

Computational assignment 1

due on September 29 2025

Introduction

The coursework within this class aims at implementing the major components of a treatment planning system for radiotherapy. This primarily amounts to:

- A pencil beam dose calculation algorithm
- An optimization method to generate a treatment plan for intensity modulated radiotherapy

In order to simplify the implementation, our treatment planning system will be two-dimensional only, i.e. we will work with only one slice of the patient instead of the whole 3D volume. Apart from this simplification, our treatment planning system will be relatively realistic. It will be based on a realistic patient geometry (i.e. a CT image) and dosimetric data that could equally be the input to a real treatment planning system. We will use Python as a common platform.

Provided is a Matlab structure called TPlan (for ‘Treatment Plan’) with the following fields:

- ct - one slice of the CT of a patient with a tumor surrounding the spinal cord
- voi - containing the volumes of interest, ie. a segmentation of the patient into different organs
- voinames - the names of the organs contained in voi
- voxelsize - the size of one image pixel in mm

The coding of the voi field is as follows:

0: everything outside of the patient
1: everything inside the patient that is not assigned to a particular organ
2: right lung
3: left lung
4: spinal cord
5: esophagus
6: tumor

The provided Python file `mat_loader.py` contains functions for loading the MATLAB structure into a dictionary.

Assignment 1

Write a function that displays the CT image together with the contour of the tumor, the spinal cord, and the esophagus.

Hint: You can use the function `imshow` to display the CT image and `contour` to display the organs. Both functions are available in the Matplotlib library.