

From low-rank to hero?

Optimization of radiotherapeutic plans using dynamical low-rank algorithms for dose calculation

Target group

B.Sc./M.Sc. Mathematics

Description of the topic

Radiation therapy (RT) is one of the most common treatments for cancer. It applies high-energetic, ionizing radiation to control cancerous tissue while sparing healthy tissue. Planning an RT treatment involves a multi-step process, ranging from initial patient imaging and segmentation to dose calculation, optimization and evaluation, to quality assessment and actual treatment.

This project aims to investigate the application of dynamical low-rank algorithms (DLRA) for dose calculation. DLRA is a numerical method that evolves the solution of a time-dependent PDE on a low rank manifold, thereby, reducing the computational costs and memory requirements of the approximation. You will perform dose calculation and optimization for different RT benchmark cases (CShape, head-and-neck, ...), and quantitatively analyze the effects of DLRA on the optimization results, compared to classical dose calculation methods, e.g. Monte Carlo or pencil-beam algorithms. In addition to the written thesis, you will also be able to integrate your work within existing software packages and thereby contribute to future research.

Helpful prerequisites

Helpful prerequisites for working on this topic:

- Interest in interdisciplinary work at the intersection of mathematics, computer science, and radiation therapy
- Basic knowledge of optimization theory, numerical analysis, differential calculus
- Programming experience in Python and Julia (optionally: Matlab)

Exemplary questions (current or new)

- How does DLRA differ from classical dose calculation methods?
- What are the advantages/disadvantages of using DLRA in RT optimization?

Contact

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