**Friday December 4th (Double Tree Hilton, Richardson @ US 75 and Campbell) – Bluebonnet Room**

5 – 6 pm  Demonstrations
6 – 6:30 pm  Opening Remarks
6:30 – 7 pm  Dinner
7 – 8 pm  Keynote talk – Jack S. Snoeyink, NSF Program Director

**Saturday December 5th (Location TBD)**

9 – 9:15 am  Opening Remarks
9:15 – 10 am  Interactive Computing Research
   - Ryan McMahan (UT Dallas) and Eric Ragan (Texas A&M University)
10 – 10:45 am  Robotics and Computer Vision Presentations
   - Raúl Enrique Sánchez Yañez and Victor Ayala Ramírez
     (both from Universidad de Guanajuato)
10:45 – 11 am  Coffee Break
11 – 11:45 am  Computational Geometry Presentations
   - Sergey Bereg and Benjamin Rachel (both from UT Dallas)
11:45 – 1:15 pm  Poster Presentations and Lunch
1:15 – 2:15 pm  High Performance Computing Problems in Medical Physics and Radiation Therapy
   - Jing Wang, Weihua Mao and Xun Jia
     (all from University of Texas Southwestern Medical Center)
2:15 – 3 pm  Spatial Grammar and Visualization
   - Kang Zhang (UT Dallas) and Yizhong Wang (Retina Foundation)
3 – 3:45 pm  Closing Statements, Coffee.
1. Jing Wang, University of Texas Southwestern Medical Center

Four-dimensional cone-beam computed tomography reconstruction with multi-organ mesh model for image-guided and adaptive radiation therapy

Abstract:
Cone-beam computed tomography (CBCT) has been integrated into treatment machines in radiation therapy. In the integrated systems, imaging can be performed with a patient in the actual treatment position, allowing direct visualization of the target and relevant anatomy in the treatment room. In addition, the CBCT images also provide anatomical and density information of the patient in the treatment position, which can then be used to calculate and verify the radiation dose delivered to the patient. Although CBCT offers significant advantages for improving radiotherapy, one drawback that limits its potentials is the motion artifacts in CBCT introduced by the respiration motion, leading to decreased localization accuracy. We have developed a novel reconstruction algorithm that can perform simultaneous motion estimation and image reconstruction (SMEIR) for four dimensional cone-beam CT (4D-CBCT). In this talk, I will discuss our recent efforts on the development of a multi-organ mesh model to improve the computation efficiency and motion estimation accuracy of SMEIR for 4D-CBCT. Feature-based adaptive meshes are generated to reduce the number of unknowns in the deformable vector fields estimation and accurately capture the organ shapes and motion. Additionally, the discontinuity in the motion fields between different organs during respiration was explicitly considered in the multi-organ mesh model.

Short Bio:
Jing Wang received his B.S. degree in Materials Physics from University of Science and Technology of China in 2001, and the M.A. and Ph.D. degrees in physics from the State University of New York at Stony Brook in 2003 and 2006, respectively. He finished his postdoctoral training in the Department of Radiation Oncology at Stanford University in 2009. He is currently an Assistant Professor and Medical Physicist in the Department of Radiation Oncology at the University of Texas Southwestern Medical Center. Dr. Wang has published more than 45 peer reviewed journal papers. His research focuses on medical imaging and its application in radiation therapy. Dr. Wang’s research has been supported by National Institute of Health, American Cancer Society, Department of Defense and Cancer Prevention and Research Institute of Texas.

2. Weihua Mao, University of Texas Southwestern Medical Center

3D-2D Deformable Image Registration Using Feature-Based Non-uniform Meshes

Abstract: By using prior information of planning CT images and feature-based non-uniform meshes, this paper demonstrates that volumetric images can be efficiently registered with a very small portion of 2D projection images of a Cone-Beam Computed Tomography (CBCT) scan. After a density field is computed based on the extracted feature edges from planning CT images, non-uniform tetrahedral meshes will be automatically generated to better characterize the image features according to the density field, i.e. finer meshes are generated for features. The displacement vector fields (DVFs) are specified at the mesh vertices to drive the deformation of original CT image. Digitally reconstructed radiographs (DRRs) of the deformed anatomy are generated and compared with corresponding 2D projections. DVFs are optimized to minimize the objective function including differences between DRRs and projections and the regularity. To further accelerate the above 3D-2D registration, a procedure to obtain good initial deformations by deforming the volume surface to match 2D body boundary on projections has been
developed. This complete method is evaluated quantitatively by using several digital phantoms and data from head and neck cancer patients. The feature-based non-uniform meshing method leads to better results than either uniform orthogonal grid or uniform tetrahedral meshes.

