Purpose:4D dose mapping accuracy is limited by the accuracy of the displacement vector fields (DVF) generated by deformable image registration (DIR) algorithms. DIRs depend on user adjustable parameters whose election may result in different resulting DVFs. This work evaluates the clinical impact of DIR parameter selection on 4D accumulated doses.

Methods:A 180 cGy/fraction PTV dose clinical treatment plan is generated, with dose calculated on each phase of a ten-phase 4D lung CT image. Per-phase doses are mapped to a reference phase using DVFs from the demons DIR implemented in a research version of Pinnacle 9.1 for dose accumulation using a variety of settings for DIR user-adjustable parameters. Dose-volume histograms, TCP, and NTCP values are evaluated for each accumulated dose as are differences in accumulated dose values.

Results:Cumulative dose values vary with the user adjustable parameters. The maximum dose difference is 62.5 cGy/fraction when the number of image filter histogram bins changes from 32 to 16 and 14.9 cGy/fraction when the number of level 4 iterations (where the image is downsampled to 1/8 of the original resolution) changes from 50 to 10. Dose variance tends to be in specific locations that accumulate most differences. These regions are suspect for dose accumulation errors. Despite the dose differences found, DVHs, TCP, and NTCP values varied little, indicating minimal clinical impact of DIR parameters.

Conclusions:Accumulated dose variations due to DIR parameter selection occur in limited regions of an image. Such variation can be used to estimate the precision of 4D dose. Although minimal clinical impact is found for the case presented, additional study with more patients and different planning features are required prior to establishing global conclusions.

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