

RESEARCH TOPIC FOR THE PARISTECH/CSC PHD PROGRAM

Field: *Information and Communication Sciences and Technologies*

Subfield: Smart Cities, Artificial intelligence, Environment

Title: Artificial intelligence and the Internet of Things to monitor and accommodate with urban pollution in smart cities

ParisTech School: Ecole des Ponts ParisTech (ENPC)

Advisor(s) Name: Françoise Lucas (Leesu, ENPC)

Advisor(s) Email: francoise.lucas@enpc.fr, lucas@u-pec.fr

Co-advisor: Sami Souihi (LiSSi, University Paris-Est Créteil)

co-advisor Email: sami.souihi@u-pec.fr

Research group/Lab: consortium of 3 laboratories: Leesu (ENPC and University Paris-Est Créteil), LISA and LiSSi (University Paris-Est Créteil)

Lab location: Leesu, ENPC, Champs-sur-Marne, France

(Lab/Advisor website): <https://www.leesu.fr/> and <http://www.lissi.fr/>

Short description of possible research topics for a PhD:

This thesis is part of the Smart Cities paradigm. It aims to investigate the potential use of artificial intelligence to assess and reduce the pollution impact on human health in urban areas. Nowadays, the development of the Internet of Things allows the deployment of large sensor networks to monitor different aspects of Smart Cities. For instance, different applications and services inform the inhabitants of large cities about the degree of air or water pollution. This information, however, remains scattered through different databases, with very difficult interpretation and it does not take into account the cumulative impact of the various chemical, physical and biological perturbations, which remains difficult to quantify. The first objective of this research is to establish a unified knowledge plane (KP) that aggregates all the pollution data that can impact human health from aerial and aquatic monitoring programs in urban areas. The second objective is to use this KP, to produce and test an adaptive and predictive model of urban pollution assessment, which will be based on the techniques of belief functions and Deep Learning. The last objective of this thesis is to explore the possibility of an adaptive data visualization by considering a real application scenario.

Required background of the student:

- Good Python programming skills,
- Knowledge in Probabilistic theory,
- Knowledge in Machine Learning

A list of 5 (max.) representative publications of the group: (Related to the research topic)

1. ROGUET, Adélaïde, THERIAL, Claire, CATHERINE, Arnaud, et al. Importance of Local and Regional Scales in Shaping Mycobacterial Abundance in Freshwater Lakes. *Microbial ecology*, 2018, vol. 75, no 4, p. 834-846.
2. MARÉCAL, Virginie, PEUCH, V.-H., ANDERSSON, Camilla, et al. A regional air quality forecasting system over Europe: the MACC-II daily ensemble production. *Geoscientific Model Development*, 2015, vol. 8, no 9, p. 2777-2813.
3. MA, Jun, CHENG, Jack CP, LIN, Changqing, et al. Improving air quality prediction accuracy at larger temporal resolutions using deep learning and transfer learning techniques. *Atmospheric Environment*, 2019, vol. 214, p. 116885.
4. AMOUR, Lamine, SOUIHI, Sami, HOCEINI, Said, et al. A hierarchical classification model of qoe influence factors. In : *International Conference on Wired/Wireless Internet Communication*. Springer, Cham, 2015. p. 225-238.
5. RATHORE, M. Mazhar, AHMAD, Awais, PAUL, Anand, et al. Urban planning and building smart cities based on the internet of things using big data analytics. *Computer Networks*, 2016, vol. 101, p. 63-80.