Souhaiel BenSalem

Personal Data

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Research Interests

I am deeply passionate about visual cognition (from images or video), learning theory (especially the self-supervised and unsupervised learning paradigms) and representation learning. More precisely, I am interested in the convergence of these fields. I believe that vision has always been a part of an action-perception loop, informing and guiding both learning and acting processes, thereby acting as a catalyst for more intuitive interactions and autonomous decision-making in complex, visually-centric environments. To this end, I am interested in developing methods to apply the aforementioned paradigms to train predictive architectures, particularly in the context of robot learning, to learn robust and hierarchical (multi-levels of abstraction) representations.

Work Experience

Apr. 2024 - Present
Deep Learning & Computer vision Research Engineer at Parrot Drones, Paris, France
Working within the Deep Learning and Computer Vision team to develop algorithms and train models for depth estimation, image denoising and obstacle avoidance, contributing to the autonomous flight capabilities of Parrot's market leading professional drones .

May 23 - Oct. 23
Research Internship (Computer Vision & Deep Learning) at Inria, Paris, France
Research internship within the Astra-Vision team (Inria Paris + Valeo.ai) working on data-efficient Language driven 3D scene understanding by transferring knowledge from 2D VLMs/VFMs to 3D networks.
Advised by Raoul de Charette, Renaud Marlet, Gilles Puy and Alexandre Boulch.

Mar. 22 - Aug. 22
Research Internship (Reinforcement Learning) at Inria & INSA Lyon, Lyon, France
Research internship within Inria's CHROMA Team. Worked on Multi-agent Reinforcement Learning for Dec-POMDPs under hierarchical information sharing, studying its consequences on the theory of cooperative MARL and the new properties induced in this setting.

Mar. 21 - Sept. 21
Robotics and Embedded Systems Internship at STMicroelectronics, Tunis, Tunisia
Worked within the MCU division of STMicroelectronics on the design and development of an open HW/SW robotic architecture for STM32 didactic purposes. Designed the motherboards for the robot, developed the sensor drivers and code for various tasks executed by the robot, and implemented the didactic project, which included tutorials and teaching materials.

July 20 - Sept. 20
Embedded C/C++ internship at STMicroelectronics, Tunis, Tunisia
Worked within the MCU division of STMicroelectronics and engaged in software development for a multi-purpose mobile robot, creating software tools for MCU/sensor communication and developing components for tasks such as obstacle avoidance, line following, maze solving, and wireless control.

Education

2022 - 2023
M.Sc. in Applied Mathematics (MVA), ENS Paris-Saclay, Paris, France
Master's degree in Applied Mathematics, Computer Vision and Machine Learning.
Graduated with highest honours.
Coursework: Deep Learning, (Deep) Reinforcement Leaning, generative models for images, object recognition and (3D) computer vision, Graphs in ML, convex optimization

2021 - 2022
M.Sc.in Autonomous Robotics (MARS), Grenoble INP - UGA, Grenoble, France
Master's degree in Mobile Autonomous Robotic Systems.
Courses in advanced control theory (MPC and Non-linear control), Robotics (perception, navigation and planning) and AI / ML (statistical learning, AI for robotics)

2018 - 2021
M.S.E.in Robotics and Embedded Systems, University of Carthage, Tunis, Tunisia
National engineering degree in Mechatronics, Robotics and Embedded Systems.
Rank: 1
Courses in applied mathematics, control theory, soft computing, signal/image processing and embedded systems.

2015 - 2018
Pre-Engineering phase: Mathematics and Physics, IPEIT, Tunis, Tunisia
Intensive courses in Mathematics, theoretical physics and computer science

Languages

English:	Fluent (advanced C1)
French:	Fluent (advanced C1)
German:	Notions

Technical Skills

Tools and Languages:	Python, C/C++,Matlab/simulink, ROS, Git, Docker
Applied mathematics:	Modelling, Probability and Statistics, Game theory, Convex Optimization, signal and image processing
Robotics and Control:	Non linear and model predictive control, navigation and path planning, perception and object tracking

Libs: numpy, pytorch, tensorflow, keras, jax, SciPy, scikit-learn, dopamine, openCV, acme, matplotlib, pandas, jupyter, lasagne, numba, pillow, networkx, flask

Selected Academic Projects

2023 *Self-Supervised Learning of Visual Representations*
- Study and evaluation of the VICReg method
- Pretrain a visual backbone on smaller datasets
- Extend the evaluation of an ImageNet pretrained model to new downstream tasks

2023 *GAN-based Photo Realistic Single Image Super Resolution*
- Tackle the DIV2K dataset using a variety of single image super resolution methods, GAN-based such as SRGAN, ESRGAN or non-GAN-based such as SRResNet
- Proposed a new perceptual loss function for more efficient training
- Examined their performances for different loss functions

2023 *Audio Denoising U-Net*
- Designed and trained a UNet model for advanced audio denoising tasks.
- Leveraged predicted noise magnitude spectograms for noise separation.
- Used inverse STFT for accurate original audio reconstruction.

2023 *Exposure Fusion for HDR Imaging*
- Implemented Exposure Fusion technique, eliminating the need for physically-based HDR assembly
- Achieved image quality comparable to traditional tone mapping operators

2023 *Image Dehazing with Boundary Constraint and Contextual Regularization*
- An attempt to recreate DXO's ClearView Plus technology
- Studied, imlemented and adapted the image dehazing technique introduced by Meng et al

2022 *On flight drone estimation*
- Estimating the aerodynamic forces acting on a drone using an extended Kalman filter.

2022 *Longitudinal and Lateral Control of an automotive vehicle*
- Implemented a control strategy for a vehicle, modeled based on the Bicycle-Model, focusing on both lateral and longitudinal dynamics
- Implemented model predictive control (MPC) for automated steering and a PI controller for longitudinal speed tracking
- Unified longitudinal and lateral control strategies, enhancing overall control performance, validated through simulations using the Pure Pursuit algorithm

2021 *Smart surveillance & violence detection*
- Edge-AI-based surveillance camera using a raspberry pi board and its camera module
- Transfer learning for violence detection using a CNN-LSTM based model

2020 *Deep Learning on ARM-based MCUs*
- Deploying the MNIST handwritten digit recognition model on the STM32F429 DISCOVERY board

2020 *Drone modelling and control*
- Modelling, simulation and control of a DJI Mavic Pro Quadcopter under simplified assumptions

Blog Posts

Feb 2022 *Introduction to Cooperative Autonomous Multi-Robot Systems*

Miscellaneous

Interests *I am passionate about reading (research papers included), reverse-engineering, (discussing) anthropology and game theory.*