Radiology and Imaging Sciences, Clinical Center
National Institutes of Health

# CIPS Quarterly Newsletter

Q3 2011

5/31/2011

## Introduction

**The Clinical Image Processing Service (CIPS) offers timely and accurate advanced image processing of diagnostic radiology images for clinical care, research, and training. CIPS provides both clinical services and scientific research assistance without charge to the intramural community. This newsletter is intended to inform you and your lab about CIPS and the services we offer.**

## How to Request a Consultation

**You can get in touch with CIPS by using the following contact information:**

Clinical Image Processing Service
HTTP://WWW.CC.NIH.GOV/DRD/INFO/CIPS.HTML

1C515, Building 10
Radiology and Imaging Sciences,
Clinical Center
National Institutes of Health
Bethesda, Maryland
20892-1182

Phone: 301-402-3225
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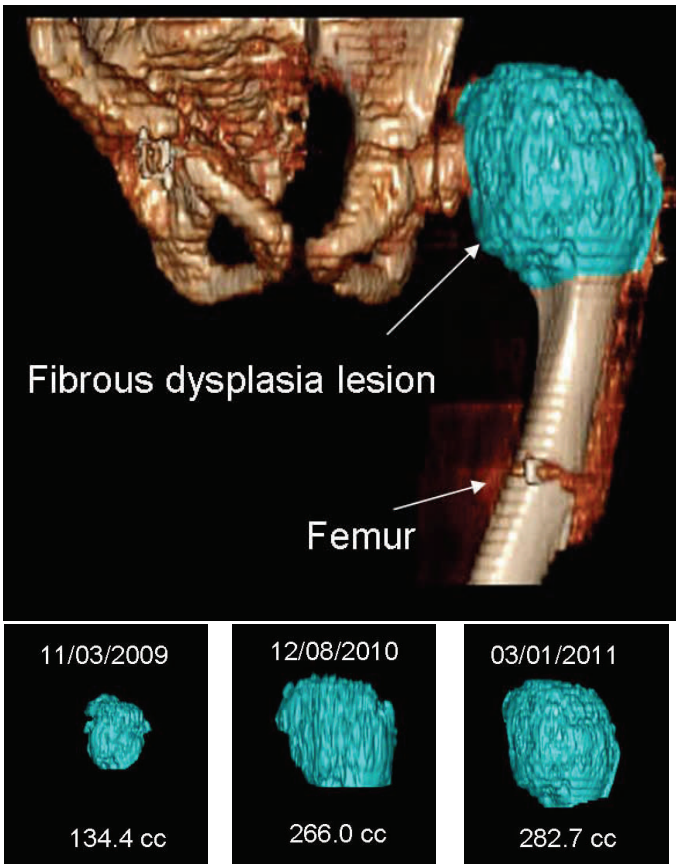
E-mail: cips@nih.gov

**New Protocol:**
A group of investigators led by Adrian Wiestner, MD, PhD, Hematology Branch, NHLBI in collaboration with Dr. Gerald Marti, MD, PhD (PHS, retired) is working with CIPS to classify whole body CT scans in patients with chronic lymphocytic leukemia (CLL).

**New Collaboration:**
CIPS is working with Dr. Michael Collins (NIDCR) in accurately assessing the extension of fibrous dysplasia lesions using medical imaging data (image on right).

## Image of the Quarter




**This is an example of a manually segmented proximal femoral mass. The images were obtained with the Vitrea Server. The mass's growth over time is given in the lower three images. The large image is of the most recent measurement (in blue).**

### CIPS can help your research by:

- Providing quantitative analysis of medical imaging data
- Providing advanced visualization for diagnosis and presentation
- Providing one-on-one training in the use of our imaging software (Vitrea and AWS)
- Developing and validating custom image analysis software

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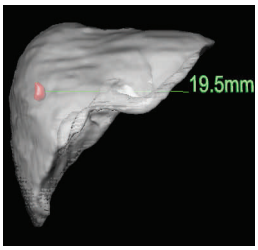
## Service Introduction :

