AbstractID: 10935 Title: An online replanning technique with deformation-based aperture morphing and weight optimization

Purpose:We have previously proposed a fast online replanning method using contour-based segment aperture morphing (SAM) and segment weight optimization (SWO), that was shown to be effective in correcting interfractional variations. Here we propose to enhance the replanning method by developing new SAM algorithm using deformation field.

Methods :A new software tool was developed to incorporate the full 3D deformation field between the planning and daily CTs to morph the planed apertures based on the daily CT. The previously reported deformable registration algorithm based on a fast symmetric Demons method with the use of masks was utilized to generate the deformation vector field. The vector field was used to generate daily contours and to morph aperture shapes. The SWO was applied to further improve the dosimetry for the morphed apertures. The resulting doses were compared with those obtained with the full-scope reoptimization (the golden standard), rigid-body-registration based repositioning (the current IGRT practice), and the previous contour-based SAM. The new deformation-based SAM and SWO process was tested for selected prostate cases with large daily organ deformation.

Results :The deformable image registration took 1 minute, and the entire deformation-based SAM and SWO process was completed within 5 minutes. The plans generated by the new deformation-based SAM were considerably better than those from the repositioning, and were comparable to the contour-based SAM. SWO further improved the plan quality, resulting in the final plans that are comparable to the full-blown reoptimization plan.

Conclusion: An algorithm using deformation field for aperture morphing was successfully developed and tested. The replanning process including the new algorithm is effective and can be completed within a reasonable timeframe (5-10 minutes) for practical implementation. The new replanning process can be fully automated and can effectively correct for interfraction errors, even for complex cases with multiple targets and overlapping critical structures.