PhD student in photon counting CT in treatment planning of proton therapy

Project description

This PhD project focuses on the investigation of a new computed tomography (CT) scanner technology, so-called photon counting CT, for the use in treatment planning of proton therapy.

Proton therapy is an advanced treatment form for cancer, which involves irradiating the tumor with high-energy proton beams. To plan the treatment, a CT scan of the patient is acquired, visualizing the internal anatomy of the patient in the region of the tumor. This CT scan is used to segment the tumor and the surrounding healthy tissues, as well as to calculate the proton dose deposition. The physical properties of protons make proton therapy a very valuable treatment choice for many types of tumors, since protons deliver the highest dose to the tumor and thereby spare the healthy tissue for dose compared to conventional photon-based radiotherapy. However, uncertainties related to calculating proton dose based on a CT scan enforce extra margins to be used around the tumor to ensure that the tumor will receive a sufficient dose, but with the disadvantages that the surrounding healthy tissue is exposed to high doses, which can be damaging. It is therefore important to develop strategies to estimate the proton range in human tissues more accurately, to be able to reduce the needed treatment margin.

Photon counting CT is a new CT technology which has recently been studied for radiological applications due to its many advantages for tissue visualization in comparison to regular CT scanning. These advantages can also be exploited in radiotherapy, including proton therapy, to obtain a more accurate tumor segmentation. Moreover, the multi-energy capability of photon counting CT can be utilized to develop more accurate algorithms for proton dose calculation.

In this project, the possibility to reduce the so-called range uncertainty margin in proton therapy will be investigated. New methods for proton range estimation will be developed and evaluated to investigate their accuracy, and their potential gain will be clinically assessed by applying them on retrospective patient data to evaluate if they will lead to a dose reduction to the healthy tissue. Moreover, based on photon counting CT scans of prostate cancer patients, included in a randomized clinical trial for photon vs proton therapy, the advantages of photon counting CT in terms of image quality will be investigated for the potential improvement of delineation accuracy.

The position

The PhD education in Denmark is three years, and a full-time job position for the full length of the PhD education is offered.

The project will take place at the Danish Centre for Particle Therapy (DCPT) in Aarhus, Denmark. The research team at DCPT includes more than 50 full-time researchers representing various nationalities and educational backgrounds. The project will also be integrated in the clinical team at DCPT. DCPT is a well-established proton facility which started proton treatment in January 2019. The project will also partly take place at Herlev Hospital, Herlev, Denmark, where research and clinical collaborations are established.

During the research project, there will be possibilities to participate in national and international conferences. The PhD has a mandatory research stay (1-6 months) at another clinic or university in Denmark or abroad.

The candidate

Educational Background:

- A Master's degree (or equivalent) in Physics, biomedical engineering, or a related field, is required.

Research Experience:

- Demonstrated experience in computed tomography (CT) and/or proton therapy will be a significant advantage.
- A clinical background in medical physics is an asset (but no prerequisite).

Programming Skills:

- Proficient programming skills in Matlab and/or Python will be a considerable advantage.

Publication Record:

- Previous publications or other research disseminations will be an advantage (but no prerequisite).
- Good writing skills are a considerable advantage.

Mindset:

- Scientific mindset.
- Good communication skills.
- Good collaboration skills, as the project involves collaborating with people with different professions (researchers, medical physicists, physicians, radiotherapy technicians) both internally and externally.
- An ability to focus on the task at hand.
- Goal oriented and persevering in your work.
- Have a professional approach.
- Independence and ability to think creatively to develop the project are required.

Admission requirements

To be admitted to the PhD program at Faculty of Health at Aarhus University, the applicant must have a relevant higher education degree, corresponding to a Danish Master's degree ("kandidatgrad") of 120 ECTS credits or a similar relevant five-year degree program. Moreover, excellent communication skills in English are required. The English language requirement is comparable to a minimum of TOEFL 83 or IELTS 6,5. For Danish applicants, TOEFL 83 or IELTS 6,5 correspond to having passed English B from upper secondary school ("gymnasium"). For more information, please consult the graduate school webpage.

Other information

To know more about doing a PhD at Faculty of Health at Aarhus University please browse the information provided by the graduate school.

The successful candidate will have to apply for enrollment at the graduate school of Health at Aarhus University at the biannual open calls. The candidate will be supervised in this process by the supervisor team.

How to apply for the position

Applications can be addressed to Vicki Trier Taasti by email: vicki.taasti@rm.dk. Please attach your CV of max 2 pages explaining your competences and educational background, a motivation letter telling why you would like to do a PhD in Aarhus on this topic, as well as your diplomas confirming academic degrees (Master degree) and academic transcripts.

Deadline: February 19, 2024.

Contact

If you have question or would like further information on the position, please contact:
Vicki Trier Taasti: vicki.taasti@rm.dk