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Entwicklung eines Softwaresystems und neuer Evaluierungsmethoden für quantitative Auswertung der Strahlentherapie

Development of a Software System and New Evaluation Methods for Quantitative Analysis of Radiotherapy

Promotionsfach: DKFZ

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Modern computer techniques have the potential to improve the success of radiotherapy considerably. However, more and more 3D information makes the assessment and comparison of radiotherapy plans more complex. A number of methods and algorithms were developed in literature to support the quantitative analysis of radiotherapy, including dosimetric analysis such as DVH and radiobiological analysis such as TCP/NTCP models. Commercial treatment planning systems support only some of the methods and algorithms; while other software tools provide some other useful features. Such tools should not only provide powerful analysis functionalities, but also enable easy data exchange with planning systems as well as flexible integration into planning systems. .

The purpose of the work was to develop new evaluation methods as well as the design and implementation of software solutions to support quantitative analysis of radiotherapy parameters. For this, also a new method was developed to evaluate and visualize the uncertainty of the prediction of radiobiological models. The application of this method in clinical workflow shows that it enables the clinician to assess the uncertainty of predicted TCP- or NTCP-values due to inter-individual radiosensitivity variation.

Important requirements and design considerations for a radiotherapy analysis tool were discussed and presented in this work. An overview of existing software tools supporting radiotherapy analysis was performed. These tools were checked against the presented requirements. However, none of them could meet all of our demands. Thus, several software solutions were designed and implemented in this work, including the software library RTToolbox, a visualization wrapper to the software MeVisLab and the integration of the RTToolbox in the large scale platform RONDO. The software solutions developed in this work can meet not only the functional requirements, but also the conceptional requirements such as reusability, flexibility and extensibility. They not only support comprehensive plan review and comparison using a number of dosimetric and radiobiological methods,

but also facilitate easy data exchange between different systems and enable flexible model extension and integration for various use cases. These benefits were tested by different applications in medical workflow.