

AbstractID: 2890 Title: Robustness of two 4D radiotherapy approaches with respect to temporal irregularity in organ motion

**Purpose:** Respiratory motion of cancer patients during radiotherapy often lacks spatial and temporal regularity. Delays between motion monitoring and radiation adjustment in motion tracking treatment can cause large deviations between the delivered and the intended dosimetry. We demonstrate the advantage of a motion-pattern-based 4D approach we developed previously with regard to organ motion temporal variation for lung cancer radiotherapy.

**Method and Materials:** A 4D CT image set of a lung cancer patient and a moving phantom were studied using 4D treatment planning in the in-house TPS PLUNC, with and without the 4D optimization that is based on *large-deformation diffeomorphic registration* and *index-dose gradient optimization* algorithms. 4D dosimetry refers to the cumulative dose received by anatomical structures in patients with deformable organ motion. The 4D optimization generates static IMRT plans that can be delivered via compensators. The 4D IMRT treatment is compared with non-IMRT motion tracking treatment, with and without tracking delay, for robustness against temporal motion pattern irregularity. The same beam setup, field margin, and dosimetric goal were used by all the plans in the comparison.

**Results:** The perfect motion tracking technique gave the best CTV 4D DVH. The 4D IMRT performed better than the motion tracking treatment with systematic delays of 0.5 second or larger (motion cycle is 4 seconds). The 4D IMRT yielded better sparing of lung tissue and heart than all the non-IMRT motion tracking treatments. Results on EUD are also presented.

**Conclusion:** The motion-pattern-based 4D IMRT has the advantages of treatment delivery simplicity and robustness with respect to organ motion temporal irregularity. Compared to non-IMRT motion tracking, it gives better 4D dosimetry for the moving tumor, lung, and heart in treatments of small-size and large-motion lung tumors having irregular temporal motion pattern.

**Conflict of interest:** Research is partially supported by Siemens.