

AbstractID: 2663 Title: Incorporate the imager's performance characteristics into the design of prostate IMRT dose painting protocols

**Purpose:** There is much interest in using biological and functional imaging to provide guidance in IMRT dose painting. Yet, it is important to incorporate the performance characteristics of these modalities. In this study an example of Ultrasound Tissue Typing (UTT) was utilized to investigate the implications of the imager's performance on the design of a population based prostate dose painting protocol.

**Method and Materials:** The performance of an imaging modality can be evaluated via the receiver operating characteristic curve, which is a plot of the imaging modality's sensitivity versus false-positive ratio (1-specificity). As sensitivity increases, more tumors are detected, although specificity worsens, causing more false negatives. The UTT tumor map obtained with a specific sensitivity and specificity setup is fused with the patient's CT image to guide IMRT planning. The optimal escalation dose to the tumor positive region identified by UTT, as well as the safe dose to the identified tumor negative background was obtained by maximizing uncomplicated control, which is a combination of tumor control probability (TCP), and weighted normal tissue complication probability (NTCP).

**Results:** A practical dose escalation protocol requires a high specificity imager setup to reduce complications. For tumors at the high-risk stage, with sensitivity at 0.6 and specificity at 0.9, optimal dose to the positive and negative regions are 88.2Gy and 83.6Gy respectively, which resulted in a 25% NTCP reduction compared to that the whole prostate is dose escalated to the same TCP. If the imager becomes more accurate, i.e., sensitivity improves to 0.9 when specificity remains at 0.9, the optimal plan would have a further 10% NTCP decrease with a 2% TCP increase.

**Conclusion:** Performance characteristics of an imager as described by sensitivity and specificity has important implications in prostate dose painting, and should be considered in the future design of dose painting protocols.