

M.Sc. project in Medical Physics

## Exploring artefacts in 4D-CT acquisition

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### The department

Radiotherapy uses ionizing radiation to irradiate tumor tissue to a high dose while sparing the surrounding normal healthy tissue as much as possible. The cluster radiotherapy of the Antoni van Leeuwenhoek hospital uses the most modern techniques to irradiate its patients.

### The project

Prior to actual delivery of radiation dose, treatments are simulated on tumour and surrounding tissues delineated on a CT scan of the patient. At this stage, the process of dose delivery to tumour and surrounding tissues is optimized regarding steering parameters of the radiation machine, i.e. beam weights, angles and apertures. In order to take into account motion in the thorax due to breathing, respiration-correlated 4D-CT scanning is applied. By simultaneously acquiring overlapping images of the patient and registering the breathing signal of the patient, a movie of the breathing patient can be reconstructed. This 4D-CT scan is then post-processed to calculate the time-averaged position of the tumour. At the Antoni van Leeuwenhoek we have about 10 years of experience with this technique which was partially developed in-house.

Irregularities in the breathing pattern can lead to non-trivial artefacts in such a 4D-CT. For example, a patient holding its breath slightly longer in between two breaths might lead to a misalignment of the images in the breathing-cycle. Artefacts like this introduce an uncertainty in the exact tumour position and thus lead to a less precise treatment.

The aim of this project is to properly understand several types of artefacts that can occur and understand their impact on treatment. To achieve this, we shall simulate, based upon a simple geometrical model the effect of different breathing irregularities on 4D-CT scans. Based upon these simulations and experiments, guidelines will be developed to describe the change in accuracy of treatment if a certain artefact occurs.

In this project, you will design and develop simulations of 4D-CT-scanning of a simple geometric object and therewith study the effect of breathing irregularities. You will perform experiments on the CT scanner to verify the simulations. Apart from the experience of the project itself, you will have the opportunity to experience daily practice at a medical physics department with a strong focus on research and innovation.

### Interested?

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