AbstractID: 3361 Title: Autostereoscopic display of the 3D dose distribution to assess beam placement for robotic radiosurgery

Purpose: To study whether a 3D view of the dose distribution and treatment beams on an autostereoscopic display facilitates a 'smart' placement of additional beams for robotic radiosurgery.

Method and Materials: Treatment plans for robotic radiosurgery with the CyberKnife system (Accuray Inc., Sunnyvale) consist of a large number of non-isocentrical, cylindrical beams directed towards arbitrary points within the target volume. We implemented a tool to visualize the resulting 3D dose distribution and the beam directions using the visualization toolkit (VTK). A hypsometric color scheme allows to identify cold and hot spots in the target volume, i.e. regions where the dose is close to the lower or upper bound specified for the target. Given this information we manually added a 20 beams to an existing treatment plan with 1200 beams for an intracranial tumor. The beams where placed such that a large number of cold voxels were hit but hot voxels were avoided.
To assess the spatial extent of the cold and hot regions and the orientation of the beams an autostereoscopic display (SeeReal Technologies GmbH, Dresden) was used. An inverse planning algorithm similar to the one used by the CyberKnife system was implemented to re-optimize the plan, the result was compared to the original plan.

Results: The original plan consisted of 119 weighted beams with an accumulated weight of 21763.3 MU. Adding 20 beams we obtained a plan with 123 beams with the total weight reduced to 21610.7 MU. All 20 new beams got the maximum weight of 250 MU per beam, i.e. other, less efficient beams were discarded by the optimizer.

Conclusion: The visualization tool proved to be useful in the guidance of beam placement. A direction of additional beams towards cold spots in the target volume can improve the plan quality.