



Thesis/internship assignment

Joint embedding learning of cardiac MRI & radio-frequency sensing

Location: Utrecht Science Park (in-person / hybrid)
Company: UMC Utrecht and PrecorDx
Start date: As soon as possible (flexible)
Duration: ~6 months

Objectives

Cardiovascular disease (CVD) remains the leading cause of death worldwide. Imaging modalities such as echocardiography and cardiac magnetic resonance imaging (MRI) are the gold standard to measure mechanical cardiac biomarkers. However, MRI and echocardiography are limited to single point measurement and hospital-based, while early identification of declining cardiac function is pivotal to tailoring medical therapy and slowing disease progression.

PrecorDx and UMC Utrecht developed a promising non-invasive, new measurement technique called radio-frequency sensing (RFS), which uses compact, on body RF antennas to track cardiac activity (see Fig. 1). This technology allows for use outside hospital settings such as the home, and for longitudinal monitoring.

In this project, we will explore the use of foundation models (FM) to find a shared embedding space of cardiac MR data and RF signals (see Fig. 2). Recent advances in pretrained FM's and contrastive learning strategies show promise to find such a space.

Once a shared embedding is found for cardiac MR and RF signals, the goal is twofold. First, from an RF embedding, we aim to reconstruct the corresponding MR data, such that clinical parameters can be extracted in a conventional way. Second, from the RF embedding we aim to directly predict clinical parameters without first decoding the MR data.

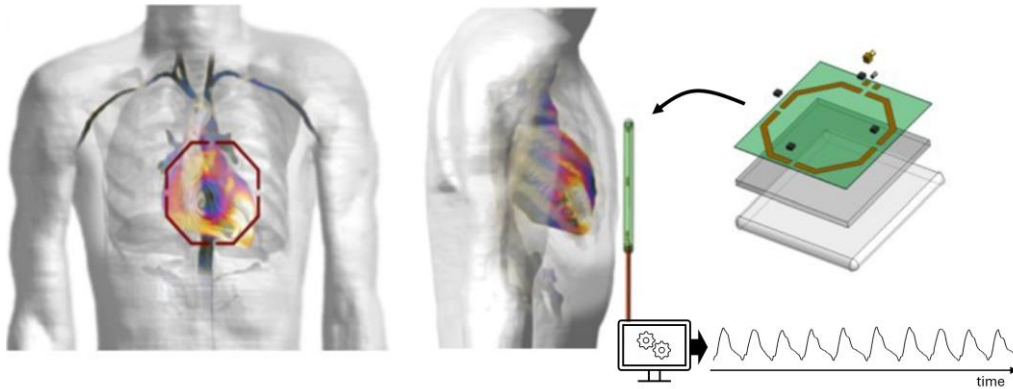


Fig. 1: Setup of PrecorDx's RF antenna that measures cardiac motion.

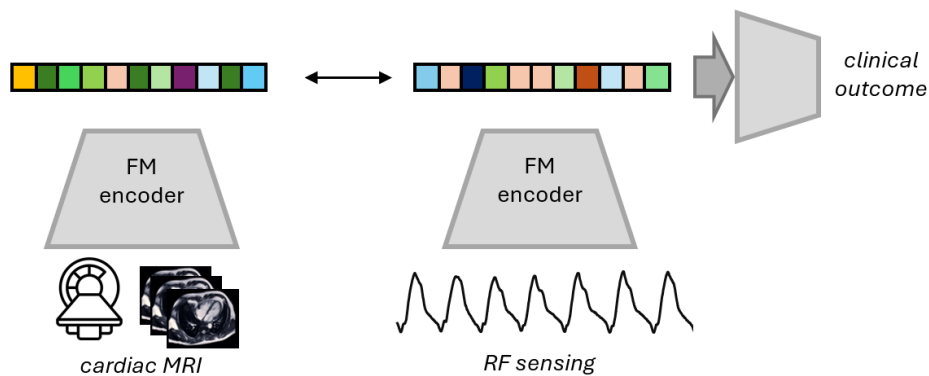


Fig. 2: A multi-modal embedding learning setup in which foundation model (FM) encoders embed different data modalities to a latent space, which is subsequently used to predict clinical outcome variables.

Responsibilities

- Develop a Python pipeline for extracting embeddings from MR and RFS data.
- Investigate strategies to train/finetune the embedding models such that shared embeddings between both modalities can be found.
- Set up experiments to validate the pipeline using simultaneously matched MR and RFS data.
- Build and validate a model to predict clinical parameters.
- Document results and report them to the team.

Your profile

- **Educational Background:** MSc candidate in Electrical Engineering, Biomedical Engineering, Applied Physics, Artificial Intelligence or Scientific Computing ;
- **Experience & Skills:** Machine/deep learning, Python, Pytorch/Tensorflow/Jax, biomedical data
- **Mindset:** Critical attitude, keen interest in biomedical applications, creative, team player with good communication skills, but also being able to work independently.

What We Offer

- Mentorship and coaching from experienced UMCU researchers and the PrecorDx team.
- A dedicated workspace at the Utrecht Science Park, with one foot in academia, and one in a startup setting.
- The unique opportunity to contribute to a breakthrough medical device that will directly improve the lives of heart failure patients.

About Us

UMC Utrecht and PrecorDx (med tech startup) are on a mission to transform cardiology by developing a new class of diagnostic and monitoring solutions that will change the lives of millions of heart failure patients. We work with physicists, clinicians, hardware and software specialists to develop this technology into practical clinical applications.

Interested? If you're ready to make an impact on cardiovascular healthcare, we'd love to hear from you! Please send your resume and a short motivation to iris.huijben@precordx.com, and we'll get back to you shortly.