Mohamed Nennouche

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EDUCATION

Centrale Méditerranée — Marseille, France
PhD degree - Underwater Optical Wireless Communications — *February 2023 - In progress*

Main focuses: *Underwater optical communication, machine learning, deep learning, signal processing, signal modulation and demodulation, channel modeling, semantic communication*

Brief summary: In this thesis, I primarily work on underwater and water-to-air wireless optical communications under the supervision of Dr. Mohammad-Ali Khalighi. My research mainly focuses on modeling and estimating optical channels (underwater and water-to-air) and applying artificial intelligence to these communications for signal demodulation and end-to-end systems, in comparison with traditional approaches.

Ecole Nationale Polytechnique — Algiers, Algeria
Engineering degree - Electronics - 17.5/20 — *September 2019 - July 2022*

Courses: *Analog and digital electronics, embedded systems, embedded computing (C-C++), telecommunication, advanced signal processing, image processing, machine learning*

Ecole Nationale Polytechnique — Algiers, Algeria
Master's degree - Signal and Telecommunication - 17/20 — *Septembre 2019 - July 2022*

Courses: *Telecommunication, antenna, antenna processing, embedded computing, machine learning*

Ecole Nationale Polytechnique — Algiers, Algeria
Preparatory classes — *Septembre 2017 - July 2019*

Courses: *Calculus, Algebra, Mechanics, Chemistry, Electromagnetic, Fluid mechanics, Computer science*

Main achievements: Ranked 4/350 (top 1.4%) during my two years of preparatory studies and then 5/1080 (top 0.5%) in the national competitive entrance exam to the engineering schools.

RESEARCH INTEREST

- Visible Light Communications (VLC) / Free-Space Optics (FSO) / Semantic Communication / Deep Learning in Signal Processing and Information theory

PUBLICATIONS

- **Manuscripts in preparation**:

  - **M. Nennouche**, MA. Khalighi, AA. Dowhuszko, D. Merad, JM. Boï "Bit Error Rate Performance of Water-to-Air Wireless Optical Channel Using a Mixture of Gamma Distribution"

- **Manuscripts in submission**:

  - **M. Nennouche**, MA. Khalighi, AA. Dowhuszko, D. Merad, JM. Boï "Water-to-Air Optical Wireless Channel Modeling Considering Surface Waves and Air Bubbles Effects" - Submitted to a Q1 journal.

  - **M. Nennouche**, MA. Khalighi, AA. Dowhuszko, D. Merad, JM. Boï "Semantic Underwater Optical Wireless Communication Using Variational Autoencoders" - Submitted to an international conference.

- **Conference Proceedings**:

  - **M. Nennouche**, MA. Khalighi, A. Dowhuszko, D. Merad, JM. Boï "Application of Machine Learning to Signal Detection in Underwater Wireless Optical Communication Links" *IEEE International Symposium on Communication Systems, Networks and Digital Signal Processing - CSNDSP 2024*

SKILLS SUMMARY

- **Programming Languages**: Python, C, C++, SQL, Bash, VHDL, Matlab, Latex, Arduino, Mbed
- **Libraries**: Scikit-learn, TensorFlow, Keras, Pytorch, Pandas, Numpy, Matplotlib, Seaborn, Scipy, OpenCV, SymPy
- **Tools and databases**: GNU Radio, GIT, PostgreSQL, MySQL, SQLite
- **Platforms**: Linux, Windows, WSL, Arduino, Raspberry, AWS, GCP
- **Soft Skills**: Leadership, Project Management, Writing, Public Speaking, Time Management

EXPERIENCE

- **Aix-Marseille Université**
  On site
  Temporary teacher
  Jan 2025 - Present
  - **Role**: I work at the University of Aix-Marseille as a part-time lecturer at its Institut Universitaire de Technologie Réseaux et Télécommunications. I'm in charge of the "Physics of Telecoms" module for 2nd year students, where I give a course on electromagnetic waves and their propagation in transmission lines, and impedance matching techniques. I'm also in charge of the 'Signals and Systems for Transmissions' module for 1st year students, where I lead practical work on transmission and filtering techniques for telecoms systems.
  - **Courses and labs**: Courses: Physics of Telecoms / Labs : Signals and Systems for Transmissions
  - **Tools and skills**: Digital communication, High-frequency systems, Smith chart, Filters, Matlab

- **DICE - Aalto University**
  On site
  Visiting PhD Student (Full-time)
  May 2024 - June 2024
  - **Role**: I successfully completed a Short Term Scientific Mission (STSM) funded by the NewFocus COST association through its CA19111 action. I'm working under the supervision of Dr. Alexis Dowhuszko in the VLC laboratory. Our objective is to gather experimental data from an optical link (VLC) emulating communication between a device on the surface of the sea and an aircraft, and to apply detection methods based on Machine Learning and comparing them to traditional signal detection techniques such as Maximum Likelihood Detection.
  - **Technologies and tools**: Optical communication, VLC, Advanced signal processing, GNU Radio, Machine Learning, Deep Learning, Python

- **LIS Lab - Centrale Méditerranée**
  On site
  PhD Student (Full-time)
  Feb 2023 - Present
  - **Subject : Hybrid RF/Optical Links for Airborne-Underwater Data Communication**: I'm conducting my thesis at the Ecole Centrale Méditerranée under the supervision of Pr. Ali Khalighi. During this thesis I will have to intervene mainly on three parts: 1) Optimize the optical communication in the seabed sensor network 2) Ensure an optimal optical communication between the central node of the sensor network and the platform above the water 3) Ensure the optical/RF conversion of the transmitted signal and ensure the sending of the data to a drone or a low orbit satellite.
  - **Technologies and tools**: Optical communication, Advanced signal processing, Hybrid telecommunication, Deep learning for telecommunication, Unsupervised Learning, Channel coding, Python

