Biomedical Engineering Seminar Series

2nd Semester, Academic Year 2016

Date: February 21, 2017
Time: 11.00-12.00 AM
Room 6373, 3rd level, Building 3,
Department of Biomedical Engineering,
Faculty of Engineering;
Mahidol University

Sureerat Reaungamornrat, Ph.D.,

"Deformable Image Registration for Surgical Guidance using Intraoperative Cone-Beam CT"

Accurate localization of the surgical target and adjacent normal anatomy is essential to safe and effective surgery. Preoperative computed tomography (CT) and/or magnetic resonance (MR) images offer exquisite visualization of anatomy and a valuable basis for surgical planning. Multimodality deformable image registration (DIR) can be used to bring preoperative images and planning information into alignment with intraoperative CT or cone-beam CT (CBCT), in turn improving surgical precision and safety. This talk focuses on advanced DIR developed for key image guidance applications in otolaryngology and spinal neurosurgery. For transoral robotic based-of-tongue surgery, a hybrid DIR method integrating surface-based and shape-driven Demons registration was developed to resolve the large deformation associated with the operative setup, achieving registration accuracy of ~1.7 mm in cadaver studies. For orthopaedic spine surgery, a rigidity-penalized free-form DIR method was developed to resolve rigid-body motions of bones while accommodating deformation of surrounding soft tissues, demonstrating registration accuracy of ~1.4 mm and preservation of rigid-body morphology (near-ideal values of dilatation and shear) and topology (lack of tissue folding/tearing) in cadaver studies. For spinal neurosurgery, where preoperative MR is the preferred modality for delineation of tumors and critical soft tissues, a multimodality DIR method was developed to realize viscoelastic diffeomorphisms between MR and intraoperative CT using a modality-independent-neighborhood descriptor (MIND) and a Huber metric in multiresolution Demons optimization. Clinical studies demonstrated sub-voxel registration accuracy (< 2 mm) and diffeomorphism of the estimated deformation (sub-voxel invertibility error = 0.001 mm and positive Jacobian determinants). These promising advances could facilitate more reliable visualization of preoperative planning data within up-to-date intraoperative CT or CBCT in support of safer, high-precision surgery.

Bio: Sureerat Reaungamornrat received a PhD from Johns Hopkins University, where she pursued graduate research focusing on the development of novel DIR methods for image-guided procedures under the supervision of Prof. Jeffrey H. Siewerdsen, Russell H Taylor, and Jerry L. Prince. Her work includes first-author peer-review articles, for example in IEEE Transaction on Medical Imaging, presentations, for example at SIAM Imaging Science and SPIE Medical Imaging, and invited talks, for instance at Siemens Corporate Research Seminar Series. Her work additionally earned the 2014 and 2016 SPIE Young Scientist awards and the 2016 Robert Wagner All-Conference Best Student Paper award.

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