



**ERCIM "ALAIN  
BENSOUSSAN"  
FELLOWSHIP  
PROGRAMME**



## Scientific Report

First name / Family name

Youcef Djenouri

Nationality

Algerian

Name of the *Host Organisation*

NTNU

First Name / family name  
of the *Scientific Coordinator*

Kjetil Nørvåg

Period of the fellowship

01/07/2018 to 29/02/2020

# I - SCIENTIFIC ACTIVITY DURING YOUR FELLOWSHIP

My research activities were organized from 01.07.2018 to 29.02.2020 at NTNU in the Department of Computer and Information Science (IDI) under the supervision of Prof. Kjetil Nørnvåg.

During my fellowship, I have worked on the application of data mining and machine learning on solving different complex problems. The main directions of research have been:

- **Improving Fundamental Data Mining Algorithms:** In this context, the aim was to improve the various data mining techniques in order to deal with large and big database. In particular, we have been attempting to introduce concepts and ideas from different classical and emergent optimization domains such as: decomposition, and high performance computing. The outcome of this research is two research papers, one accepted paper in prestigious conference ICDE (International Conference on Data Engineering), and one submitted to a top tier journal in data mining (ACM Transactions on Knowledge Discovery from Data).
- **Smart Building:** I worked with other colleagues on other research institutes in topics related to smart building. We wrote a survey paper exploring the different machine learning techniques in addressing the smart building challenges such as occupancy detection, activity recognition, preferences and behaviors, energy profiling and demand estimation, and others. The outcome of this research is published in one of the top journal in computer science, which is ACM Computing Surveys.
- **Intelligent Transportation:** It aims to explore machine learning techniques such outlier detection, clustering density estimation in urban traffic data. In the first work, we proposed several data mining algorithms based to identify the group of trajectory outliers. The outcome of this research is a paper submitted to DASFAA (International Conference on Database Systems for Advanced Applications). In the second work, we produced a comprehensive survey paper for space time series clustering, with a case study applied on intelligent transportation. The outcome of this research is one journal paper submitted to IEEE Access.
- **Others:** In addition, several collaborations have been made, with national colleagues: Dr. Jerry Chun-Wei Lin (Western University of Applied Sciences, Bergen, Norway), or international

colleagues: Prof. Djenouri Djamel (West University of Bristol England, Bristol, UK), Prof. Florent Masegla (INRIA, Montpellier, France), Dr. Alberto Cano (Virginia Commonwealth University, Virginia, USA), and others. The outcome of this research is several papers published in international conferences and journals.

## II - PUBLICATION(S) DURING YOUR FELLOWSHIP

During my fellowship, I succeeded to publish several papers, and making strong collaborations with several research institutes. In the following, I give some selected publications:

- 1- **Djenouri, Youcef**, Jerry Chun-Wei Lin, Kjetil Nørvåg, and Heri Ramampiaro. "Highly Efficient Pattern Mining Based on Transaction Decomposition." In *2019 IEEE 35th International Conference on Data Engineering (ICDE)*, pp. 1646-1649. IEEE, 2019.
- 2- Djenouri, Djamel, Roufaida Laidi, **Youcef Djenouri**, and Ilangko Balasingham. "Machine Learning for Smart Building Applications: Review and Taxonomy." *ACM Computing Surveys (CSUR)* 52, no. 2 (2019): 24.
- 3- Lin, Jerry Chun-Wei, Yuyu Zhang, Binbin Zhang, Philippe Fournier-Viger, and **Youcef Djenouri**. "Hiding sensitive itemsets with multiple objective optimization." *Soft Computing* (2019): 1-19.
- 4- Lin, Jerry Chun-Wei, Jimmy Ming-Tai Wu, Philippe Fournier-Viger, **Youcef Djenouri**, Chun-Hao Chen, and Yuyu Zhang. "A sanitization approach to secure shared data in an IoT environment." *IEEE Access* 7 (2019): 25359-25368.
- 5- **Djenouri, Youcef**, Kjetil Nørvåg, and Heri Ramampiaro, Florent Masegla, Jerry Chun-Wei Lin Space Time Series Clustering: Algorithms, Taxonomy, and Case Study on Urban Smart Cities, *IEEE Access* (Submitted).
- 6- **Djenouri, Youcef**, Jerry Chun-Wei Lin, Kjetil Nørvåg, and Heri Ramampiaro, When Decomposition meets Pattern Mining, *ACM Transactions on Knowledge Discovery from Data* (Submitted).
- 7- **Djenouri, Youcef**, Kjetil Nørvåg, and Heri Ramampiaro, Jerry Chun-Wei Lin, Data Mining Solution for Group Anomaly Trajectory Detection, *DASFAA* (Submitted).

### **III - ATTENDED SEMINARS, WORKHOPS, CONFERENCES**

*IEEE 35th International Conference on Data Engineering (ICDE), Macau SAR, China, 08-11 April 2019*

### **IV - RESEARCH EXCHANGE PROGRAMME (REP)**

1. Location: Zenit Team, INRIA, Montpellier, France.  
Duration: 10-02-2019 to 20-02-2019  
Contact: Prof. Florent Massegli

The group coordinated by Prof. Florent Massegli has an excellent reputation in time series analysis. In particular, I have discussed about the space time series clustering paper and about the use of data distribution in identifying anomalies from the set of time series. We discussed several approaches in outlier detection such as Matrix Profiler. I have also given a presentation of my work which shows and describes the different outlier detection methods for urban traffic data.

2. Location: Warsaw University, Warsaw, Poland.  
Duration: 14-10-2019 to 24-10-2019  
Contact: Prof. Tomasz Michalak

The group coordinated by Prof. Tomasz Michalak has an excellent reputation in graph and social network analysis. In particular, I have discussed the possibility to extend my published works on graph and social network analysis, in particular my works on pattern mining, and outlier detection. We also discuss the possibility of exploiting high performance computing tools such as GPU in graph and social network analysis. I have also given a presentation of my work which shows and describes the different deep learning methods in addressing the different challenges of smart city applications.