AbstractID: 8853 Title: Four dimensional inverse planning for intensity modulated radiation therapy

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Four dimensional inverse planning for intensity modulated radiation therapy

Purpose: This work develops 4D inverse planning methods and demonstrates the potential benefit of 4D IMRT.

Method and materials: Two 4D planning strategies are proposed and compared. The first one treats all respiration phases as a system and optimizes the dose delivery collectively in space and phase. The method is referred to as *collective optimization of all phases (COAP).* In this approach, a deformable model is employed to establish a voxel-to-voxel correspondence and the goal is to maximize the accumulative dose to the tumor target while minimizing the dose to the organ-at-risk (OARs). The second one treats each phase as an independent 3D inverse planning problem and optimizes them separately. The final dose distribution is obtained by summing the dose of each phase after a deformable image registration. This method is called *separate optimization of each phase (SOEP).* In both approaches, the dose is optimized with a linear programming technique.

Results: The resultant dose distribution of COAP is markedly better than that of SOEP in both target dose coverage and organ-at-risk sparing. The improvement of COAP is resulted from reallocation of dose among the phases to cater for anatomical changes during the breathing process. It is found that, for a phase with favorable geometry for dose delivery, more doses are allocated by COAP, and *vise versa*. COAP optimally assigns dose for all the involved phases. Because of the lack of this degree of freedom, SOEP yields almost identical intensity maps and dose distributions for all the phases.

Conclusions: Simultaneous spatio-temporal dose optimization in 4D inverse planning allows one to take consideration of the spatial variation of the patient anatomy caused by respiration and yields the optimal accumulative dose distribution.