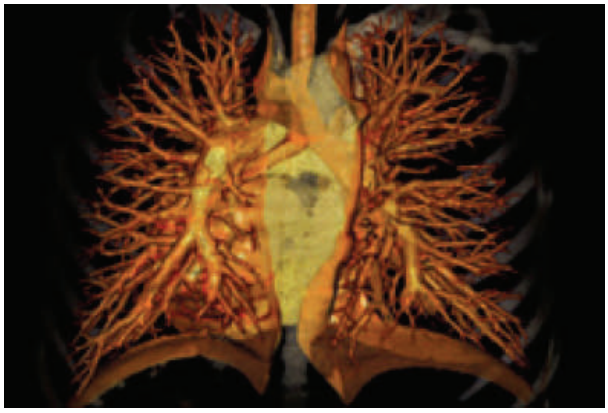
## IP Measurement

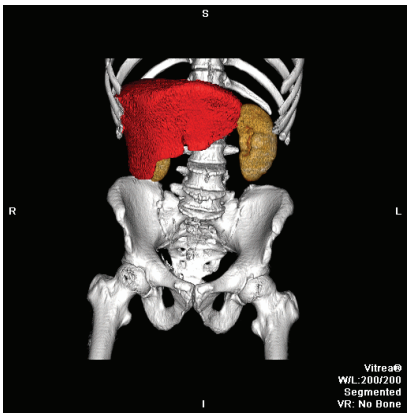



IP Measurement analyzes areas of medical interest using 3D image measurements based on size, position, brightness, shape and topology. The reported numerical values represent width, height and density of specific anatomical regions and can be used for treatment monitoring (i.e., drug therapy, etc.).

# Software Introduction: Vitrea

Vitrea® Enterprise Suite (VES) is an advanced clinical image visualization and processing server recently deployed at the Radiology and Imaging Sciences department in the NIH Clinical Center. VES is manufactured by Vital Imaging Inc (Minnetonka, MN, USA). VES is a thin-client server and is accessible from any Web-enabled PC using an NIH login. This Web-enabled imaging solution allows any number of clinicians to interactively review 2D, 3D, and 4D patient data from any networked computer. Intuitive applications and automated workflows speed diagnosis, communication and collaboration for efficient, confident decision making and improved patient care. Advanced image processing packages include cardiovascular imaging analysis, neuro imaging solutions, oncology imaging solutions, CT colonography, CT lung analysis, a lung nodule CAD system, and orthopedic visualization. By centralizing data management, clinical pre-processing, and distribution of imaging data, VES is able to optimally manage the data explosion created by the demand of thin-slice CT scans. With a single DICOM push from PACS or any modality to the VIMS server, both network traffic and time to first image is significantly reduced. The system is fully integrated into Carestream ® PACS in the radiology department and can be launched through CITRIX.



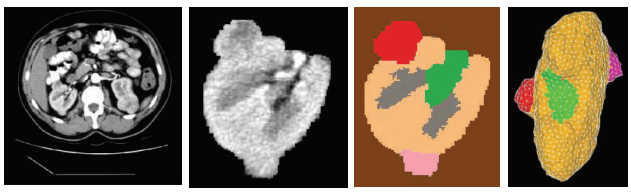



**The left image shows pulmonary vasculature. The right image shows the volume rendering of abdominal organs and bone structures.**

# Scientific Research Paper

Xinjian Chen, Ronald Summers and Jianhua Yao, FEM Based 3D Tumor Growth Prediction for Kidney Tumor, IEEE Transactions on Biomedical Engineering, Vol. 58, NO. 3, March 2011, 463-467.

*Abstract*— It is important to predict the tumor growth so that appropriate treatment can be planned in the early stage. In this paper, we propose a finite element method (FEM) based 3D tumor growth prediction system using longitudinal kidney tumor images. To the best of our knowledge, this is the first kidney tumor growth prediction system. The kidney tissues are classified into three types: renal cortex, renal medulla and renal pelvis. The reaction-diffusion model is applied as the tumor growth model. Different diffusion properties are considered in the model: the diffusion for renal medulla is considered as anisotropic, while those of renal cortex and renal pelvis are considered as isotropic. The FEM is employed to solve the diffusion model. The model parameters are estimated by optimizing of an objective function of overlap accuracy using a hybrid optimization parallel search package (HOPSPACK). The proposed method was tested on two longitudinal studies with seven time points on five tumors. The average true positive volume fraction (TPVF) and false positive volume fraction (FPVF) on all tumors is 91.4% and 4.0%, respectively. The experimental results showed the feasibility and efficacy of the proposed method.



