# Call for Applications

*February 2021*

We are currently seeking applications for a <u>fully funded PhD position</u> with joint appointment between University of Amsterdam (Faculty of Economics and Business) and Harvard Medical School/Massachusetts General Hospital (Department of Radiation Oncology). The applicant will be working on the optimization part of the  Real-time Adaptive Particle Therapy of Cancer (RAPTOR) project.
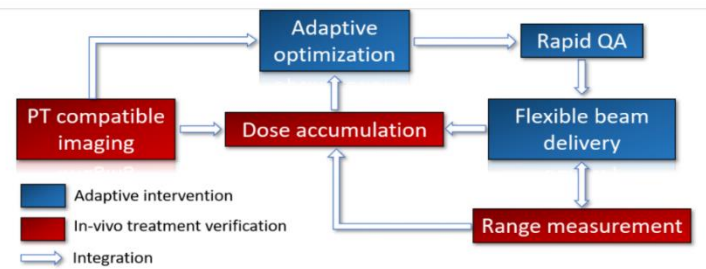


Figure 1. Schematics of the RATPOR project workflow.

**Project Description**: Standard radiation treatment (RT) planning is usually a static non-adaptive process which does not respond to the changes in patients' anatomy and biology throughout the radiation treatment process (which often spans several weeks). The goal of the RAPTOR project is to facilitate efficient adaptive treatment planning for particle radiation therapy through imaging, online adaptation, and uncertainty management. On the optimization side, this is envisioned in <u>three complementary subprojects</u>:

1. **Offline adaptation**: the student will develop optimization algorithms for offline adaptation, where a new plan is optimized taking all information from previous days into account, but not information obtained on the current day. Even though offline adaption is not the primary focus of RAPTOR, it will be important to understand the benefits of online over offline adaptation.
2. **Online adaptation:** here the patient-specific information, specifically imaging information acquired just before the treatment starts, will be included in the optimization of the plan of the day. Consequently, the optimization must be executed rapidly, within about a minute. The algorithm will be based on our previous work using <u>Dynamic Programming</u>, and will be generalized to adapt not only the dose level but the entire plan from day to day.
3. **Robust optimization**: The third sub-project will address the issue of robustness in the adaptive setting. Residual uncertainties are unavoidable even with adaptive planning. We will pursue methods of <u>Adjustable Robust Optimization</u>. Here the motivation is that collecting information about the patient during the treatment and knowing that we will adapt to those variations, will let us use smaller margins even in the first few treatment fractions.

**Appointment:** The student will be enrolled at University of Amsterdam in the Netherlands. The student will spend about half of his/her time at the Massachusetts General Hospital (MGH) in Boston to develop and test methods in a real-world clinical environment. The main supervisors are Prof. Dick den Hertog (UvA) and Prof. Thomas Bortfeld (MGH). The student can participate in extensive teaching opportunities at the MGH Cancer Center. The student will be able to attend lectures on mathematical optimization at the Massachusetts Institute of Technology (MIT) and the Dutch Network on the Mathematics of Operations Research.

**Requirements:** Candidates are expected to have solid foundations in optimization theory and strong passion for application-based and interdisciplinary work. They also should possess programming skills in at least one of the main languages (C++, Python, MATLAB).

**Funding:** Full

**Funding duration:** Four years

**Application:** [PhD Recruitment – RAPTOR (raptor-consortium.com)](raptor-consortium.com)


For inquiries, please contact **Prof. Dick den Hertog** (d.denhertog@uva.nl)

*[More information can also be found at https://raptor-consortium.com/offer-description/phd-position-raptor-esr6/]*