**MSc project in Medical Physics:**

# Dosimetric comparison of interfraction variations in MR-guided adaptive cervix cancer brachytherapy, using a manual vs. an AI-based automatic image registration approach

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The Department of Radiation Oncology at the Medical University of Vienna welcomes applications for a master project in medical physics starting from February 2021 (a.s.a.p.)
The project will be carried out in the framework of FWF project KLI965-B33.

## Motivation:

Cervix cancer brachytherapy is typically delivered in a 3-4 fraction schedule, with the option to deliver one plan multiple times, if the relative position between implant and target volume remains stable and organs at risk (OAR) volumes and locations are similar over time. Detailed MRI-based dosimetric evaluation of a changed implant and organ configuration in an online-mode is not feasible, as there are no quick solutions for transferring an existing treatment plan to a new MR scan implanted in commercial treatment planning systems (TPS). An option to perform a landmark-based image-registration between MRI from different time-points exists, but is not suitable for a fast online dosimetry check just before irradiation. Therefore, in-house tools for automating this process are being developed and include a fully automatic AI-based rigid image-registration algorithm.

Our research hypothesis is: Automated applicator-based image registration can be used for dose-assessment for fractionated HDR brachytherapy, with dosimetric differences compared to a manual approach being <5%.

## Work description:

The goal of this MSc project is to analyze the dosimetric differences between the manual TPS-based and the automatic AI-based registration methods for at least 10 patients. The following steps will be the focus of the project:

- Manual placement of applicators in control MRI of at least 10 patients (test cohort) using a commercial TPS
- Landmark-based image registration of planning and control MRI and reporting of interfraction dose variations for OARs
- Data preparation for automated handling of MR images and OAR structures extracted from the TPS
- Automatic applicator-based registration of MR images with in-house AI-based algorithm
- Development of a MICE (2020 NONPI Medical AB) script to
    - transfer and adapt OAR structures from planning MRI to control MRI
    - propagate dose distribution to control MRI and report interfraction DVH variations between MRI
- Statistical comparison of the “manual” vs. automated workflow
- Depending on the experience and progress of the student with creating the manual control dataset, autocontouring of organs at risk for the automatic workflow could be included in the analysis

## Qualifications:

- Student of physics, Biomedical Engineering or similar technical studies with basic understanding of medical imaging
- Fluent in English (oral and written)
- preferably programming experience in python
- Knowledge of image processing and machine learning libraries, such as ITK and PyTorch would be beneficial but not required

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