

AbstractID: 13491 Title: A novel aperture-based algorithm for fast treatment plan optimization of volumetric modulated arc therapy (VMAT)

Purpose: To develop a novel aperture-based algorithm for volumetric modulated arc therapy (VMAT) treatment plan optimization where the very high quality treatment plans can be found very efficiently. **Method and Materials:** The problem is formulated as a large-scale convex programming problem and a column generation approach is developed to deal with its dimensionality. The algorithm generates multi-leaf collimator (MLC) apertures one by one by solving a master problem and a subproblem iteratively. The subproblem in each iteration generates the most promising MLC aperture which can account for deliverability constraints imposed by the MLC system. By limiting to one aperture in each beam angle and taking MLC leaf motion constraints into account, the subproblem has the ability to generate deliverable while high-quality apertures. The master problem re-optimizes the intensities for all generated apertures using a gradient projection method. **Results:** Five clinical prostate cases and five clinical head-and-neck cases were tested to evaluate the treatment plan quality and planning efficiency. Very promising results were obtained. Compared to 9-field prostate and 5-field head-and-neck IMRT treatment plans, the direct aperture VMAT plans delivered much lower doses to the organs at-risk (OARs) and more conformal doses to the targets. In addition, it takes only 5~10 minutes to generate such plans in MATLAB implementation on a PC compared to hours for existing algorithms on a similar platform. **Conclusion:** This work provides an aperture-based direct VMAT optimization method to generate clinical deliverable treatment plans in a very efficient way. The ability of this approach to efficiently find very high-quality treatment plans has been demonstrated with 10 clinical cases.