Internship/ Master project

Spring (April) or fall 2026 (Sept/oct)

AI-based predictive model of consciousness in patients with acute brain injury based on multimodality imaging and clinical data.

Keywords: machine learning, heterogeneous data fusion, population graph learning, prognostic model, neuroimaging

Context

Disorders of consciousness (DOC) represent a broad spectrum of conditions characterized by impaired awareness of oneself and one's surroundings, which can occur as a result of various brain injuries (e.g., head trauma) and include coma, vegetative state, and minimally conscious state.

Although each of these states has distinct clinical characteristics, the accurate diagnosis of DOC in the acute phase, as well as the prognosis for the patient's progress in the months following this episode, are major challenges for clinicians.

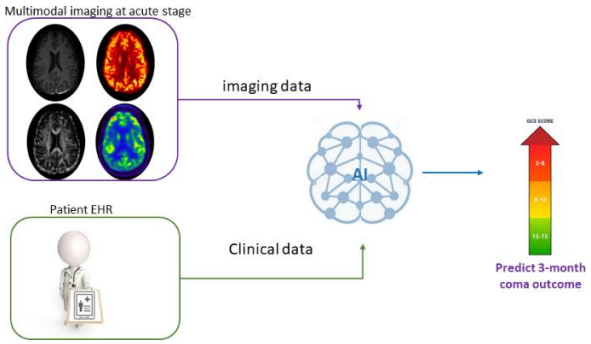

Fig 1 : general overview of the pipeline

Multimodal brain imaging (e.g., MRI, PET) is useful for more accurately assessing residual brain function. However, merging the massive amount of information provided by these different imaging modalities, supplemented by the patient's clinical data, is a complex task.

As part of the IMAGINA research project, we have compiled a unique database of patients in acute comatose states (70 examinations) using a hybrid machine that allows simultaneous acquisition of functional information via positron emission tomography (PET) and functional or structural information via magnetic resonance imaging (MRI).

The objective of this project is to develop an artificial intelligence-based prognostic model for patient outcomes at 3 months, using heterogeneous information from multimodal imaging data and clinical data.

This work will build on the encouraging results of an initial statistical learning model combining MRI and PET imaging data. Several avenues will be explored in the fields of deep learning and population graph learning. The candidate will have access to a unique database collected as part of the ANR IMAGINA project, aggregating examinations of comatose subjects in the

acute phase (>70 examinations) performed on a hybrid machine allowing the simultaneous acquisition of functional information in PET and functional or structural information in MRI.

Research axes

The main part of the internship will aim to develop a novel deep learning architecture that integrates these different types of data. The major challenge for this second approach is to be able to train a deep AI model from a small database (<100 subjects).

-The first avenue we intend to explore is to propose a transfer learning or multi-task learning strategy based on a network we recently developed for another application in the context of stroke [Liu et al MICCAI 25]. The objective will be to propose a transfer learning and/or multi-task learning protocol in a low-data learning context using data from the IMAGINA database.
-The second avenue we propose is to explore the potential of graph learning (GNN) at the patient level for this task.

