



TO MAGNIFICO RETTORE OF UNIVERSITA' DEGLI STUDI DI MILANO

ID CODE 5834

I the undersigned asks to participate in the public selection, for qualifications and examinations, for the awarding of a type B fellowship at Dipartimento di Informatica Giovanni Degli Antoni dell'Università degli Studi di Milano

Scientist- in - charge: Prof. Piuri Vincenzo

**Najoua Kouka**

## CURRICULUM VITAE

### PERSONAL INFORMATION

Surname	Kouka
Name	Najoua

### PRESENT OCCUPATION

Appointment	Structure
Research doctor	REGIM-Lab.: REsearch Groups in Intelligent Machines, University of Sfax, National Engineering School of Sfax (ENIS), BP 1173, Sfax, 3038, Tunisia

### EDUCATION AND TRAINING

Degree	Course of studies	University	year of achievement of the degree
PhD	Computer Science and Engineering	National College of Engineers at Sfax, Tunisia	2023
Engineering	Computer and Multimedia Technology Web	Higher Institute of Computer Science and Multimedia at Sfax, Tunisia	2015
Bachelor	Computer Science	Higher Institute of Computing and Mathematics of the University of Monastir, Tunisia	2012



## REGISTRATION IN PROFESSIONAL ASSOCIATIONS

Date of registration	Association	City
2023	IEEE Women in Engineering Membership	USA
2020-2023	IEEE Computational Intelligence Society (CIS)	USA
2021-2022	CIS Secretary	IEEE Tunisia section
2017-2023	IEEE Young Professionals	USA
2016-2023	IEEE Membership	USA

## FOREIGN LANGUAGES

Languages	level of knowledge
Arab	Mother Tang
French	Read, spoken and written
English	Read, spoken and written

## AWARDS, ACKNOWLEDGEMENTS, SCHOLARSHIPS

Year	Description of award
2022	Certificate of Winner: Outstanding participation and honorable achievement to the 7th IDSS (Intelligent Decision Support Systems) 2022 COVID-19 AI Detection Challenge: First place
2021	Scholarship of IEEE CIC for supporting the project "EEG Channel Selection-based Binary Particle Swarm Optimization with Recurrent Convolutional Autoencoder for Emotion Recognition" ( <a href="https://cis.ieee.org/activities/educational-activities/research-grants">https://cis.ieee.org/activities/educational-activities/research-grants</a> )
2020	Scholarship of EU for supporting 3 months internships at LISSI laboratory, France
2020	Registration Grant of IEEE CEC 2020 Paper: "Dynamic Multi-Objective Particle Swarm Optimization with Cooperative Agents"

## TRAINING OR RESEARCH ACTIVITY

### Skills and experience during PhD in Computer Sciences:

During my PhD in Computer Science, supervised by Professor Adel M. Alimi, I had the opportunity to delve into the field of evolutionary computation with the goal of enhancing the performance of Particle Swarm Optimization (PSO) in tackling complex problems. Specifically, our research focused on employing the PSO algorithm to address the challenges posed by problems with an increasing number of objectives and dynamic properties. To tackle the real-world complexity, I investigated the proposed approach in the context of EEG-channel selection for emotion recognition and seizure prediction.

In our first contribution, we introduced a novel variant of the PSO algorithm designed to handle many-objective optimization problems (MaOPs), which involve more than three objectives. Traditional PSO algorithms struggle to maintain diversity and convergence across all objectives as the number of objectives increases. To address this challenge, we proposed new selection criteria based on Inverted Generational Distance (IGD). Additionally, we utilized a multi-agent system (MAS) to model the intelligent behavior of multi-swarms, leveraging MAS features such as cooperation and coordination. This work, conducted in collaboration with Professor Amir Hussain from Edinburgh University, has been successfully published in



the Information Sciences journal (2023).

In our second contribution, we developed a Change Severity Degree-based Dynamic Multi-Objective Optimization Algorithm with Alternating Response Strategy (DMOPSO-ARS). We recognized that many real-world optimization problems are not static but evolve over time, requiring the identification of optimal solutions in a timely manner. Our approach involved dynamically selecting an adaptive response strategy, including predicting the moving optimum using a Long short-term memory (LSTM) model and incorporating these predictions into the optimization process. In addition, we introduced elite-based learning to guide the population towards new promising search directions when detecting low-severity environmental changes. Experimental studies, comparing DMOPSO-ARS with other algorithms, demonstrated its effectiveness in tracking environmental changes and outperforming state-of-the-art approaches. These contributions enabled me to acquire valuable skills in the optimization field, particularly in static and dynamic optimization.

The third and fourth contributions of my research involved the application of the proposed approach to real-world problems, specifically the selection of relevant EEG channels. These two contributions are supervised by Professor Patrick Siarry (UPEC University, France).

