055:191
Electrical & Computer Engineering Graduate Seminar

Speaker: Asst. Prof. R. Alfredo C. Siochi

Department of Radiation Oncology
The University of Iowa Hospitals and Clinics

"Towards an Adaptive Phase-Based Gating Strategy for Lung Cancer Radiotherapy"

Thursday, September 13, 2007
3:30–4:20 p.m. 3321 SC

Abstract:
Focusing radiation on tumors and minimizing healthy tissue dose improves cancer treatment. Part of the uncertainty of aiming at tumors in or around the lungs is that they are moving targets because of breathing. A strategy for dealing with tumor motion involves gating the radiation beam, i.e., the beam is turned on only when the tumor moves into a predefined treatment field. This involves monitoring the breathing pattern of the patient with devices like strain gauges that sense the pressure changes associated with the expansion and contraction of the lungs. A gating signal is sent to the linear accelerator when the phase of the breathing cycle associated with the treatment position has been reached. The trigger phases are usually determined from the 4D CT scan taken for the initial treatment plan. However, the relationship between tumor position and respiratory phase depends on the amplitude of tumor motion, and this amplitude changes from one treatment fraction to the next. One can still treat the tumor correctly when it reaches the treatment position if the appropriate phase is chosen for the tumor motion amplitude at the time of treatment. Hence, the trigger phase adapts to the daily tumor motion. We can determine this tumor motion by analyzing the raw projection data of the patient localization 3D Mega-Voltage Cone-Beam CT (MV CBCT). Although the tumor is not sufficiently well-defined in all views, we can estimate its motion from the motion of the top of the diaphragm in these "rotating fluoroscopy" data sets, since the diaphragm is clearly visible in all projections. This assumes a relationship between the tumor motion and the diaphragm motion, and that relationship must be assessed periodically. This can be done by creating a weekly 4D MV CBCT. The 3D data from each of the 5 treatment days of the week are registered into a common coordinate system. The 4D MV images can then be created by 1) sorting the raw projection data according to the phase of the respiratory cycle at which the projection was imaged and 2) performing the cone-beam reconstruction on the phase sorted projections, thus producing one 3D data set for each phase of the respiratory cycle. The 3D data sets can then be arranged in order of their phases, and by animating them one produces a 4D data set. The tumor motion and diaphragm motion in the 4D data set can be measured, thus establishing the relationship for subsequent adaptive phase determinations.

Bio:
Dr. Siochi is an Assistant Professor in the Department of Radiation Oncology at the University of Iowa Hospitals and Clinics. He has been involved with the establishment of many of the patient related QA software tools for plan parameter comparisons and dosimetry, especially for intensity modulated radiation therapy (IMRT). He has also worked at St. Jude Childrens Research Hospital and Siemens Medical Systems, where he did research on IMRT, specifically in the field of leaf sequencing, and has been responsible for technological developments and numerous patents that have provided shorter and more accurate radiation treatments and optimal utilization of beam defining radiation therapy hardware. His current research interests involve patient related verification of 4D radiation therapy, imaging to therapy translational utilities, and calculation based IMRT QA.

All ECE graduate students are required to attend.

For more information contact:

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