

Kaouther Messaoud

RESEARCHER · DEEP LEARNING

Lausanne, Switzerland

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Research Experience

VITA Lab, EPFL | Valeo AI

Lausanne, Switzerland

Postdoctoral Researcher, Representation Learning, Multi-Modality and Generalization

Apr. 2022 - Present

- Building SOTA **transformer**-based frameworks for multi-modal motion prediction using representation learning; self-distillation and masked reconstruction.
- Developed cross-domain generalization techniques, parameter efficient fine-tuning strategies, and robustness measures.
- Identified vulnerabilities in motion prediction models to different backdoor attacks and developed a defense mechanism.

ASTRA Lab, INRIA

Paris, France

Postdoctoral Researcher, Trajectory Prediction and Planning

Jul. 2021 - Apr. 2022

- Integrated spatio-temporal transformer models for trajectory prediction and planning in dynamic environments.

LISA Lab, UCSD

San Diego, California, USA

Visiting Researcher, Context-based Trajectory Prediction for Autonomous Driving

Jan. 2020 - May 2020

- Proposed an approach using MHA and a joint representation of the static scene latent features and surrounding agents.
- Used each attention head to generate a distinct future trajectory compliant with scene structure and agent configuration.
- Achieved **second place** in the nuScenes trajectory prediction challenge with the MHA-JAM model.

RITS Lab, INRIA | Sorbonne University

Paris, France

Ph.D. Researcher, Attention-based Trajectory Prediction for Autonomous Driving

Oct. 2017 - Jun. 2021

- Explored fundamental challenges in deep learning-based motion prediction and interaction dynamics within complex environments, emphasizing multi-modal generation and physical feasibility.
- Published **award-winning work**, including the IEEE TIV's George N. Saridis Best Transactions Paper Award.

RITS Lab, INRIA | Valeo

Paris, France

Research Engineer, Multi-Sensor Data Fusion for Agents Tracking

Apr. 2017 - Sep. 2017

- Designed algorithms for multi-sensor fusion (Camera-Lidar), enhancing real-time agent tracking and re-ID in dynamic environments.
- Combined Advanced Kalman filtering and multi-hypothesis tree reasoning.

IRIS Lab, UTK

Knoxville, Tennessee, USA

Research Intern, Image Enhancement and Restoration

Feb. 2015 - Aug. 2015

- Developed histogram based image enhancement algorithms to improve quality and restore visual data effectively.

Education

Sorbonne University - INRIA Paris

Paris, France

PhD Degree

Oct. 2017 - Jun. 2021

- Thesis Title: Deep Learning-based Trajectory Prediction for Autonomous Vehicle.

École Polytechnique de Tunisie, Top engineering school in Tunisia

Tunis, Tunisia

Engineering Degree

Sep. 2012 - Jun. 2015

- Core curriculum: Multidisciplinary studies including Mathematics, Physics, Electronics.
- Oriented studies: Signal and Image Processing, Artificial Intelligence, Computer Science, Embedded Systems.

Sfax Preparatory Engineering Institute

Sfax, Tunisia

Preparatory Classes

Sep. 2010 - Jun. 2012

- National examination for admission to engineering schools, Mathematics and Physics, Ranked : 37/2000.

Featured Projects

PerReg+: Generalizable Trajectory Prediction using Representation Learning

Switzerland

VITA EPFL - Valeo AI

Jan. 2023 - Nov. 2023

- Designed and implemented PerReg+, an advanced trajectory prediction model integrating Dual-Level Representation Learning with Self-Distillation and Masked Reconstruction to capture global context and granular details.
- Enhanced multimodal handling through register-based queries, pretraining and adaptive prompt tuning.
- Achieved SOTA results on three motion datasets, with a 6.8% error reduction on the small dataset and an 11.8% improvement in cross-domain generalization.

UniTraj: Unified Framework for Cross-Dataset Prediction

Switzerland

VITA EPFL - Valeo AI

Jan. 2024 - Sep. 2024

- Co-developed UniTraj: a framework that harmonizes diverse datasets, models, and evaluation metrics.
- Benchmarked various prediction models across multiple autonomous vehicle datasets, providing critical performance insights on prediction models' cross-dataset generalizability and dataset characteristics.
- Achieved state-of-the-art results on the nuScenes dataset by enhancing data diversity and scalability.

