

MLL-KOLLOQUIUM

Donnerstag, 19.01.2017, 16¹⁵ Uhr

Hörsaal der LMU in Garching, Am Coulombwall 1
Treffen zum gemeinsamen Kaffee 16 Uhr

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The promise of the MRI linac: simultaneous MRI and irradiation

Image guidance during radiotherapy is widely applied in the current clinic. Prior to treatment a variety of imaging modalities is used to localize and characterize the tumour and the surrounding organs at risk. These data are used to optimize the treatment plan, i.e. optimize the radiation dose delivery. Still, during the course of radiotherapy many sources of geometrical uncertainties exist, leading to treatment margins and with that to unwanted involvement of healthy tissues in the targetted volume. By integrating 1.5 T MRI functionality with a radiotherapy linear accelerator (linac), the anatomy can be visualized during irradiation and thus decreasing the geometrical uncertainties and improve the targetting.

Together with Elekta (Stockholm, Sweden) and Philips (Best, The Netherlands) a 1.5 T MRI system is integrated with a 7.2 MV linac. The active shielding of the MRI as well as the layout of the linac is modified to mitigate the magnetic interference. A dedicated cage of Faraday was designed to mitigate the RF interference and a beam window in the MRI was created to allow beam passage. In parallel with the hardware developments a pipeline for daily online and ultimately real-time plan adaptation has been set-up. This enables to adapt the plan as soon as an anatomical change is detected. The pipeline can re-optimize the treatment plan for the latest state of the anatomy while taken into account the dose delivered so far. This loop can be run daily but also on an intra-fraction time scale. Currently the fourth MR linac is installed in Utrecht, this is the pre-clinical MR linac that will be introduced in the clinic. Currently the system is being accepted and commissioned for clinical introduction. The adaptive treatment pipeline has been shown to converge for regular clinical plans. Also for changing anatomies over the course of days and for changes during a single fraction the dose distribution converges to a clinically acceptable dose distribution. Currently the loop is fast enough, in the order minutes, for daily plan adaptation. We are working on speed optimization for the intra-fraction applications. In summary, the 1.5 T MRI linac is operational in a research setting and work on the clinical introduction is ongoing. The advent of on-line MRI directly from the treatment table enables true on-line adaptive radiotherapy.

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