

# MSc project – Multi-label DL contouring for prostate, rectum and bladder

## The problem

In MRI-guided radiotherapy a new optimal dose plan is created for every radiation treatment of the patient. To make such a plan, currently the radiation oncologist delineates the targets and organs at risk for every treatment. This is a time consuming process that takes up to a quarter of the time that the patient is on the treatment table. By use of deep learning (DL) we want to automate and accelerate this delineation process to increase patient comfort and make the workflow more efficient.

## Current practices/research

DL segmentation is an evolving field in radiotherapy. However, most of it is focused on segmentation based on CT imaging or 1.5T MR imaging, whereas for the MRIdian MR-linac segmentation based on 0.35T MR imaging is needed (see: <https://viewray.com/mridian/discover-mridian/>). For this purpose already a DL model has been created to delineate the prostate. However, no DL segmentation is available for the rectum and the bladder.

## The desired solution

A deep learning based multi-label model that creates delineations for prostate, rectum and bladder on 0.35T MRI data is needed to speed up the workflow. Preferably the model indicates a confidence value for each edge/voxel that it is pertaining to a certain structure (for example by a color-coded display).

## About the MSc project

The goal of this MSc project is to extend, train and evaluate the existing DL model for the prostate to a multi-label model that generates, apart from prostate contours, rectum and bladder contours for the MRIdian MR-linac. It concerns a Biomedical Engineering (BME) project (60 ECT, 10 months full-time) at the Catharina Hospital Eindhoven supervised by dr. Hanneke Bluemink and dr. Coen Hurkmans. The project can be started as from April 2023.

## Datasets

For 85 patients a TRUFI MR sequence on the MRIdian MR-linac with delineation for a radiotherapist of the prostate, bladder and rectum is available. This dataset can be used to train the multi-label model. 61 of these patients have already been anonymized and used to train an Attention U-net model to segment the prostate.

## Evaluation

Evaluation of the model is to be performed based on overlap, distance and volumetric measures. The segmentations predicted by the model should be compared to the delineation of the radiation oncologist.

## Reporting

A final report will be written in the form of a scientific article, using the IEEE scientific journal template. Potentially, an abstract about the performed research can be submitted to a scientific conference, and an adapted version of the final report can later on be offered for publication to a scientific journal.

## Final presentation & defense

The MSc project is concluded with a 25-min presentation and a 45-min defense session.

## Expected skills and experience

- Programming in Python, other languages (e.g. course BMB502417)
- Machine learning / deep learning (e.g. courses 8DM40, 8DM00)
- Medical image analysis (e.g. courses 8DC00, 2DMM10)
- Experimental study design (course 8DM20)
- Written and oral communication in English and Dutch
- Good social skills

## Contact

Are you interest in this project? Do you want more information?

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