We formulated this task as MaOPs, with each solution encoded as a binary vector indicating whether a channel is selected or not. The objective was to identify the most activated brain regions for each task. In the case of EEG-based emotion recognition, we further enhanced our previous MaOPs approach by adapting a recent learning strategy (convLSTM-based model). For the prediction of the preictal state in epilepsy, we addressed the challenge of random population initialization by applying mutual information. The aim here was to alert epileptic patients of an impending seizure onset, thereby preventing them from potentially harmful situations. This contribution is currently under review in the Cognitive Computation Journal.

Overall, throughout my PhD, I gained expertise in utilizing evolutionary algorithms to solve a wide range of optimization problems.

[Papers and codes for each contribution are shared in the following link:](#)

[https://drive.google.com/drive/folders/1dswKwLwFg\\_WTevQD7VzqfZdAulKBpCOH?usp=sharing](https://drive.google.com/drive/folders/1dswKwLwFg_WTevQD7VzqfZdAulKBpCOH?usp=sharing)

### **Current research work: Optimization approaches for green deep learning**

After my thesis project, I had the chance to approach the field of Neural Network pruning and quantization, with a collaboration of Professor Mounir Ben Ayed (University of Sfax, Tunisia ) and Assistant Professor Rahma Fourati (University of Jendouba, Tunisia).

This research project is composed of three work packages as follows:

Work package 1: Binary PSO for solving Multi-Objective Filter pruning problem

Work package 2: Bi-level optimization: Multi-Objective layer and filter pruning problem

Work package 3: A hybridization between Filter pruning and quantization applied in EEG signals.

### **Training Courses:**

- June 2020: Course certificate «Neural Networks and Deep Learning» (An online non-credit course authorized by deeplearning.ai and offered through Coursera)



- June 2020: Course certificate « Machine Learning Foundations: A Case Study Approach (A MOOC from the University of Washington and offered through Coursera)
- April-Mai 2015: Certificate in English of Business Communication
- Mai- June 2014: Certificate in J2EE Programming
- Aug 2012-Sep. 2012 Certificate French language, Monastir Languages, Tunisia
- 13 Feb. 2012-15 Feb. 2012 Attendance certificate «Design and Develop Mobile Application » Orange Society, Monastir, Tunisia

## PROJECT ACTIVITY

Year	Project
2021	<p>EEG Channel Selection-based Binary Particle Swarm Optimization with Recurrent Convolutional Autoencoder for Emotion Recognition. Supported by IEEE CIS</p> <p>UPEC -PARIS-EST CRETEIL University, Laboratory of Intelligent Images, Signals, and Systems, UPEC University) » with Pr. Patrick Siarry.</p> <p>Main research activities:</p> <ol style="list-style-type: none"> <li>1- Design a new Particle Swarm Optimization algorithm for EEG channel selection</li> <li>2- Study and experimentation on EEG datasets for emotion recognition</li> <li>3- Research report</li> </ol>

## PATENTS

Patent

## CONGRESSES AND SEMINARS

Date	Title	Place
9-12 July 2023	Certificate of Appreciation in organizing the 28th IEEE Symposium on Computers and Communications (IEEE ISCC 2023)	Gammarth - Tunisia
December 18-20, 2022	35th Workshop on Intelligent Machines: Theory & Applications Of ReGIM-Lab (35th WIMTA)	Sousse, Tunisia
July 15 - 17 2022	1st International Conference on Information Technology & Smart Industrial Systems ITSIS2022	Virtual Meeting
December 29, 2021	34th Workshop on Intelligent Machines: Theory & Applications Of ReGIM-Lab (34th WIMTA)	Sfax, Tunisia
March 17-18, 2021	33th Workshop on Intelligent Machines: Theory & Applications Of ReGIM-Lab (33th WIMTA)	Sfax, Tunisia



Jul 19- 24, 2020	IEEE World Congress on Computational Intelligence (IEEE WCCI)	Virtual Meeting
Jul 19- 24, 2020	Poster presentation at the IEEE CEC entitled: "Dynamic Multi-Objective Particle Swarm Optimization with Cooperative Agents"	Virtual Meeting
Dec 25-27 2020	32 <sup>th</sup> Workshop on Intelligent Machines: : Theory & Applications Of ReGIM-Lab (32th WIMTA)	Virtual Meeting
January 16, 2016	Attendance Certificate « Training on scientific research indicators»	Sfax, Tunisia
October 28-30, 2016	Oral Presentation at the Applied Computing Conference 2016, entitled: "A NEW ARCHITECTURE BASED DISTRIBUTED AGENTS USING PSO FOR MULTIOBJECTIVE OPTIMIZATION"	Virtual Meeting

