AbstractID: 13276 Title: Inverse Planning for IMRT with Flattening Filter Free (FFF) Beams

Purpose: High dose rate photon beam with FFF has recently become available for clinical use. For IMRT with FFF beams, the strategy of inverse planning should be modified to minimize the segments and MUs by accommodating the cone-shaped beam fluence. **Method and Materials:** FFF beam data measured from a Varian Trilogy MX unit was employed for dose calculation and optimization. An incident beam is divided into a collection of 0.5X0.5cm beamlets. To accommodate the inherent non-flatness of FFF fluence, a total-variation regularization (TVR) is introduced in the objective function to encourage piece-wise constant fluence in the FFF fluence domain, which is mathematically equivalent to working in the conventional flat fluence domain when the beamlet intensities are normalized according to the measured FFF fluence profile. The system was optimized by using MOSEK software package. The performance of the method is evaluated by using phantom and clinical cases. **Results:** TVR-based inverse planning utilizes the known profiles of the incident beams and provides clinically sensible IMRT solutions with much reduced number of segments as compared to conventional approaches. To obtain an inverted cone-shaped isodose distribution (phantom case), the solution requires only one segment when TVR is used. Multiple segments and much higher MUs would be required when conventional beamlet-based or direct aperture optimization is used. For clinical cases, the total numbers of segments are reduced significantly as compared to the beamlet-based optimization without regularization. The final dose distributions are found to be more conformal than that obtained of DAO using 6 segments for each field. **Conclusion:** A TVR-based inverse planning with explicit inclusion of FFF profiles provides an effective way to find IMRT plans with minimized number of segments or MUs and may find natural application in IMRT with FFF beams.