REZKELLAH NOUREDDINE KHIATI

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Research Interests

World models for physical-world understanding · Energy-based and latent variable models · Non-generative self-supervised learning (JEPA architectures) · Latent-space planning and hierarchical prediction · Model-based reinforcement learning over continuous signals · Structured representation learning for 3-D medical imagery

Education

Ph.D. in Computer Science (CIFRE) Mar. 2023 – Feb. 2026
Institut Polytechnique de Paris & Keyrus
Thesis: *Deep Generative and Predictive Models for Lung Pathology Analysis in CT.* Focus on latent-space generative architectures, energy-guided segmentation, and predictive modelling of disease progression from volumetric medical signals.

M.Sc. Computer Vision & Intelligent Machines 2020 – 2022
Université Paris Cité (Paris Descartes)
Distinction (16/20). Coursework: variational inference, representation learning, probabilistic graphical models.

B.Sc. Computer Science 2019 – 2020
Sorbonne Université, Paris

B.Sc. Computer Science 2016 – 2019
Université Ibn Khaldoun, Tiaret, Algeria
Ranked 1st out of 440 students.

Selected Publications

[1] **N. Khiati** et al., "Lesion Segmentation and CT Biomarkers for TB Assessment and Follow-Up," *SPIE Medical Imaging*, 2026. *(Accepted)*

[2] **N. Khiati** et al., "Multiscale Graph Attention Network for Topology-Aware Airway Segmentation in Lung CT," *SPIE Medical Imaging*, 2026. *(Accepted)*

[3] **N. Khiati** et al., "Diff-Lung: Diffusion-Based Texture Synthesis for Enhanced Lung CT Representation," *IEEE ISBI*, 2025. *(Accepted)*

[4] **N. Khiati** et al., "Shape-Aware Cycle-GAN for Energy-Guided CT Lung Segmentation," *SPIE Medical Imaging*, 2025. *(Accepted)*

[5] **N. Khiati** et al., "Vessel-Based Lung Lobe Partitioning in UTE-MRI," *SPIE Medical Imaging*, San Diego, CA, 2024.

Research & Engineering Experience

Doctoral Researcher Mar. 2023 – Feb. 2026
Institut Polytechnique de Paris & Keyrus, Palaiseau / Évry

- Designed latent-space predictive models for lung pathology segmentation on volumetric CT, learning structured representations that capture disease topology without pixel-level reconstruction losses.
- Developed diffusion-based and adversarial generative pipelines (Diff-Lung, Shape-Aware Cycle-GAN) for synthetic pathology augmentation, improving downstream segmentation by 4+ Dice points on scarce clinical data.
- Built graph-attention architectures that encode multiscale airway topology, enabling topology-aware segmentation where standard convolution-only baselines fail.
- Managed end-to-end experimental pipelines: data curation (DICOM → NIfTI), distributed training on multi-GPU clusters, and reproducible evaluation with Weights & Biases.

Research Engineer Sep. 2022 – Mar. 2023
Institut Polytechnique de Paris, Palaiseau / Évry

- Benchmarked encoder–decoder architectures (U-Net, TransUNet, Swin-UNETR) for medical image segmentation, systematically ablating attention mechanisms and skip connections.
- Deployed pulmonary disease detection models (COVID-19, pneumonia) on clinical CT data; designed evaluation protocols aligned with radiologist ground-truth standards.

Research Intern – Multimodal Representation Learning Apr. 2022 – Aug. 2022
CERES, Sorbonne Université, Paris

- Investigated joint visual–contextual embeddings by fusing CNN features with Transformer-based contextual encodings for large-scale image retrieval and clustering.

- Explored non-generative contrastive objectives for aligning heterogeneous feature spaces, a paradigm closely related to JEPA-style latent prediction.

Research Intern – Efficient Neural Architectures May 2021 – Jul. 2021
Polytechnique Montréal, Canada

- Implemented Binary Neural Networks (XNOR-Net) and evaluated structured pruning strategies, achieving >10× compression with <2% accuracy loss on image classification.
- Studied incremental learning under compute and memory constraints – directly relevant to continual-learning requirements in persistent-memory world models.

AI Project Lead Sep. 2021 – Mar. 2022
Groupe IGS, Paris

- Designed a fuzzy-logic evaluation engine and content-based recommendation system for adaptive learning; deployed a pedagogical chatbot serving 200+ students.

Open-Source Projects

latent-world-model – Hierarchical Latent Video Prediction GitHub

- Implemented a hierarchical JEPA-inspired architecture that predicts future video frames entirely in latent space, bypassing pixel-level reconstruction and learning energy-based compatibility scores between context and target representations.
- Achieved competitive FVD on Kinetics-400 while using 3× fewer FLOPs than diffusion-video baselines, demonstrating that non-generative latent prediction scales efficiently for physical-world understanding.

ssl-volumetric – Non-Generative SSL for 3-D Signals GitHub

- Built an I-JEPA / V-JEPA-style self-supervised framework extended to high-dimensional volumetric data (CT, MRI), predicting masked 3-D patch representations in a learned latent space without decoding to voxels.
- Pre-trained representations transfer to five downstream medical tasks, outperforming MAE and contrastive baselines by 2–5% on linear probing, validating the energy-based, non-generative paradigm on continuous 3-D signals.

distributed-world-train – GPU-Optimised World-Model Training GitHub

- Developed a modular PyTorch + JAX training harness with custom CUDA kernels for fused attention and latent-space EBM energy computation, reducing wall-clock time by 35% on 8×A100 clusters vs. naïve baselines.
- Integrated FSDP / tensor-parallel sharding, mixed-precision (bf16), and Slurm orchestration; open-sourced reproducible configs for training world models at 1B+ parameter scale.

Technical Skills

Core Research	Self-supervised learning (JEPA, contrastive, masked prediction), world models, energy-based models, latent variable models, planning in latent spaces, diffusion models, generative adversarial networks, medical image analysis
Engineering	PyTorch, JAX/Flax, CUDA (custom kernels), distributed training (FSDP, DeepSpeed, tensor parallelism), mixed-precision training, ONNX, TensorRT
Tools	Docker, Slurm, Weights & Biases, Git, Linux, Hydra/OmegaConf, CI/CD, PostgreSQL, Flask
Languages	Python, C/C++, SQL, Bash · French (native), English (fluent), Arabic (native)