# Methods for Automatization of Radiotherapy Dosimetry

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### Abstract:

Radiotherapy dosimetry is critical in ensuring the precision and safety of cancer treatments.  The complexity and variability of treatment planning necessitate advanced methodologies for automation and optimization. This thesis introduces novel approaches aimed at automating the radiotherapy dosimetry process.

The research begins with developing a dosimetry optimizer and comprehensively evaluating existing open-source optimization algorithms for dose optimization. Then, this thesis analyzes the relationships between different treatment plans. This analysis leads to the proposal of a novel framework for multi-objective optimization and robust plan selection using graph theory.

To further reduce the time required for radiotherapy planning, the thesis explores the application of reinforcement learning for dose optimization. The proposed system performs dosimetry for new patients by leveraging dose data from past patients. This fully automated method can adapt to clinical dependencies, reducing the need for manual fine-tuning and easing its adoption in practice.

In addition, the thesis investigates the use of deep learning for dose prediction, proposing a series of models guided by target Dose Volume Histograms (DVH). This guidance facilitates the incorporation of guidelines into the deep-generated doses. Moreover, it allows a single model to be trained instead of one for each clinic.

The contributions of this thesis represent advancements in radiotherapy dosimetry, paving the way for the development of a fully automated, clinically dependent treatment planning system designed to operate with minimal human intervention. These innovations could enhance clinical workflows and improve patient outcomes, making radiotherapy more efficient and effective.

### Contributions:

#### ArXiV: Radiotherapy Dosimetry: A Review on Open-Source Optimizer

#### ESTRO: A Novel Framework for Multi-Objective Optimization and Robust Plan Selection Using Graph Theory

#### SFPM: Dose Volume Histograms Guided Deep Dose Predictions

#### AIME: Radiotherapy Dose Optimization via Clinical Knowledge Based Reinforcement Learning (full paper coming soon)

#### ASTRO: Clinically Dependent Fully Automatic Treatment Planning System

#### SFRO: Attention Mechanism on Dose-Volume Histograms for Deep Dose Predictions