Forecast-PEFT: Efficient Fine-Tuning for Motion Prediction

Switzerland

VITA EPFL

Jan. 2024 - Sep. 2024

- Designed Forecast-PEFT, a fine-tuning strategy significantly reducing training costs by freezing most model parameters and leveraging prompts and adapters.
- Enhanced prediction accuracy by up to 9.6% compared to conventional methods, achieving state-of-the-art efficiency with only 17% of the trainable parameters.
- Conducted cross-dataset evaluations to demonstrate robust generalization.

Securing Autonomous Driving: Backdoor Attacks in Prediction

Switzerland

VITA EPFL - Valeo AI

May. 2023 - Mar. 2024

- Identified vulnerabilities in motion prediction models to backdoor attacks.
- Developed a defense mechanism using social attention to detect and mitigate abnormal agent influence, reducing attack success rates without degrading benign performance.
- Validated the approach on two datasets.

Social-Transmotion: Multi-Modal Human Motion Prediction

Switzerland

VITA EPFL

Sep. 2022 - Jan. 2022

- Designed Social-Transmotion, a transformer-based model that integrates diverse multimodal visual cues.
- Employed masking techniques to ensure robustness against missing cues and validated on multiple datasets.
- Advanced understanding of critical spatiotemporal interactions through temporal and spatial attention analysis.

Certificates & Awards

2024	Self-leadership , with Melissa Davies	EPFL, Switzerland
2023	Best Paper Award , George N. Saridis Best Transactions Paper Award of The IEEE TIV	INRIA Paris, France
2023	AgilePM Project Management Certification , with Niels Van Bemmelen	EPFL, Switzerland
2023	Essential Management Skills , with Heather Bunney	EPFL, Switzerland
2020	ICRA 2020 Prediction Challenge , 2nd Position Award	UTK, USA

Skills

Coding	Python, PyTorch, TensorFlow, Git, Docker, WandB, OpenCV, NumPy, SciPy, Scikit-learn, Pandas
Deep Learning	Self-Supervised Learning, Representation Learning, Transfer Learning, Graph Neural Networks
Computer Vision	Semantic Segmentation, Object Detection, Multi-Object Tracking, Motion Prediction
Languages	English (Fluent), French (Fluent), Arabic (Native)

Teaching Experience

2024	Students Projects Supervision , 10 Semester Projects	EPFL, Switzerland
2023	Master Thesis Student Supervision ,	EPFL, Switzerland
2023	TA, invited lecturer , projects supervision in Deep Learning for Autonomous Driving Master Course	EPFL, Switzerland
2019	Lead TA, invited lecturer , in Machine Learning Master Course	ESIEE, Paris

Publications

Towards Generalizable Trajectory Prediction using Dual-Level Representation Learning and Adaptive Prompting

[Kaouther Messaoud](#), Matthieu Cord, Alexandre Alahi. Under Review

UniTraj: A Unified Framework for Scalable Vehicle Trajectory Prediction

Lan Feng, Mohammadhossein Bahari, [Kaouther Messaoud](#), Éloi Zablocki, Matthieu Cord, Alexandre Alahi. **ECCV 2024**

Manipulating Trajectory Prediction with Backdoors

[Kaouther Messaoud](#), Kathrin Grosse, Mickael Chen, Matthieu Cord, Patrick Pérez, Alexandre Alahi. Under Review

Social-Transmotion: Promptable Human Trajectory Prediction

Saeed Saadatnejad, Yang Gao, [Kaouther Messaoud](#), Alexandre Alahi. **ICLR 2024**

A Lightweight Goal-Based model for Trajectory Prediction

Amina Ghoul, [Kaouther Messaoud](#), Itheri Yahiaoui, Anne Verroust-Blondet, Fawzi Nashashibi. **ITSC 2022**

Trajectory Prediction for Autonomous Driving based on Multi-Head Attention with Joint Agent-Map Representation

[Kaouther Messaoud](#), Nachiket deo, Mohan M. Trivedi and Fawzi Nashashibi. **IV 2021**

Attention Based Vehicle Trajectory Prediction

[Kaouther Messaoud](#), Itheri Yahiaoui, Anne Verroust-Blondet, and Fawzi Nashashibi. **TIV 2020**

Relational Recurrent Neural Networks For Vehicle Trajectory Prediction

[Kaouther Messaoud](#), Itheri Yahiaoui, Anne Verroust-Blondet, and Fawzi Nashashibi. **ITSC 2019**

Non-local Social Pooling for Vehicle Trajectory Prediction

[Kaouther Messaoud](#), Itheri Yahiaoui, Anne Verroust-Blondet, and Fawzi Nashashibi. **IV 2019**