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**Prof. Johan de Mey, Promoter**  
Department of Radiology  
Vrije Universiteit Brussel

**Prof. Dirk Verellen, Promoter**  
Department of Radiotherapy  
Universiteit Antwerpen



Joint PhD VUB & UAntwerpen  
2020-2021

INVITATION to the Public defence of

**Jennifer DHONT**

To obtain the academic degree of

**'DOCTOR OF MEDICAL SCIENCES'**

**Optimization of high precision hypofractionated  
radiotherapy for moving targets : markerless tumor  
tracking**

The defence will take place on **Thursday, 8<sup>th</sup> October 2020 at 4 p.m.**

and will be organised online via Zoom meeting  
accessible through the following link:

[https://gf.vub.ac.be/redirects/PhD\\_defense\\_Jennifer\\_Dhont.php](https://gf.vub.ac.be/redirects/PhD_defense_Jennifer_Dhont.php)

and in Auditorium Piet Brouwer  
Faculty of Medicine and Pharmacy, Laarbeeklaan 103, 1090 Brussel

**ADMITTANCE** to the auditorium will only be granted upon presentation of  
the personal invitation from the PhD candidate.

## Summary of the dissertation

Respiratory-induced motion of tumours located in the thorax can significantly degrade the geometrical accuracy of radiotherapy and as such result in lower tumor control and higher soft tissue complication probabilities. Therefore, several motion management strategies have been developed and clinically implemented, which can typically be categorized in passive and active strategies. Using passive strategies, the extent of the respiratory-induced motion is measured once, pre-treatment, and motion encompassing volumes are defined to ensure the tumour receives sufficient dose. On the contrary, with active motion management, the tumour location and motion is monitored in real-time and treatment parameters are updated as such.

The first aim of this thesis was to quantify breathing-induced motion variability, to evaluate the robustness of passive motion management strategies and the reliability of a single pre-treatment measurement. Second, the aim was to develop a markerless tumor tracking framework, applicable on conventional radiotherapy systems, which would enable active motion management, but also real-time monitoring during passive motion management, on a broad scale. The studies performed in this thesis showed that breathing-induced motion variability is large for lesions moving with higher amplitudes, and so passive motion management is only advisable for those tumours moving with smaller amplitudes. Further, a framework for markerless tracking was developed based on three pillars ; the visibility of tumours on real-time images was improved through the development of dual-energy imaging techniques, a robust tracking algorithm was translated from computer vision to the medical imaging domain, and a framework was developed to make optimal use of pre-treatment information.

## Curriculum Vitae

Jennifer Dhont was born on the 10th of June 1991 in Waregem, Belgium. In 2012, she obtained a Bachelor's degree in Physics and Astrophysics at the Vrije Universiteit Brussel, followed by a Master's degree in Engineering with a specialization in Medical Physics in 2014. Her masterthesis titled 'A comparison of two clinical correlation models for dynamic tumour tracking with a focus on geometrical accuracy' was performed under the guidance of Prof. Dirk Verellen in the Radiotherapy department of the University Hospital Brussels.

In that same year, she was hired as a teaching assistant at the Vrije Universiteit Brussel to perform a PhD thesis and assist in the courses on Biomedical Physics at the Faculty of Medicine and Pharmaceutical Sciences. She started her PhD research under the guidance of prof. Dirk Verellen at the Radiotherapy department of the University Hospital Brussels, was an invited researcher at the Gemelli University Hospital in Rome for several months, and then moved to the department of Electronics and Informatics at the Faculty of Engineering under the guidance of prof. Jef Vandemeulebroucke and Prof. Johan de Mey to pursue her interest in the application of artificial intelligence in Medicine. Over the last few years, Jennifer has been recognized as an expert in the fields of motion management and machine learning in radiotherapy. She serves as a faculty member for the European Society for Radiation Oncology and has been an invited speaker to several national and international conferences. She plans to continue her research career at Maastrro Clinic, Maastricht (The Netherlands).