MASTER THESIS PROJECT in the Prof. COAN's LMU GROUP

'Brilliant X-Rays for Medical Diagnostics'

within the Research Training Group / Graduiertenkolleg GRK 2274

"Advanced Medical Physics for Image-Guided Cancer Therapy"

Our group at the LMU Chair of Medical Physics in Garching (LS Parodi) is working on biomedical applications of X-ray phase contrast CT, and is looking for a highly motivated **MASTER STUDENT** to work with us.

Project Title: "Characterization of the effects of novel radiotherapies for glioblastoma on an animal model by multi-scale X-ray Phase Contrast micro-CT"

Scientific Case: Glioblastomas (GBM) are malignant gliomas and are among the most frequent primary brain tumours in adults. This type of cancer is very aggressive and locally invasive. Survival of patients affected by GBM has been unchanged over the last decades and remains of 6-12 months after diagnosis. Despite advances in surgery, radio- and chemo-therapy, the prognostic is always negative in high-grade cases. New and more efficient techniques are needed to target tumour cells while sparing surrounding healthy tissue and to increase the limited life span of patients. Microbeam Radiation Therapy (MRT) is a novel radiotherapy technique that uses spatially fractionated and highly collimated parallel arrays of X-ray microbeams. Preclinical studies have demonstrated that MRT can simultaneously provide high levels of healthy-tissue sparing and tumor-treatment efficacy. This unique properties are due to the so-called dose-volume effect and the differential radio-response to beam fractionation of normal vs. tumour tissues, bringing MRT to the front line among innovative radio-therapeutic techniques.

Experiments: Based on published results of a feasibility study by the group, a series of *in-vivo* irradiations were performed on both healthy and tumour-bearing rats. Several irradiation geometries and delivered doses were used to compare new radiotherapy techniques with standard ones. X-ray phase-contrast micro-CT experiments showed the possibility to successfully visualize, at different spatial resolutions (pixel size of 3 µm, 1.63 µm and 0.65 µm), radiation-driven effects on tissues for each irradiation modality. Different radiotherapy effectiveness was also seen in terms of animal survival and variation of the tumour volume (at the age of death) on rats with glioblastoma. A new experimental session is scheduled by the end of 2020: new rat groups, with and without tumour, will be irradiated by MRT and standard broad beam radiotherapy and the treated brains will be analyzed by MRI in vivo and by X-ray phase contrast CT post-mortem considering different sacrifice times in order to longitudinally study the evolution of the effects of the treatments.

Overall Project Objectives: this scientific work aims at developing an efficient, correlative 3D imaging-based approach for the evaluation of the post-treatment effects of radiotherapies on biological tissues. The purpose is to overcome the limitation of standard histopathology, which remains a highly time-consuming, laborious and observer-dependent and only 2D techniques. The outcomes of this research will channel more efficient treatment of the glioblastoma.

Specific Thesis Work Objectives: You will participate in the experimental radiotherapy and imaging sessions at the European Synchrotron Radiation Facility (Grenoble, France – depending on the national and international regulations concerning COVID-19 pandemic management). You will learn how to design and perform MRT irradiation and imaging follow-up experiments and how to reconstruct multi-scale X-ray phase contrast micro-CT datasets. The latter work will include the implementation of effective tools for the corrections of artifacts in CT imaging. You will qualitatively and quantitatively analyze the acquired phase-contrast CT datasets of both healthy and tumour-bearing rat brains. You will compare the results among different irradiation geometries and doses. The comparison will be done e.g. in terms of tumour volume and quantification of microcalcifications at different time points after irradiation. From the reconstructed phase-contrast CT datasets you will learn to produce correct volumetric data and extract meaningful structural parameters by segmentation and 3D visualization. You will learn to critically evaluate your analytic methods and correlate X-ray phase contrast results to data obtained by histology and MRI on the same organs. Your work will play a crucial role within this project, and will be instrumental to the successful publication of our results.

Candidate: Previous knowledge in Phython and/or Matlab could be an asset (but it is not mandatory), and the candidate should be interested in developing new analysis tools for image quantification.

Scientific and academic context: This Master project will profit by the scientific network originated in the framework of the Research Training Group / Graduiertenkolleg GRK 2274 "Advanced Medical Physics for Image-Guided Cancer Therapy" funded by the German Research Foundation (DFG), which is a joint initiative of the Physics and Medical Faculties of the Ludwig-Maximilians-Universität München (LMU) and the Technische Universität München (TUM) as well as the Helmholtzzentrum München. The student will work in a highly motivated and well established team within a multidisciplinary and international network embedded in a stimulating scientific environment with a long tradition of collaboration and excellence in biomedical research, with outstanding research and clinical infrastructures.

Start date: flexible

Please get in contact with us if you are interested in knowing more - we would be happy to hear from you!

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