AbstractID: 8448 Title: A novel registration tool of large deformations for adaptive radiation therapy

Purpose: Available deformable registration methods are often inaccurate for large deformations encountered, for example, for the rectum and bladder. The purpose of this work is to develop a novel approach to accurately and effectively register large deformations for adaptive radiation therapy.

Method and Materials: A software tool combining a fast symmetric Demons algorithm and the use of masks was developed using ITK to register CT images acquired from planning and treatment fractions. A multi-resolution deformation is implemented to improve speed. In cases of large (<70% Dice's coefficient (DC), defined as overlap divided by average volume) organ discrepancies, masks are used to guide the deformation and concentrate the registration on the organs of interest. The tool was tested for deformations of prostate, bladder and rectum and used to calculate accumulated dose for multiple prostate treatment fractions. The bladder and rectum volume were masked with a uniform intensity of -1000 and 1000 Hounsfield number respectively in both the planning and treatment images. Calculation of the overlap of these organs is facilitated by the masks. The masks can be manually or automatically generated.

Results: The deformable registration tool is able to accurately register organs over different days with organ overlaps as low as 36% DC. The overlap of the original and deformed contours reaches 97% DC. Repeated registration with the lowest image resolution can further increase the overlap to 99%. Registration of 512x512x100 resolution images took 6-10 minutes depending on the degree of disagreement. The prostate and seminal vesicles were correctly placed even though they are not masked. The cumulative doses for fractions with large deformation were computed and verified.

Conclusion: The tool developed can accurately register large deformations and can be effectively used for adaptive planning to correct for interfractional changes.