

<p>Thesis title: An Integrated Monte Carlo and Artificial Intelligence Framework for Response Prediction in Targeted Radionuclide Therapy</p>
<p>Host laboratory: ICMUB</p>
<p>Speciality: Computer science</p>
<p>Keywords: Monte-Carlo simulations, Artificial Intelligence</p>
<p>Job description</p> <p>Radionuclide therapy, particularly using ^{177}Lu and alpha-emitting radionuclides, is a rapidly developing therapeutic modality. However, the accuracy of post-treatment quantification using single-photon emission computed tomography (SPECT) remains limited, which affects the precision of dosimetric assessment and, potentially, the ability to predict treatment response.</p> <p>This project aims, initially, to develop an approach based on Monte Carlo simulation to generate realistic SPECT images. These simulations will complement experimental data and improve quantification methods by incorporating detailed modelling of physical interactions, as well as correction and reconstruction processes.</p> <p>In a second phase, the project will focus on the large-scale integration of heterogeneous pre-therapeutic data. This will include imaging parameters (radiomics, SUV, tumour volumes), as well as clinical and biological data. Methods for structuring, harmonising and multimodal fusion will be implemented to build a coherent, rich and usable database. On this basis, artificial intelligence algorithms will be developed to train robust predictive models, combining simulated and real data.</p> <p>The final aim of this PhD is to identify reliable predictive biomarkers, to improve the prediction of therapeutic response, and to better link pre-treatment characteristics to dose distributions and biological effects.</p>
<p>Bibliography</p> <p>[1] Merlet A, et al. Validation of a discovery MI 4-ring model according to the NEMA NU 2-2018 standards: from Monte Carlo simulations to clinical-like reconstructions. <i>EJNMMI Phys.</i> 2024;11(1):13</p> <p>[2] Pham T, et al. Pre-treatment dosimetry in ^{90}Y-SIRT: Is it possible to optimise SPECT reconstruction parameters and calculation methods for accurate dosimetry? <i>Physica Medica: European Journal of Medical Physics</i>, 2023; 115</p> <p>[3] Payan N, et al. Respective contribution of baseline clinical data, tumour metabolism and tumour blood-flow in predicting pCR after neoadjuvant chemotherapy in HER2 and Triple Negative breast cancer. <i>EJNMMI Res.</i> 2024;14(1):60.</p> <p>[4] Payan N, et al. Diagnostic ^{68}Ga-PSMA-11 PET/CT image-based dosimetry: a better estimate of ^{177}Lu-PSMA-617 therapy absorbed dose than PET uptake metrics. Annual Congress of the European Association of Nuclear Medicine (EANM), 2025.</p> <p>[5] Gong K. et al. Predicting Response to [^{177}Lu]Lu-PSMA Therapy in mCRPC Using Machine Learning. <i>J. Pers. Med.</i> 2024, 14, 1068.</p> <p>[6] Ranjan et al. The role of multimodality imaging in selection, response assessment, and follow-up of patients receiving ^{177}Lu-PSMA-therapy. <i>Insights into Imaging</i> 2026, 17:13</p>
<p>Applicant profile</p> <p>This work is intended to be transdisciplinary, involving clinicians, IT specialists, and medical physicists. Applicants must hold at least an upper second-class degree or equivalent qualification in a relevant subject, such as computer science, applied mathematics, biomedical engineering or medical physics. A Master's degree in a relevant discipline and additional research experience would be advantageous.</p> <p>Candidates should be fluent in English or French.</p>

Personal characteristics:

- Curiosity, independence, initiative and scientific rigour;
- Interpersonal skills and professional discretion (work in a hospital environment)

Grant MESRI Université Bourgogne Europe

Deadline 24/05/2026

Start of the PhD: 01/10/2026

Salary (gross): 2300 € per month

Thesis supervisors

- Benoit Presles (main supervisor) – benoit.presles@ube.fr
- Jean-Marc Vrigneaud (main co-supervisor) – jean-marc.vrigneaud@ube.fr
- Nérée Payan (co-supervisor)
- Alexandre Cochet (co-supervisor)

Application

Applicants are invited to submit their application to the PhD main supervisors.

Application must contain the following documents:

- CV
- Cover letter
- At least one reference letter