**(a) (b) (c) (d)**

**Fig. 3. Segmentation and meshing results for the second study.** (a) Original image, (b) the segmented kidney, (c) the segmented tissues and two tumors (cortex: orange, medulla: black, pelvis: green, tumors: red and pink), (d) one view of volumetric mesh

## News

**Increase in orders:**
Since the same time last year, orders to CIPS have doubled.

**Upcoming Advanced Imaging Seminar:**
The Department of Radiology and Imaging Sciences is holding seminars on the new Advanced Imaging products now being hosted by the department. The seminars are held the last Wednesday of each month at 9AM in the Doppman Conference Room (10/1C331X).

**Promotion:**
Dr. Jianhua (Jack) Yao, manager of CIPS, has been promoted from staff scientist to associate scientist. He has thus been recognized as one of "the relatively small number of staff scientists who are functioning at a senior level."

## CIPS Staff

**Ronald M Summers MD, PhD**
Ronald Summers, senior investigator and chief of the Imaging Biomarkers and Computer-Aided Diagnosis Lab, directs CIPS. His research interests include virtual colonoscopy, CAD, multi-organ multi-atlas registration and image databases.

**Jianhua (Jack) Yao, PhD**
Jianhua (Jack) Yao is an associate scientist and manages CIPS. His interests include clinical image processing, CT colonography, deformable models, and nonrigid registration.

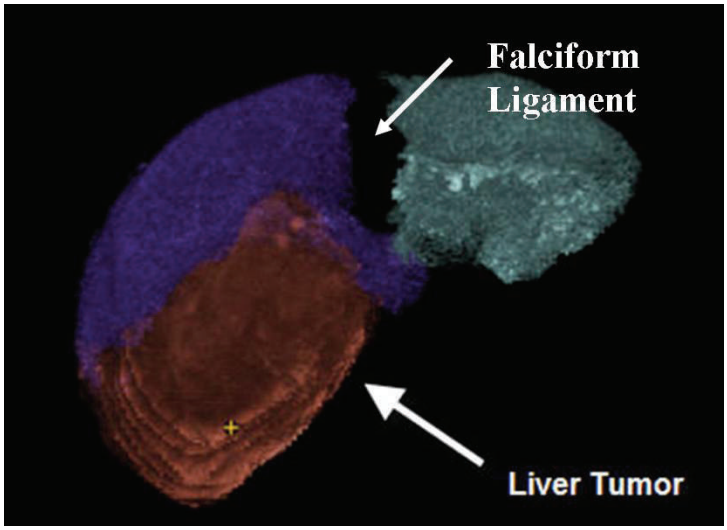
**Marius George Linguraru, D.Phil**
Marius George Linguraru is a Staff Scientist in CIPS. His research interests include medical image analysis, computer-aided diagnosis, and multi-organ models.

**Francine Thomas, BS ARRT/M/CT**
Francine Thomas has been working in CIPS as an image processing specialist. She has expertise in computerized tomography, mammography, adipose values, 3D reconstruction and tumor measurements.

**David Williams, BS ARRT/CT**
David Williams is an image processing specialist. His areas of expertise include CT segmentations, fat measurements, 3D reconstructions and perfusion studies.

## Case of the Quarter

Among the many requests of the Clinical Image Processing Service (CIPS) Staff are requests for liver segmentations for patients undergoing major liver resection. A recent representative case was that of a patient with metastatic adrenal cancer and extensive right lobe metastatic disease, who was being evaluated by the Surgical Oncology Branch regarding the feasibility of extended right hepatectomy. Systematic measurements of the anticipated future liver remnant, as a percentage of whole liver volume, are crucial to ensure a safe hepatic resection. This is because a future liver remnant of less than approximately 25% in patients with healthy liver and <30% in patients with impaired liver function has been associated with a significant risk of liver failure following surgery, and is generally contraindicated. In borderline cases, portal vein embolization has been employed, where embolization of the affected lobe's portal vein facilitates contralateral lobar hypertrophy, and may optimize the percentage of the anticipated future liver remnant. In the example patient's case, the adrenal mass had invaded the liver and it was technically challenging to measure its margins, although this was ultimately successful. The goal of the CIPS staff was to segment the whole liver volume containing tumor (as the total liver volume) as well as to segment the healthy portion of the left lobe of liver (the anticipated future liver remnant). In this case, the anticipated future liver remnant composed 28.3 % of the total liver volume, and the patient underwent subsequent portal vein embolization prior to the hepatectomy. Volumetric analyses like this are used routinely to predict the risk of hepatic dysfunction following major liver resection, and are useful in suggesting whether other procedures (e.g. portal vein embolization) should be done to prevent this complication.




