# PhD Thesis

## MRI post-processing for Radiotherapy and online MRI guided treatment planning

Division of Medical Radiation Physics, Department of Radiotherapy

Medical Univ. Vienna / AKH Wien;

**Supervisor:** Univ-Prof. Dr. Dietmar Georg (Medical University of Vienna)

**Co-Supervisor:** Prof. Dr. Tufve Nyholm (University of Umeå)

### Motivation for the project

In today's radiation therapy, image guidance became a crucial part for precision radiotherapy. Moreover, it is the prerequisite for adaptive treatment concepts and approaches, respectively. Most commonly these imaging methods are X-ray based, but magnetic resonance imaging (MRI) as a non-invasive imaging technology is rapidly emerging and entering clinical practice. At present here is no consensus on how an MR Scanner is ideally integrated and adopted for external beam radiotherapy.

Several challenges still need to be addressed when aiming for an MRI-only based workflow. For example, obtaining CT equivalent information from MR images for dose calculation, such as electron density for photon therapy or stopping power data for proton therapy, or the use of MR data for position verification at the treatment unit equipped with X-ray imagers are important pre-requisites for MR guided radiotherapy.

While working solutions or prototypes for MR guided photon beam therapy do exist, MR-guided proton beam therapy is still in its infancy. From a theoretical point of view MR-guidance can be considers as being more important for protons than photons, as particles are more sensitive to anatomical variations. So far, only a very limited number of scientific publications and working groups explored MR guided proton beam therapy. There are basic questions that need to be addressed, such as the optimal field strength for MR based anatomic image guidance, or the optimal use of MR images for patient positioning, plan adaption and dose calculation as the charged proton beam will undergo deflections by the magnetic field.

### Aim and concept of the PhD thesis

Develop and establishing a workflow for MR guided photon beam therapy as well as for proton therapy. Ideally in treatment planning for photon therapy and proton therapy is based on MR data sets without additional CT information. This implies MR imaging information is converted into synthetic CT for treatment planning purposes. For photon beam therapy such concepts have been investigated mainly for prostate cancer. In the frame of this PhD thesis such methods need to be extended toward cervical cancer, head as well as head-and-neck cancer patients. Finally, it is aimed to derive and validate methods to convert MR information into synthetic stopping power as the basis for MR guided proton. Next proton therapy workflow concepts for on-line and off-line adaptive radiotherapy shall be explored.

### About the Working Environment

The PhD thesis will be conducted at the Department of Radiation Therapy at the MedUni Vienna in the framework of the third party founded "MAGIG-PRO" project under the supervision of Prof. Dietmar Georg. MR scanners wit field strength between 0.35 T and 3T can be utilized, as well as dual energy CT for research on conversion of MR imaging into

synthetic CT. The Department of Radiation Therapy is highly involved in the non-clinical research at the MedAustron ion beam therapy facility, where a dedicated research room is available. A magnet for principle investigations will be available from 2018 at MedAustron. The work will be in cooperation with the University of Umea as well as the company Spectronics (CEO Carl Siversson). Prof. Tufve Nyholm will act as co-supervisor of this PhD thesis.

**Duration** 3 years, the position is open from 07/2017

**Qualification**

- Master in Physics or Biomedical Engineering or similar
- Programming skills
- Experience in MR imaging

**Contact**

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