## PUBLICATIONS

Articles
Kouka N., Fourati R., Fdhila R., Siarry, P. and Alimi, A.M EEG channel selection-based binary particle swarm optimization with recurrent convolutional autoencoder for emotion recognition, <i>Biomedical Signal Processing and Control</i> , (84),2023 ( <a href="#">Q1 with impact factor 5.076</a> )
Kouka N., BenSaid, F., Fdhila, R., Fourati, R., Hussain, A., and Alimi, A. M. A Novel Approach of Many-Objective Particle Swarm Optimization with Cooperative Agents based on an Inverted Generational Distance Indicator. <i>Information Science journal</i> , 2023 ( <a href="#">Q1 with impact factor 8.233</a> )

Articles in reviews
Kouka, N., Fourati, R., Baghdadi, A , Siarry, P., and Alimi, A. M., A mutual information-based many-objective optimization method for EEG channel selection in the epileptic seizure prediction task. <i>Cognitive Computation</i> 2023 (Submitted) ( <a href="#">Q1</a> )
Kouka, N., Fourati, R., Fdhila, R., Hussain, A., and Alimi, A. M. A Change Severity Degree-based Dynamic Multi-Objective Optimization Algorithm with Adaptive Response Strategy. <i>Information Science journal</i> , 2023 (submitted). ( <a href="#">Q1</a> )

Congress proceedings
Kouka N., Fdhila R., Hussain A. and Alimi, A.M, "Dynamic Multi Objective Particle Swarm optimization with Cooperative Agents," 2020 IEEE Congress on Evolutionary Computation (CEC), Glasgow, United Kingdom, 2020, pp. 1-8 ( <a href="#">Core A</a> )
Kouka N., Fdhila R., Alimi A.M. (2017) Multi Objective Particle Swarm Optimization Based Cooperative Agents with Automated Negotiation. In : Liu D., Xie S., Li Y., Zhao D., El-Alfy ES. (eds) <i>Neural Information Processing. ICONIP 2017. Lecture Notes in Computer Science</i> , vol 10637. Springer, Cham ( <a href="#">Core A</a> )
Kouka, N., Fdhila, R., Alimi, A.M.: A NEW ARCHITECTURE BASED DISTRIBUTED AGENTS USING PSO FOR MULTIOBJECTIVE OPTIMIZATION. In : 13th International Conference on Applied Computing, (2016) ( <a href="#">Core C</a> )



## OTHER INFORMATION

<p><b>TEMPORARY TEACHER</b> - Object-oriented concepts at Higher Institute of Computer Science of Mahdia-Tunisia (September-January2023)</p>
<p><b>Research internship</b> in « Laboratory of Intelligent Images, Signals, and Systems, UPEC University) » with Pr. Patrick Siarry (<a href="mailto:siarry@u-pec.fr">siarry@u-pec.fr</a>)</p> <ul style="list-style-type: none"><li>• October 2021 supported by University of Sfax (4000 TND)</li><li>• July- August 2021 supported by <u>IEEE CIS Grant (2500 \$)</u></li><li>• September- December 2020 supported by EU (3000 €)</li></ul>
<p><b>Reviewer at:</b></p> <ul style="list-style-type: none"><li>• IEEE CEC since 2021</li><li>• IEEE Transactions on Cybernetics (2022)</li><li>• ICONIP (2023)</li><li>• Journal of Computational Design and Engineering (2023)</li></ul>
<p><b>Special Skills:</b></p> <ul style="list-style-type: none"><li>• Development language: Python, Java   J2EE</li><li>• Python frameworks (Pandas, Numpy, Scikit-learn, Scipy), Jupyter Notebook, Matplotlib</li><li>• Tensorflow/Keras, Pytorch</li><li>• Recurrent neural networks (LSTM, ConvLSTM)</li><li>• Generative models ( data augmentation: cVAE, cGAN)</li></ul>
<p><b>Referees:</b></p> <p>Pr. Adel M. Alimi (Sfax University, Tunisia) <a href="mailto:adel.alimi@ieee.org">adel.alimi@ieee.org</a> Pr. Patrick Siarry (UPEC University, France) <a href="mailto:siarry@u-pec.fr">siarry@u-pec.fr</a> Pr. Amir Hussain (Edinburgh University, Brittan) <a href="mailto:hussain.doctor@gmail.com">hussain.doctor@gmail.com</a></p>

Declarations given in the present curriculum must be considered released according to art. 46 and 47 of DPR n. 445/2000.

The present curriculum does not contain confidential and legal information according to art. 4, paragraph 1, points d) and e) of D.Lgs. 30.06.2003 n. 196.

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Place and date: Mahdia, Tunisia, 01/08/2023