

Master 2 Internship / Final Project – Year 2026

1. Team Information

- Team name: MYRIAD
- Contact email: chantal.muller@insa-lyon.fr
- Laboratory / Institute: CREATIS, INSA Lyon
- Supervising team: Chantal REVOL-MULLER (Associate Professor HDR), Maël ROCHER (PhD student), Thomas GRENIER (Associate Professor HDR).

2. Internship Information

• Internship title:

A Generative Prompt Model for 3D Synthetic Brain MRI, enhanced by Multiple Sclerosis Lesions.

• Topics

Medical imaging, Generative AI, Latent diffusion model, Text conditioning, Multiple sclerosis, Data augmentation, 3D MRI.

• Internship Summary

This Master project focuses on generating 3D brain MRI images from textual prompts, in the context of studying multiple sclerosis (MS). Based on an initial generative model designed to produce healthy-subject images from textual descriptions integrating patient and acquisition information, we aim to enrich this approach by incorporating textual descriptions of MS lesions. The project relies on a text-conditioned latent diffusion model (LDM), with the objective of overcoming limitations of existing MRI datasets, which are often too small to effectively train deep learning models [1].

Generating pathological images via prompt should enable more realistic MS MRI than traditional methods that artificially add lesions via masks. Such approaches do not account for disease-induced global changes, such as cortical thinning or reduction of subcortical structures. The model will first be trained on a healthy subject image/text dataset, then adapted to generate images with MS lesions controllable by textual description. Ultimately, this methodology may improve MS biomarker analysis and enhance the explainability of generative models used in neuro-imaging.

• Assigned Tasks

The project aims to develop a text-conditioned latent diffusion model (LDM) describing brain structure and MS lesions. Latent diffusion models have shown remarkable ability to generate realistic and diverse images [2]. Based on “DALL-E Brain” 2D and 3D models developed in the team and capable of generating healthy brains [3, 4], the project will adapt them to add MS lesions in a controlled manner. The model will rely on a 2D and 3D healthy subject dataset built from T1-w, T2-w, and FLAIR MRI sequences (IBSR, OASIS, IXI, Kirby), and a new text/image dataset describing lesions.

Expected Work:

- Fine-tuning the healthy model to add text-described lesions
- Studying prompt impact on generated images
- Implementing 2D and 3D image generation

- Running scripts on the Jean Zay HPC architecture
- Developing metrics to evaluate prompt control on lesion size and placement after segmentation

• **Expected Results / Deliverables:**

- 2D and 3D MRI generation model enriched with MS lesions
- Training pipelines with and without fine-tuning, with documentation and Jean Zay configurations
- Comparative studies and ablations (description detail level, patient information: age, gender, EDSS score)

• **Duration:**

6 months, early 2026 (flexible depending on university calendar)

• **Supervision:**

Chantal REVOL-MULLER – main supervisor, generative models

Maël ROCHER – co-supervisor, strong link with his PhD topic

Thomas GRENIER – collaborator, expertise in MS lesion modeling

3. Relevance and Impact

Relevance for Myriad:

- Generation of multimodal synthetic datasets for MS lesion segmentation
- Generation and multimodal fusion of text / image information
- Control & explainability: evaluation of prompt control (position, size, MRI sequence, patient info) and cross-attention maps
- Metrics for prompt-lesion consistency
- Building controllable latent spaces for constrained reconstruction

4. Additional Useful Information

- Access to Jean Zay HPC infrastructure (A100 & H100 GPU hours)
- Expected collaboration with CREATIS MUSIC project members (MS and neuro-inflammation):
 - neuroradiologist for clinical validation
 - expert researcher in MS lesion modeling
- Work based on dedicated 2D/3D anatomical description / healthy brain datasets
- Ongoing creation of a lesion description / MS patient dataset

References

- [1] Yi Zhu, Thomas Grenier, and Chantal Revol-Muller. "Comparative analysis..." 2024.
- [2] Rombach et al. "High-resolution image synthesis with LDMs." CVPR 2022.
- [3] El-Allaly, Grenier, Revol-Muller. "DALL-E Brain: Generating 2D MRI from text." EUSIPCO 2025.
- [4] El-Allaly, Grenier, Revol-Muller. "DALL-E Brain: 2D MRI generation from text." GRETSI 2025.