Systems and methods for learning and accumulating optimal strategies for radiation treatment planning

Unmet Need

Cancer is a leading cause of death worldwide, with almost 10 million deaths and over 19 million new cases in 2020. These numbers are expected to grow, with 28 million new cases estimated to be diagnosed in 2040. Some of the most effective therapies for cancer are based around beams of radiation applied by an external source, such as intensity-modulated radiation therapy (IMRT) and stereotactic body radiation therapy (SBRT). External radiation therapy is an almost $6B a year market, which is expected to grow at a CAGR of about 6.3% to almost $8B by 2023. However, these types of radiation treatments have to be planned for each individual patient so that the beams deliver the maximum dose to the planning target volume (PTV) while sparing nearby healthy tissue and organs at risk (OAR), a time-consuming process managed by a team of clinical professionals. Software solutions are becoming more common, but these systems often only work on patient case data that closely matches the training case dataset, and outliers cannot be effectively processed. There is a need for software techniques that will learn to accommodate complex outlier cases.

Technology

Duke inventors and colleagues have developed software systems and methods for generating radiation treatment plans for complex outlier cases. When case input data does not match with an existing model in use, this technology uses reinforcement learning based on preferred user parameters that mimics a human planner's iterative inverse optimization to generate a radiation treatment plan. This technology is starting clinical testing for pancreatic cancer treatment planning

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Publication(s)

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External Link(s)

• From the lab of Dr. Jackie Wu

and has been shown to produce pancreas SBRT plans with optimization of maximum PTV dosing and OAR sparing comparable to human-designed plans.

Advantages

- Software can be used on complex outlier cases that other software solutions cannot effectively evaluate
- Faster plan design, on the order of several minutes compared to several hours, allowing for more approaches to be analyzed more efficiently
- Technique can be integrated into other software to supplement existing models and create a one-stop, fully-automated approach
- Reinforcement learning approach delivers reproducible plans in a style more familiar and understandable to clinical professionals than black box machine learning approaches