

## AbstractID: 7119 Title: EUD-based Indication for Re-planning during Image-guided Adaptive Radiotherapy

**Purpose:** A quantitative real-time indicator for re-planning due to the inter-fractional anatomic changes (e.g., volume and shape changes) during the course of radiation treatment is not available for image-guided adaptive radiotherapy (IG-ART). In this work, we propose a EUD-based indicator to address this issue.

**Methods and Materials:** A EUD-based quantity

$$IEUD = 1 / (1 - k \sum_{i=1}^n EUD_{OAR}^i / \sum_{j=1}^m EUD_{Target}^j)$$

is introduced to assess the complicated EUD changes due to the inter-fractional changes collected with daily CT images. Both target(s) and normal structures are considered. IEUD is calculated using the DVHs based on the original planning CT and the daily CT images. To demonstrate feasibility, we have calculated IEUD for selected representative cases in three tumor types: lung, head-and-neck and sarcoma, based on daily CT images acquired with a tomotherapy (HiArt, Tomotherapy) and a CT-on-Rail (Primatom, Siemens). The clinical target volumes (CTVs) and various normal structures were contoured on a series of daily CTs. The verification DVHs were generated by applying the original (or previous re-planning) beam setups to the CT set of the day using either the XiO (CMS) planning system (for the patients treated with the Primatom) or the tomotherapy Planned Adaptive software (for those treated with Tomotherapy).

**Results:** Significant inter-fractional anatomic changes were observed on all selected cases, and these changes can be quantified by the values of IEUD. For a soft-tissue sarcoma at chest, for example, the CTV in the middle of the treatment was found approximately doubled from that on the planning day. Such dramatic volume changes resulted in significant decreases in the CTV coverage (95 reduced to 30%), the IEUD value dropped by 15.6% (compared to that of the original plan), indicating the necessity for re-planning.

**Conclusions:** Dramatic anatomic changes may be observed during the treatment. The presently proposed EUD-based indicator, capable of quantifying such changes, can be used to trigger re-planning for IG-ART.