Minisymposium on Optimization in Cancer Treatment

March 31, room T-50A, Tias building, Tilburg University

10:00 Prof. dr. Ben Heijmen, Erasmus MC:

"On the clinical importance of optimization of radiotherapy plans"

Clearly, current interactive, 'manual' optimization of treatment plans has distinct limitations, including variability in plan quality, plan quality that is dependent on the planner and allotted time, large workload, and restrictions for an efficient and patient-friendly workflow. Fully automated treatment planning can overcome these hurdles. Automated plan generation can also be used as a tool to stimulate standardization in care, provide high level QA of clinical studies, and for unbiased treatment technique comparisons, e.g. to select patients for expensive treatment techniques such as proton therapy. An overview of the features of automated planning will be provided.

10:30 dr. Marleen Keijzer, TU Delft

"Delft mathematics students at the Erasmus MC"

In recent years a series of Delft mathematics students have done their BSc, MSc and PhD research projects in radiotherapy planning. The projects were a collaboration of the Delft Institute of Applied Mathematics and the Erasmus MC Cancer Institute. The students have worked on different aspects of radiotherapy planning, in particular on the Lexicographic Reference Point Method. In this talk, one of their supervisors gives an overview of the results of the different projects.

11:00 Koos van Amerongen, BSc, master student at Tilburg university

"Fast approximate fluence map delivery for VMAT: algorithms using variable dose rate and non-unidirectional leaf trajectories"

Methods for optimizing the dynamic delivery of fluence maps typically fix the dose rate at its maximum level and use the leaves of the MLC to modulate the field. These methods achieve perfect fluence map replication but often require higher than necessary treatment time. By allowing for variable dose rates and non-unidirectional leaf trajectories, the treatment time can often be reduced. We examine the trade-off between treatment time and treatment plan quality. For a given fluence map and treatment time, the optimization of MLC leaf trajectories and dose rate, to form the given fluence map, is a non-convex optimization problem. Recently, Craft & Balvert (2016) modeled the leaf trajectory and dose rate optimization problem as a non-convex continuous optimization problem and solved it by an interior point method from randomly initialized feasible starting solution. To improve on the computation time of their approach, we introduce algorithms that generate constructive starting solutions.

11:15 Stefan ten Eikelder, BSc, master student at Tilburg university

"The optimal fractionation problem for combined photon-proton treatments"

The project extends the optimal fractionation problem from single modality to combined modality, based on the Biological Effective Dose (BED) model. The resulting mathematical formulation of the problem is non-convex. We introduce an algorithm that solves the problem and is able to take into

account max point dose, mean dose and DVH constraints. Results indicate that for a significant portion of patients the optimal solution uses both proton and photon fractions, so combined modality treatment plans may provide an interesting alternative to plans using proton fractions only.

11:30 dr. David Craft, Massachusetts General Hospital/Harvard Medical School

"Machine learning for the drug-cell line sensitivity prediction problem"

Abstract: We discuss machine learning algorithms that are appropriate for solving the problem of predicting the effect of a drug or radiation on a cell line. We investigate problems of noisy data, various approaches to multi-task learning, and the incorporation of prior biological knowledge into the machine learning algorithms, including the case of biologically relevant kernel design. Results are described for simulated datasets and for the data at cancerrxgene.org.

12:00 Lunch

14:00 Public defense Marleen Balvert, dissertation "Improving the quality, efficiency and robustness of radiation therapy planning and delivery through mathematical optimization", in the Auditorium of Tilburg University.