AbstractID: 10916 Title: Rotational smooth for arc therapy dose calculation

Purpose: In rotational radiotherapy, such as TomoTherapy® or VMAT, the gantry rotates during radiation delivery. While the gantry rotation is continuous, dose can only be calculated for a finite number of projections due to the limitation of computing power. Ideally, using more finely sampled projections approximates better the continuous delivery. We proposed and demonstrated a method that effectively produces the result of supersampling in projections without increasing memory and calculation complexity.
Method: We start with regular convolution/superposition dose calculation to get a dose distribution. Each leaf opens for a certain amount of angle in each projection. Then we calculate rotations of the dose distribution up to the mean angle of all such angles. The mean of rotations of the dose distribution is the proposed rotational smooth of the dose distribution.
Results: We compared dose calculation using 51 projections as in standard TomoTherapy^{SM} planning with and without rotation smooth against supersampling (459) of projections for a 2D disc of radius 20 cm with a tumor of radius 5 cm at the center. The result of dose calculation for 51 projections without rotation smooth showed star-shaped artifact at distance far away from the center, while the result with rotation smooth is much closer to the super-sampled case.
Conclusions: Simulation demonstrated the effectiveness of the proposed approach. Rotational smooth improves geometric accuracy for arc therapy dose calculation. This technique may be used for rotational delivery modalities, so that the geometric correction can be applied without increasing the complexity to reduce the artifact due to finite sampling in rotation angles.