On the Effectiveness and Robustness of Varian's Photon Optimizer's Auto-Feathering Feature

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JULY 12–16 2020 VIRTUAL JOINT AAPM | COMP MEETING
EASTERN TIME [GMT-4]

INTRODUCTION

The autofeathering feature included in Varian's Photon Optimizer 15.6 algorithm offers a unique method of matching photon fields. It is potentially simpler to plan than conventional moving junction techniques and could be utilized in cases such as craniospinal treatments and large field IMRT/VMAT plans. Here we evaluate the effectiveness of the algorithm in generating clinically acceptable plans and tolerance to setup error.

AIM

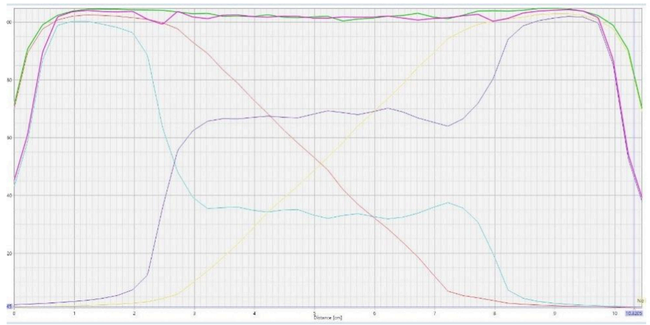
To evaluate the efficacy and robustness to setup error of Varian's Photon Optimizer (PO) 15.6 algorithm's auto-feathering feature and determine suitable multi-isocenter RapidArc clinical use cases.

METHODS

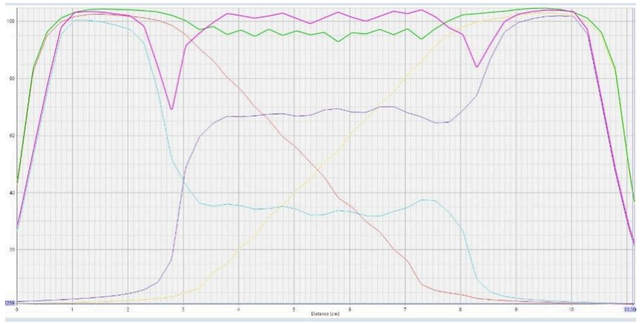
A phantom study, anal and craniospinal cases were selected to evaluate the autofeathering feature of the photon optimizer algorithm. For each case plans were created with the autofeathering feature enabled and disabled. The effect of setup errors was simulated by shifting the isocenters closer or farther apart by 1, 3, or 5 mm and comparing to the original plan. Plans with the same isocenter shifts but with autofeathering toggled were compared in order to contrast differences in the overlap region. The autofeathering feature creates a smooth gradient between the overlap boundaries of each field. The larger this region the shallower the gradient and the more robust against subsequent setup errors.

RESULTS

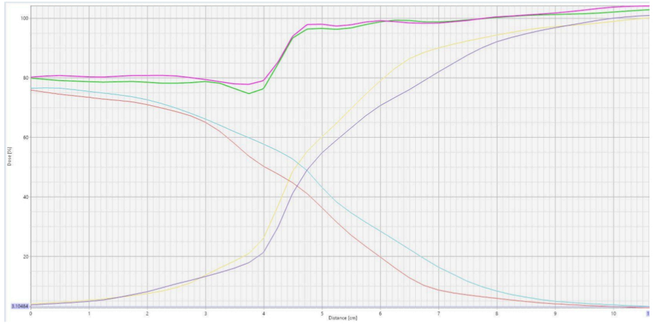
Examination of the resulting plans demonstrated the importance of the size of the overlap region. A conceptual analysis of gradients in the overlap region demonstrates that in order for 5 mm of setup error to result in less than a 10% change in dose a 5cm overlap is necessary. For simpler geometries such as the cylindrical phantom or craniospinal examples with less dose heterogeneity the dose variation remained within expected values. For the complex anal case where a multi-isocenter setup may be desired, dose variation fell outside of the expected range and was similar with feathering on and off.



Dose profiles in the junction region between two isocenter RapidArc plans in a simple geometry, one plan with auto-feathering turned on (Feath) and the other with autofeathering turned off (No Feath). Notice the smooth gradient produced by the autofeathering feature.



Dose profiles in the junction region between two isocenter RapidArc plans in a simple geometry, incorporating a simulated 3mm shift apart. Notice the improved robustness of the autofeathered plan against the cold spots exhibited without feathering enabled.



Dose profiles in the junction region between two isocenter RapidArc plans in a complex anal treatment geometry, incorporating a simulated 3mm shift apart. Notice the minimal differences in profiles with feathering on and off.

CONCLUSIONS

The Photon Optimizer 15.6 algorithm's autofeathering feature can be an effective tool for multi-isocenter setups with attention to the size of the overlap region. For 5mm setup errors to result in a 10% dose variation an overlap of 5 cm is necessary. The autofeathering feature is less effective in highly complex cases than in simpler geometries such as craniospinal cases.

ACKNOWLEDGEMENTS

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