

AbstractID: 4417 Title: 3D surface imaging for PBI patient setup

Image guided radiotherapy has primarily been implemented with technologies that utilize subsurface imaging. Radiography and ultrasonography are established methods to localize the target or critical organs on a daily basis. Imaging the patient surface can also have an important role in IGRT. Video-based surface imaging can be an alternative to radiography in patient setup of selected targets, such as partial breast irradiation (PBI). Video also has a role in continuous monitoring of patient position during treatment. There are various approaches to surface imaging; some measure the Cartesian coordinates of multiple discrete optical markers. We have utilized a stereo photogrammetric approach, where a speckle pattern is projected onto the patient surface, and surface topology is measured by cameras mounted from the ceiling. A user defined surface ROI from the treatment du jour is matched with the reference surface topology, and the rigid body translations and rotations required to bring the two surfaces into optimal congruence are determined.

The intrinsic performance of a surface imaging system can be $<1\text{mm}$ and $<1^\circ$, which is more than adequate for most clinical situations. Patient studies have been conducted to quantify the setup accuracy of laser, chestwall, and surface imaging, in comparison to ground truth (defined by radiographic clips). In these studies, effects of respiration, breast deformation, and posture variations are analyzed to determine their contribution to the uncertainties in targetry. The target registration error for surface imaging is $\sim 1\text{mm}$ relative to clips, and is more accurate than laser or chest wall setup, based on a statistically rigorous analysis.

This lecture will provide an overview of video based surface imaging as a tool for patient alignment in image guided therapy. While the focus is on PBI setup, the evaluation and analysis of how to compare IGRT approaches has general validity.

Educational Objective:

1. Understand basic principles of stereo photogrammetric surface mapping
2. Understand approaches to characterize and validate system performance.
3. Understand clinical factors that affect the Target Registration Error in IGRT.