# Section Sciences et Ingénierie de l'environnement
# Design Project 2016 (semestre de printemps)

## Proposition n°21

## Developing a Probabilistic Graphical Model for Fine Particle Estimation Using OpenSense and land-use data


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**Descriptif du projet**

In the context of the OpenSense II project [1], we are looking into enabling air quality monitoring in urban environments using mobile sensing platforms anchored on public buses provided by TL (Transports publics de la région lausannoise). Currently the Lausanne deployment consists of 10 buses equipped with sensors for measuring CO, CO2, NO2, O3 levels and Particulate Matter (PM) using the Naneos Partector [2].

Adding mobility to Wireless Sensor Networks (WSNs) can bring significant benefits to a monitoring platform: finer spatial resolution, coverage of wider area with fewer required nodes, cheaper maintenance (since nodes can be brought to a single site for inspection), etc. On the other hand, the mobility aspect raises hard challenges especially in field estimation since the data is sparse spatially and temporally. To address this problem, we have already worked on a few modelling approaches [3] (e.g., log-linear regression models and probabilistic graphical models) and we have also gathered other sources of data that can be used for the inputs of models.

In this project, to estimate the fine particles level in each street of Lausanne, we plan to extend our probabilistic graphical models [3] by integrating the land-use and traffic data to increase the accuracy of final maps.


[1] http://www.nano-tera.ch/projects/423.php and http://opensense.epfl.ch
[2] Naneos Particle Solutions GmbH - www.naneos.ch

[3] A Marjovi, A Arfire, A Martinoli, “High Resolution Air Pollution Maps in Urban Environments Using Mobile Sensor Networks”, The 11th International Conference on Distributed Computing in Sensor Systems (DCOSS), June 2015, Fortaleza, Brazil, pp. 11-20.

**Objectif**

The main goal of the project is to address the problem of modeling and field estimation of the particulate matter and to provide a probabilistic graphical model for generating PM maps for Lausanne using the land-use and traffic data.
Using lung deposited surface area (LDSA) measurements from the OpenSense deployment, together with additional sources of information (e.g., other modalities from OpenSense network, vehicles mobility data, traffic count data, weather data, land-use maps) the students will have to derive a probabilistic air pollution estimation model for the city. They will then evaluate the capacity of this model to predict measured concentration levels. Finally, they will be able to use the model and the measurements to generate the air pollution maps with high resolution in space and time.

**Descriptif tâches**

The project tasks can be summarized as follows:

- get familiar with the OpenSense project constraints regarding mobility models and particulate matter sensing
- get a working understanding of the previous modeling/mapping efforts in OpenSense framework
- analyze the different available sources of information and their utility in deriving a usable probabilistic graphical model for particle matter concentration estimation
- derive the model
- analyze and evaluate the predicting performance of the model
- generate the particulate matter maps of Lausanne

**Divers**

Work breakdown: 25% theory, 40% data analysis, 35% programming
Prerequisites: Matlab programming
Keywords: environmental monitoring, air pollution modeling, mobility, wireless sensor networks
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