PhD Position (CIFRE)
Free-breathing high-resolution 3D T1-rho mapping for enhanced myocardial tissue characterization

Collaborative project between Siemens Healthineers, AP-HM, CRMBM/CEMEREM (Marseille), and IHU Liryc (Bordeaux)

Project Overview

Cardiovascular Magnetic Resonance (CMR) imaging is a powerful, non-invasive technique that enables high-precision assessment of cardiac function and myocardial tissue characterization. Among emerging CMR techniques, T1-rho mapping has demonstrated strong potential for detecting ischemic and non-ischemic cardiomyopathies without the need for contrast agents[1–3].

However, current 2D implementations are limited by spatial resolution, acquisition time, and patient comfort (e.g., breath-holding). Moreover, image analysis remains largely manual and time-consuming for clinicians.

This CIFRE PhD project aims to develop an accelerated, super-resolved, free-breathing 3D T1-rho mapping sequence combined with AI-guided image reconstruction and analysis, to be applied in patients with immune-induced myocarditis.

The work will include:

- Methodological MR sequence development (3D, free-breathing, super-resolved imaging, advanced undersampling and reconstruction)
- Optimization and validation on phantoms and healthy volunteers at CRMBM Marseille.
- Clinical validation at AP-HM (CHU Nord and CHU La Timone), in close collaboration with cardiology and oncology teams.
- AI model design and evaluation for automated analysis and interpretation of high-resolution T1-rho data.

The candidate will be based primarily at CRMBM/CEMEREM (Marseille) and AP-HM, with regular stays and access to facilities at IHU Liryc (Bordeaux).

Supervision and Collaboration

- Main supervision & clinical translation: Prof. Alexis Jacquier (AP-HM, Marseille)
- Technical supervision : Prof. Jr. Aurélien Bustin (IHU Liryc, Bordeaux)
- Local development oversight, academic guidance, and system access: Prof. Frank Kober (CRMBM)

- Industrial collaboration with Siemens Healthineers: Dr. Thomas Troalen & Dr. Matthieu Lepetit Coiffe.

This CIFRE PhD project aims to strengthen the Marseille-Bordeaux collaboration (Jacquier, Kober, Bustin, Bartoli), consolidate the strong and already successful partnership with Siemens Healthineers, and train the next generation of experts in cardiac MR sequence development, image reconstruction, AI-based processing, and clinical translation.

Candidate Profile

Required Education:

Master's degree (MSc or equivalent) in one of the following fields:

- Biomedical Engineering
- Physics or Medical Imaging
- Applied Mathematics or Computer Science
- Life Sciences with strong quantitative background

Required Skills:

- Strong programming skills (Python, MATLAB, and/or C++)
- Experience with deep learning frameworks (PyTorch, TensorFlow)
- Solid understanding of signal processing and/or image reconstruction
- Fluent in English (spoken, written, and read)

Preferred Qualifications (a plus):

- Experience with MRI sequence programming and/or cardiac MRI
- Background in AI for medical imaging or image reconstruction
- Knowledge of MR physics or physiological modelling
- Flexibility and willingness to travel between Marseille and Bordeaux

Soft Skills:

- Above all: motivation and curiosity for interdisciplinary and translational research
- Team-oriented, proactive, and positive attitude
- Ability to work independently and collaboratively with engineers, clinicians, and industry partners

Location

The PhD student will be primarily based at CRMBM (Centre de Résonance Magnétique Biologique et Médicale), part of Aix-Marseille University, an internationally recognized center for advanced MRI research and sequence development. The

student will work in close collaboration with the local clinical teams at AP-HM to ensure a strong translational link between technological development and innovation and clinical application. Regular stays at IHU Liryc (Bordeaux) will provide access to complementary expertise in cardiac MRI sequence development, AI-driven image processing, and translational research. The project environment offers an exceptional combination of academic, clinical, and industrial collaboration, with access to state-of-the-art imaging systems (one 1.5-T and one 3.0-T Siemens systems dedicated to research and clinical translation at CRMBM and AP-HM and two1.5-T Siemens systems at Liryc fully dedicated to research), MRI phantoms (NIST/T1MES) as well as computational resources.

Application Details

Starting date: expected mid-march 2026

Contract type: CIFRE PhD (industrial PhD, 3 years)

Funding secured: Jointly supported by Siemens Healthineers and the French ANRT (CIFRE program)

Application materials:

- **CV and motivation letter**
- **Academic transcripts**
- **Contact information for two references**

Please send your application to: aurelien.bustin@ihu-liryc.fr

References

1. Zhang JH, Toupin S, de Villedon de Naide V, et al. Cardiac Magnetic Resonance T1-rho Mapping at 1.5T. *MAGNETOM Flash*. 2024;(87):2-9.
2. Bustin A, Witschey WRT, van Heeswijk RB, Cochet H, Stuber M. Magnetic resonance myocardial T1-rho mapping: Technical overview, challenges, emerging developments, and clinical applications. *Journal of Cardiovascular Magnetic Resonance*. 2023;25(1):34.
3. de Villedon de Naide V, Narceau K, Ozenne V, et al. Advanced myocardial MRI tissue characterization combining contrast agent-free T1-rho mapping with fully automated analysis. *Journal of Magnetic Resonance Imaging*. 2025;61(3):1353-1365. doi:10.1002/jmri.29502