- **Centrale Méditerranée**
  On site
  Temporary teacher
  Sept 2023 - Present
  - **Role**: I teach at Ecole Centrale Méditerranée as a part-time lecturer, mainly for practical work and seminars on digital communications, the Internet of Things, 5G and 6G, and signal processing. Through these activities, I teach practical work to 3rd and 4th year students.
  - **Seminars and courses**: Seminar: Using optical wireless communications in today's world / Training : IoT for Smart Bulding with MQTT
  - **Tools and skills**: JavaScript, NodeJS, MQTT, LoRa, Optical Communications, Teaching, Wireless communications, Public speaking

- **Decathlon El Djazair**
  On site
  Data Analyst (Full-time)
  July 2022 - Jan 2023
  - **Role**: My role in the company is to lead the data team and to carry out the company's projects. This includes using the different data sources of Decathlon El Djazair (database, API, sheets...) and extracting analysis and dashboards to make business decisions.
  - **Technologies and tools**: Python, SQL, PostgreSQL, AWS S3, AWS Redshift, AWS Quicksight, GCP, Google Data Studio, Excel

- **Paris-Saclay university**
  On site
  Intern (Full-time internship)
  Sept 2021 - Nov 2021
  - **Role**: In this internship, I was in charge of realizing a fully instrumented water rocket through the study and the realization, all under Mbed environment
  - **Technologies and tools**: C, C++, Mbed

- **3/4 School**
  Remote
  Organic chemistry teacher (Part-time)
  Sept 2019 - July 2021
  - **Role**: I was in charge of the organic chemistry module at the Ecole 3/4 for the preparation of students in their second year of preparatory classes for the national competitive entrance exam to engineering schools.
  - **Impact**: Course has been taken by 250+ students so far with 100% of success in the final exam.

- **Bomare Company**
  On site
  Engineers intern (Full time internship)
  Mars 2021 - April 2021 and July 2021 - Sept 2021
  - **Role**: I had the chance to do 2 internships at Bomare Company in the industrial projects department, the first internship was a discovery internship of the company, the second was a more concrete internship participating directly in the department's projects in the realization of an embedded systems project
  - **Technologies and tools**: C, C++, Arduino, ESP32

Scientific talks and presentations

- **CSNDSP 2024** — On-site
  Rome, Italy — *July 2024*
  - **Title**: Application of Machine Learning to Signal Detection in Underwater Wireless Optical Communication Links.
  - **Summary**: I presented our published paper at the conference on the use of Machine Learning algorithms for signal detection and demodulation in underwater optical wireless transmission.

- **WG/MC meeting NEWFOCUS COST Action CA19111** — On-site
  Stockholm, Sweden — *July 2024*
  - **Title**: Experimental Evaluation of ML-based Signal Detection Algorithms for Multi-Level Modulation Techniques in a VLC Link
  - **Summary**: I presented the results obtained during my STSM at Aalto University, as well as the prospects we have for publishing the results.

- **4th Training School NEWFOCUS COST Action CA19111** — On-site
  Madrid, Spain — *Apr 2024*
  - **Title**: Artificial Intelligence for Underwater Wireless Optical Communications (UWOC) systems
  - **Summary**: I presented a brief state-of-the-art of the use of artificial intelligence in the field of underwater wireless optical communications, as well as several prospects for future developments.

Volunteer and Training Experience

- **Polytechnic Algiers Community** — Remote
  Voluntary experiences — *Sept 2022 - Present*
  - **PhD Alumni Directory (PAD)**: Contributed in the first version of the PAD, a collection of the experiences of Ecole Nationale Polytechnique alumni who have turned to research, and preparation of the second edition.
  - **Scientific section Podcast**: hosted several episodes of the association's science podcast, which aims to present the research work of Ecole Nationale Polytechnique alumni working in the research world.

- **EU COST ACTION CA19111 NEWFOCUS 4th Training School** — Madrid, Spain
  Participation in this training school organized around optical wireless communications — *Apr 2024*

- **Micro Club - University of Science and Technology Houari Boumediene** — Remote
  Conducted 6 day online course on introduction to deep learning for robotics with Python. — *Mar 2024*

- **13 minutes des jeunes chercheurs - Aix Marseille University** — Marseille, France
  Participation as a speaker on the applications of my thesis topic to environmental protection. — *Nov 2023*

- **Vision & Innovation Club - Ecole Nationale Polytechnique** — Remote
  Voluntary experiences — *Nov 2019 - Sept 2022*
  - **Sept 2022**: Conducted 3 days online introduction to Python for Machine Learning training.
  - **Dec 2020 - Dec 2021**: Manager of the club's finance, logistics and external relations department.
  - **Sept 2020 - Nov 2021**: Head of the E-lab, mechatronics laboratory of the club within the Electronics department.
  - **Nov 2019 - Dec 2020**: Member of the club's finance, logistics and external relations department.

References

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  Associate Professor - Centrale Méditerranée, Institut Fresnel
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- **Alexis Alfredo Dowhuszko, PhD**
  Research Fellow - Aalto University, Department of Information and Communications Engineering
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- **Djamal Merad, PhD**
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