Bio: Dr Weihua Mao received his Ph.D. in Physics and he is an assistant professor at UT Southwestern. He has broad research interests in medical imaging processing, tumor tracking, image registration, and adaptive radiation therapy. He has published more than 60 papers in peer-reviewed journals.

3. Xun Jia, University of Texas Southwestern Medical Center

Table-top high-performance computing for medical physics in radiotherapy

Abstract:

Radiotherapy uses high-energy ionizing radiation for cancer treatment. Medical physics is an essential component of radiotherapy. Over the years, tremendous efforts have been devoted to developing novel imaging and treatment technologies to improve therapeutic accuracy and effectiveness. With the increasingly high numerical complexity associated with these technologies, high-performance computing plays an important role for their translation into routine clinical practice. In particular, computation realized in a table-top platform, e.g. GPU, is attractive due to the high processing power, low cost, and low burden of system deployment and maintenance. This talk will first give an introduction to medical physics in radiation oncology. It will then present a few research topics currently conducted at our group, including GPU-based 3D/4D cone beam CT reconstruction, treatment plan optimization, and Monte Carlo simulation for radiation transport.

Bio: Dr. Xun Jia earned his Master degree in Mathematics in 2007 and Ph.D. degree in physics in 2009, both from UCLA. He received postdoctoral training in medical physics from the Department of Radiation Physics and Applied Sciences, UCSD, and immediately after that he joined the faculty team as an assistant professor in the same department. In 2013, he moved to Dallas, TX and is currently an assistant professor and medical physicist at the Department of Radiation Oncology, University of Texas Southwestern Medical Center. He also serves as the Director of medical physics track for the Biomedical engineering graduate program. Over the years, Dr. Jia has conducted productive research on developing numerical algorithms and high-performance implementations for medical physics problems, particularly in the areas of low-dose cone beam CT reconstruction and Monte Carlo radiation transport simulation. His researches have received several NIH and industrial funding supports, as well as from private funding institutions. Dr. Jia has published over 70 peer reviewed research articles, including one review article on the use of GPU in radiotherapy. He is currently serving as the Associated editor of Journal of Applied Clinical Medical Physics.

5. Yizhong Wang, Retina Foundation of the Southwest, Dallas, TX, Dept. of Ophthalmology, UT Southwestern Medical Center, Dallas, TX

Segmentation, Visualization, and Analysis of Optical Coherence Tomography (OCT) Images for Assessment and Management of Retinal Diseases

Abstract:

Optical coherence tomography (OCT) is a noninvasive imaging technique that allows the capture of high-resolution, three-dimensional images of the retina. OCT has been widely used in the research, diagnosis
and management of retinal diseases, including age-related macular degeneration, diabetic retinopathy, and other types of degenerative retinal diseases. This presentation will give an overview of OCT and its application in the field of retinal diseases, with the focus on the current approaches of OCT image segmentation and visualization, as well as potential challenges. A framework is also proposed to enhance OCT image analysis and to provide a more salient approach for studying the relationship between morphological changes as determined by OCT and functional changes as measured by vision tests. These efforts may lead us to develop more effective methods for monitoring retinal diseases and for evaluating outcomes of treatment trials for retinal diseases.

Short Bio:
Dr. Yi-Zhong Wang obtained his Bachelor’s Degree in 1982 in Information and Electronic Engineering from Zhejiang University, Master’s Degree in 1988 in Biophysics from Chinese Academy of Sciences, and Ph.D Degree in 1996 in Physiological Optics and Vision Science from Indiana University. He received his post-doctoral fellow training at Department of Ophthalmology, McGill University. He is currently an Associate Scientist and Director of Macular Function Lab at Retina Foundation of the Southwest, and an adjunct faculty in Department of Ophthalmology, UT Southwestern Medical Center. He has more than 25 years experience in vision and eye disease related research, and published many peer-reviewed papers. His main research interests include macular degeneration, diabetic retinopathy, amblyopia, optical and neural limits to vision, and clinical applications of visual psychophysics and retinal imaging. He is also a co-founder of Vital Art and Science, LLC, the developer of myVisionTrack™ mobile app for use by patients with maculopathy to monitor their visual function remotely.