providing over 30 Master of Science degrees online. In addition to Master's degree programs, Graduate Certificates and Professional (non-credit) courses are available online. Students can also choose to come to campus to attend courses and interact with other classmates on campus and off campus through DEN's unique blended delivery systems.

Representatives from USC are here at RSNA to introduce our various graduate degree programs. Most of us here at IPILab are in progress or have completed our training for Masters in Medical Imaging and Imaging Informatics, which is offered on DEN. We highly recommend you to visit the exhibit if you are interested in learning more about our imaging informatics program.

### USC Technical Exhibit Schedule

Sunday, Nov 29	10am-5pm
Monday, Nov 30	10am-5pm
Tuesday, Dec 1	10am-5pm
Wednesday, Dec 2	10am-5pm
Thursday, Dec 3	10am-2pm

## Notes