AbstractID: 7971 Title: Anatomical Imaging

This presentation surveys imaging systems, their limitations and expectations for target and organ-at-risk position determination, delineation and respiratory motion estimation. Discussion will focus on systems that are in current clinical use. Imaging techniques at simulation usually attempt to use the same patient breathing conditions as at treatment, among them, breath hold, free breathing, coached breathing, or abdominal compression. CT remains the dominant standard for anatomical imaging of external beam radiotherapy simulation. CT acquisition techniques for motion estimation include breath hold at different inspiration levels, or more recently, respiration-correlated CT (RCCT), involving retrospective sorting of axial images by means of a respiration signal. A limitation of RCCT is that images at a given position along the patient are confined to a single respiratory cycle, and assumes that the breathing pattern is repeatable, which is known to be violated to some extent depending on the patient. Further, images are acquired over several cycles and resorted into a single one; thus cycle-to-cycle changes in breathing pattern lead to artifacts. Coached breathing attempts to achieve more repeatable breathing and has shown varying degrees of improvement in some patients. Breath-hold CT fidelity is similarly dependent on breath-hold repeatability. Ideally imaging over several breath cycles is desirable, but imaging dose imposes limitations with RCCT, while patient fatigue limits breath-hold CT. A possible future direction of development is to complement CT with modalities that can image over several cycles with little or no additional dose. For example, repeat MRI in the sagittal plane provides not only a self-consistent image in terms of respiratory motion but also an estimate of cycle-to-cycle variation in motion extent, which is valuable for evaluating the sensitivity of a treatment plan to such variation.

Education objectives:

1) Understand the current technological advances in radiotherapy imaging at simulation to provide spatial information and respiratory motion estimation;
2) Understand the limitations, current expectations, and possible further improvements of these imaging systems.