**Visualization and segmentation of liver and liver tumor in planning of hepatic resection.**

# Recent Publications

The researchers in CIPS published the following articles in the first quarter of 2011:

- Jianhua Yao, Andrew Dwyer, Ronald Summers, Daniel Mollura. "Computer-Aided Diagnosis Of Pulmonary Infections Using Texture Analysis And Support Vector Machine Classification." *Academic Radiology*, 18 (3): p.306-314, 2011.

- Xinjian Chen, Ronald Summers and Jianhua Yao. "FEM- Based 3-D Tumor Growth Prediction for Kidney Tumor." IEEE Transactions on Biomedical Engineering, 58 (3), 463-467, 2011.

- Xinjian Chen, Ronald Summers, and Jianhua Yao. "Automatic 3D Kidney Segmentation Based on Shape Constrained GC-OAAM." SPIE Medical Imaging, Orlando, FL, 2011.

- Zhuoshi Wei, Jianhua Yao, Shijun Wang, Ronald M. Summers. "Computer-aided Teniae Coli Detection Using Height Maps from Computed Tomographic Colonography Images." SPIE Medical Imaging, Orlando, FL, 2011.

- Jiamin Liu, Jianhua Yao, Ronald Summers. "Computer-aided abdominal lymph node detection using contrast-enhanced." SPIE Medical Imaging, Orlando, FL, 2011.

- Jesus Caban, Jianhua Yao, Daniel Mollura. "Enhancing Image Classification Models with Multi-modal Biomarkers." SPIE Medical Imaging, Orlando, FL, 2011.

- Jianhua Yao, Andrew J Dwyer, Ronald M Summers, Daniel J Mollura. "Computer-Aided Assessment of Pulmonary Disease in Novel Swine-Origin H1N1 Influenza on CT." SPIE Medical Imaging, Orlando, FL, 2011.

- Jianhua Yao, Daniel L Sussman, Ronald M Summers. "Fully Automated Adipose Tissue Measurement on Abdominal CT." SPIE Medical Imaging, Orlando, FL, 2011.

- Mark Bi, Ronald Summers, and Jianhua Yao. "3-Dimensional Automatic Computer Aided Evaluation of Pleural Effusions Using Chest CT Images." SPIE Medical Imaging, Orlando, FL, 2011.

- Javed M. Aman, Ronald M. Summers, Jianhua Yao. "Automatic Colonic Polyp Shape Determination using Content-Based Image Retrieval." SPIE Medical Imaging, Orlando, FL, 2011, (Cum Laude Poster Award).

- Ivica Kopriva, Xinjian Chen and Jianhua Yao. "Nonlinear Band Expansion and Nonnegative Matrix Under-approximation for Unsupervised Segmentation of a Liver from a Multi-phase CT image." SPIE Medical Imaging, Orlando, FL, 2011.

- Pura J.A., Butman J.A, Linguraru M.G. "Automated Segmentation of Ventricles from Serial Brain MRI for the Quantification of Volumetric Changes Associated with Communicating Hydrocephalus in Patients with Brain Tumor." SPIE Medical Imaging, Orlando, FL, 2011.

- Watt J.M., Linguraru M.G., Summers, R.M. Affine Invariant Shape Parameterization to Assess Local 3D Shape in Abdominal Organs. SPIE Medical Imaging, Orlando, FL, 2011.

- Okada T., Linguraru M.G., Yoshida, Y. Hori M., Summers R.M., Chen Y.W. Tomiyama, N. Sato, Y. "Development of a Framework of Automated Generation of Multi-structure Statistical Atlas." International Symposium on Computational Anatomy, Nagoya, Japan, 2011.

- Yokota F., Okada T., Linguraru M.G., Summers R.M, Takao M., Sugano N., Tada Y., Tomiyama N., Sato Y. "Application of Multi-structure Statistical Atlas to Muscle Localization from 3D CT Data of the Hip." International Symposium on Computational Anatomy, Nagoya, Japan, 2011.