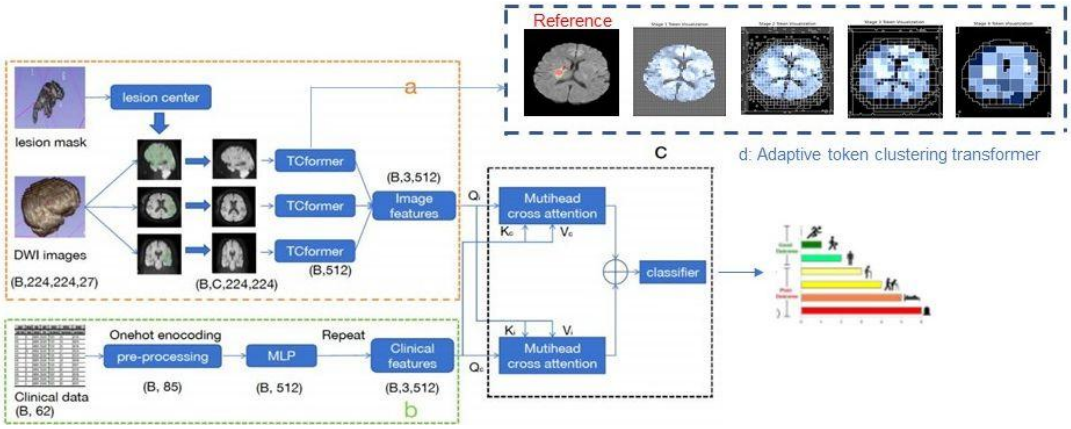

Fig 2 : LC-ViT model proposed in [Liu et al MICCAI 25]

In the second part of the internship, we want to develop a method for post-hoc corrections of predictions made by the AI models developed during the first part of the internship. The preferred approach is population graph learning, as proposed in [Raymond, CHIL24] and recently used in [Thiery, CMIG25]. The idea is to construct a graph at the patient population level, based on a model of inter-patient relationships, and to use graph learning models to propagate knowledge of neighboring patients in order to estimate a more accurate and robust prediction.

In parallel, the intern will leverage the initial machine learning prognostic model that we developed by integrating new imaging features (fMRI) as well as clinical data. The main difficulty will be to combine data from different modalities, which are therefore heterogeneous, into the current model.

Work program

The work program will include the following phases:

- State of the art in machine learning-based diagnostic and prognostic models for TDCs
- State of the art in deep learning: clinical and image data fusion models, transfer learning, multi-task learning, graph learning.
- Getting started with existing models: the machine learning (ML) model and deep learning (DL) model from [Liu et al MICCAI25].

- Adapting the DL model from Liu et al. to the task of predicting the awakening of TDC patients. In particular, this will involve determining how to adapt to modalities and clinical data that are partially similar to those of the model developed for stroke.
- Implementing a post hoc method for correcting predictions based on population graphs.
- Optional:
    - Implementation of explainability methods to extract the most influential characteristics of the classification task.
    - Implementation of uncertainty measurement methods to quantify the confidence level of the predictive model.

The last two tasks listed above are optional. Their implementation will be discussed based on the candidate's skills, progress, and the duration of the internship.

Academic Profile
This internship is suitable for a student in computer engineering, electrical engineering, or biomedical engineering with a solid foundation in programming and statistical learning, as well as knowledge of image processing and analysis. We are looking for an enthusiastic and independent student who is highly motivated and interested in multidisciplinary research (image processing and machine learning in a medical context).

Supervision:
The student will be supervised by Carole Lartizien (PhD), research director at the CREATIS laboratory, and Florent Gobert, intensive care physician at HCL and principal investigator of the IMAGINA database on which the project is based. The candidate will interact with Nicolas Costes (PhD) and Inés Mérida (PhD), research engineers on the IRM-TEP platform at CERMEP, who are responsible for image processing and descriptive statistical analysis of the IMAGINA database.

The internship will mainly take place at the CREATIS laboratory with interactions at CERMEP. This internship is part of the Agoracoma project funded by SHAPE-Med@Lyonhttps://www.shape-med-lyon.fr/projets/structurants-vague-1/agoracoma/

Information and contact:
The internship is expected to last between four and six months, starting in Spring (early April 2026) or fall (Sept/Oct 2026)
The internship agreement provides for a stipend of approximately €650/month.
To apply, send a resume and cover letter by email to carole.lartizien@creatis.insa-lyon.fr

References.

M Liu, N Hatami, L Mechtouff, TH Cho, C Lartizien and C. Frindel. Lesion-centered vision transformer for stroke outcome prediction from image and clinical data. Medical Image Computing and Computer Assisted Intervention -- MICCAI 2025, Sep 2025, Daejeon, South Korea. ⟨hal-05303811⟩

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