# Guglielmo Cappellini

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## Education

**PhD** **National PhD Program, PON R&I 2014-2020**, AI for Healthcare — Rome, IT
Jan 2022 – Dec 2024

"AI-based solution methods for PDEs with application to oncological hyperthermia". Tutored by prof. M. Vendittelli (Medical Robotics), co-funded by Medlogix Srl.

- Non-invasive temperature estimation in oncological hyperthermia (HT) treatment for decision support and optimization of dose delivery. Developed and validated a PINNs-based multiple-model adaptive observer;
- Two-papers work presented at IEEE CDC 2023, Singapore;
- Tutor of "Fundamentals of Automation", AY 2022/2023 and 2024/2025, with a focus on AI applications in healthcare;
- Supervisor for 3 final projects of "Medical Robotics", and a BSc thesis student;
- PhD thesis defended on May 30th, 2025 with Excellent classification.

**MSc** **Sapienza Università di Roma**, Nuclear Engineering — Rome, IT
Jan 2018 – May 2021

Thesis: "Study and characterization of radiolabeled nanovectors for application in precision molecular medicine", EQF 7, 108/110.

- Supervised by prof. R. Remetti (Radiation Protection for Nuclear Medicine).

**BSc** **Sapienza Università di Roma**, Energy and Nuclear Engineering — Rome, IT
Sept 2015 – Nov 2017

Thesis: "Radionuclides production and medical applications", EQF 6.

- Supervised by prof. L. Ferroni (Nuclear Energy Applications).

## Experience

**Department of Computer, Automation and Management Engineering (DIAG), Sapienza Università di Roma**, PostDoc — Rome, IT
Jan 2025 – present

Development, innovation and certification of medical and non-medical devices for healthcare (Rome Technopole Spoke 6, FP4). Supervised by prof. M. Vendittelli.

- Extending the research on AI for oncological HT, considering internal measuring points and the use of graph neural networks (GNNs);
- AI-based methods for real-time simulation of deformable tissues with application to interactive virtual reality for medical training. Preliminary results under submission;
- Interest in GNNs for modelling complex systems, and for handling multi-omics data.

**Department of Radiation Oncology, Amsterdam UMC Hospital**, Visiting PhD Student — Amsterdam, NL
Dec 2023 – May 2024

Study of HT techniques and its clinical application, to investigate and to validate new solutions to improve the real time controls, and to estimate temperature at depth in superficial HT.

- Reached experimental stage of my research project through experimental emulation of HT treatment, comprising a system to simulate perfusion, a muscle-equivalent phantom, a superficial EM applicator, and the thermometry system;
- Working in a transdisciplinary environment of medical physicists, clinicians, engineers, and data scientists;

**Department of Nuclear Medicine, Policlinico Umberto I, Rome**, MSc Thesis Intern — Rome, IT
Dec 2020 – May 2021

"99mTc-labeled Keratin-coated gold nanoparticles for selective anticancer photothermal therapy" (Frantellizzi, De Vincentis et. al.)

- Research on Theranostic, Radiopharmacology, Nanomedicine, and Nanophotonics;

- Developed mathematical model for MATLAB simulation of microfluidic devices for radiolabeled nanoparticles.

## Projects

**AMD-STITCH: Sapienza Information-Based Technology InnovaTion Center for Health (Reference)**
Ontology-based data preparation on electronic medical records of Italian diabetes patients within a 13 years timeframe

- Data modeling and data cleaning, providing effective techniques for setting up a unified and shared database;
- Working within secure data environments with large-scale healthcare datasets;

**ROBHOT: a robot-assisted technology for superficial hyperthermia treatments (YouTube)**
Grant application for EIC Accelerator (work package on AI-based temperature estimation), and for Rome Technopole.

## Skills

**Programming & Scientific Computing:** Expert in Python for computational modelling and artificial intelligence (PyTorch, Sklearn, NumPy, SciPy, pandas), specifically with PINNs, CNNs, and GNNs; version control with GitHub; familiar with reinforcement learning, containerization, and high-performance computing; good understanding of Web and app development

**Mathematics:** Specialized in computational methods for partial differential equations (MATLAB); strong foundation in numerical analysis, calculus, linear algebra, and optimization techniques for machine learning applications

**Clinical Data:** Experience working with large-scale healthcare datasets in alignment with FAIR data principles

**Languages:** English (fluent, IELTS Academic: 7.5), Spanish, Italian (native)

**Teaching & Mentorship:** Passionate educator with formal pedagogical training (Percorso formativo 24 CFU in anthropological-psychological-pedagogical disciplines and teaching methodologies); committed to clear communication of complex technical concepts across disciplines

**Professional Qualifications:** Licensed Professional Industrial Engineer (Esame di Stato Sez. A)

**Interests:** Committed to deep learning applications in radiation oncology and treatment planning; independent and creative mindset; interdisciplinary research background bridging nuclear engineering and medical physics

## Publications

**Adaptive Estimation of the Pennes' Bio-Heat Equation - I: Observer Design** Dec 2023
Cristofaro, A., Cappellini, G., Staffetti, E., Trappolini, G., Vendittelli, M.
10.1109/CDC49753.2023.10383905 (2023 62nd IEEE Conference on Decision and Control (CDC), Singapore)

**Adaptive Estimation of the Pennes' Bio-Heat Equation - II: A NN-Based Implementation for Real-Time Applications** Dec 2023
Cappellini, G., Trappolini, G., Staffetti, E., Cristofaro, A., Vendittelli, M.
10.1109/CDC49753.2023.10384113 (2023 62nd IEEE Conference on Decision and Control (CDC), Singapore)

**Adaptive Estimation of Pennes' Bio-Heat Equation: Observer Design and PINNs-based Implementation**
Cappellini, G., Cristofaro, A., De Santis, E., Staffetti, E., Trappolini, G., Vendittelli, M.
submitted to IEEE Transactions on Control Systems Technology

## Extracurricular Activities

- Independent drummer and musical director with extensive performance background across multiple genres;
- Early experiences in orchestra; co-founded bands including "Subba and the Roots" and "La Situa"; secured national touring grant (NuovoIMAIE 2018, €15k); formal jazz studies with renowned drummers (M. Guiliana, R. Gatto, M. Campanale, D. Panza, G. de Rienzo, F. Mendolia); current member of "Dimensione Brama", a multidisciplinary ensemble combining theatrical and musical performance (12th place finalists in XFactor18, 2024);
- More than 500 concerts and 3 albums released; experience in studio recording and production. My hands on these!