

Postdoctoral position

Multimodal Cardiac Digital Twin for Ventricular Arrhythmia Prediction

Context & Scientific Challenge: Cardiovascular diseases remain the leading cause of mortality worldwide, with sudden cardiac death often triggered by life-threatening ventricular arrhythmias such as ventricular tachycardia or ventricular fibrillation.

Despite significant advances, current clinical risk stratification tools—such as left ventricular ejection fraction (LVEF)—lack sufficient sensitivity and specificity. Emerging approaches based on imaging, Electrocardiogram analysis, and genetic markers provide valuable insights but remain limited by their **unimodal nature**.

Project overview: This postdoctoral position is part of the INTERACTION project, a flagship initiative of the French PEPR Digital Health program. The project aims to develop a next-generation multimodal AI framework capable of modeling the cardiovascular system as a personalized digital twin.

The ultimate goal is to improve the prediction of ventricular arrhythmias in high-risk populations, particularly post-infarction patients with reduced LVEF, by integrating structural and electrophysiological biomarkers into unified, data-driven models.

The project brings together leading French research institutions, including:

- LTSI – INSERM U1099 (Université de Rennes)
- IADI – INSERM U1254 (Université de Lorraine)
- Thorax Institute – INSERM U1087 / CNRS U6291 (Université de Nantes)

Research objectives: The successful candidate will contribute to the development of patient-specific cardiac digital twins by:

- Extracting mechanical biomarkers, particularly cardiac strain thereby quantifying myocardial deformation
- Designing methods to fuse mechanical and electrical cardiac information, integrating features derived from Electrocardiogram signals
- Enabling a personalized, multimodal representation of cardiac activity for improved risk prediction

This research lies at the intersection of:

- Biomedical signal and image processing
- Machine learning and deep learning
- Computational modelling of physiological systems

Candidate Profile: We are seeking a highly motivated candidate with:

- A PhD in biomedical engineering, signal processing, applied mathematics, or related fields
- Strong expertise in:
 - Signal and image processing
 - Machine learning / deep learning

- Numerical optimization
- Python programming skills are a must-have

Location: LTISI-INSERM U1099, Université de Rennes, Campus de Beaulieu, Rennes, France

Duration of contract: 18 months (renewable once)

Expected start date: May 1st 2026

Contact: Applications should include a detailed CV, a cover letter, a transcript of records and the PhD defense jury's report, and must be submitted to Ahmad Karfoul (ahmad.karfoul@univ-rennes.fr) & Alfredo Hernandez (alfredo.hernandez@univ-rennes.fr)

Why join this project?

- Contribute to a cutting-edge national initiative in digital health
- Work on multimodal AI and digital twin technologies
- Collaborate with leading research labs in France
- Address a major clinical challenge with high societal impact