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Garchinger Maier-Leibnitz-Kolloquium

Donnerstag, 14.12.2023, 16^{15} Uhr

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

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Ion imaging in adaptive radiation therapy: from model-based to data-driven approaches

Although the current clinical workflow in ion beam therapy is based on X-ray imaging, the native imaging technique for ion beam therapy is ion imaging. Ion imaging potentially enables direct assessment of the tissue stopping power and also its variations due to intra- and inter-fractional anatomical changes. For this reason, the role of ion imaging in ion beam therapy can be relevant to the entire adaptive radiation therapy workflow (i.e., treatment planning and treatment adaptation). A realistic way towards clinical integration of ion imaging in ion beam therapy has been envisioned as a combination of few ion radiographies, likely acquired by means of compact detector configurations, with the treatment planning X-ray tomography.
The talk introduces the scientific context of ion imaging in ion beam therapy, with reference to different configurations of prototype detectors designed for experimental ion imaging acquisitions. Fundamentals of conventional model-based approaches in ion imaging are introduced, with emphasis on tomographic image reconstruction and deformable image registration. The tailoring of these approaches to realistic scenarios of sparse ion radiographies is explained. Supported by dedicated studies, the rationale for moving beyond model-based approaches to emerging data-driven approaches is presented. Focus is given to the emerging concept of physics-informed neural networks, with particular reference to 'deep unrolling algorithms' for interpretable deep learning. The common thread from model-based to data-driven is then traced within the entire adaptive radiation therapy workflow. A vision of the roads, projects and collaborations ahead is finally illustrated.

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