AbstractID: 13987 Title: Reducing Imaging Dose without Sacrificing Target Localization Accuracy: a Feasibility Study

Purpose: We develop and investigate the feasibility of reducing concomitant imaging dose without sacrificing tumor localization accuracy in IGRT, by making "smart" imaging decisions in real-time. This study focuses on demonstrating the utility of adaptive imaging triggers instead of uniform triggering.

Method and Materials: We demonstrate the sub-optimality of the current uniform imaging scheme, in terms of accuracy v.s. imaging dose tradeoff. We developed an oracle imaging triggering strategy, which retrospectively distributes the kV imaging events to maximize localization accuracy over the treatment duration. The tradeoff between localization accuracy and total imaging dose from the oracle solution provides a performance upper bound and its deviation from the corresponding uniform image triggering scheme alludes to the potential of imaging less with the same localization accuracy. The proposed concept is tested on 159 patient derived 3D abdominal and thoracic tumor traces.

Results: The oracle tradeoff curve dominates the current practiced uniform image triggering scheme, in the sense that for the same localization accuracy, it consistently reduces the required total number of images. Quantitatively, it manage to decrease the average imaging frequency by 40% to 50% in most cases. Furthermore, significant potential dose reduction is observed throughout a large range of motion patterns and under various total imaging dose conditions.

Conclusion: We have proposed a feasibility study to investigate the As Low As Reasonably Achievable (ALARA) principle in IGRT, by reducing imaging dose while maintaining tumor localization accuracy. Future work will focus on developing real-time heuristics to approach the oracle performance and experimental verification of geometric and dosimetric accuracy.

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