**Nicolas Baudin travel grant - Internship in France proposal form**

* = mandatory fields

### SECTION 1: Hosting institution in France

**Hosting institution in France**

<table>
<thead>
<tr>
<th>Name*</th>
<th>University of Littoral Côte d'Opale (ULCO)</th>
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</table>

### Hosting laboratory / research team in France

<table>
<thead>
<tr>
<th>Name*</th>
<th>1) Computer Science Laboratory (Laboratoire d’Informatique Signal Image de la Côte d’Opale – LISIC), team « Specifi »</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address*</td>
<td>50 Rue Ferdinand BUISSON, 62228 Calais Cedex, France</td>
</tr>
<tr>
<td>Web site*</td>
<td><a href="http://www-lisic.univ-littoral.fr/">http://www-lisic.univ-littoral.fr/</a></td>
</tr>
</tbody>
</table>

### Supervisor of the intern in France

<table>
<thead>
<tr>
<th>Name(s)*</th>
<th>Pr Gilles ROUSSEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function*</td>
<td>Full Professor</td>
</tr>
<tr>
<td>E-mail*</td>
<td><a href="mailto:gilles.rousset@univ-littoral.fr">gilles.rousset@univ-littoral.fr</a>, <a href="mailto:gilles.delmaire@univ-littoral.fr">gilles.delmaire@univ-littoral.fr</a>, <a href="mailto:matthieu.puigt@univ-littoral.fr">matthieu.puigt@univ-littoral.fr</a></td>
</tr>
<tr>
<td>Contact ph*</td>
<td>+33 321 46 36 97</td>
</tr>
</tbody>
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### SECTION 2: Internship offer

**Topic of the internship (title)**

Comparison of the performance of extended Informed Non-negative Matrix Factorization (I-NMF) techniques and of PMF 5.0 when applied to pollutant source apportionment. Application to real data collected in Northern France.

**Dates of the internship**

(nb: this program supports 3 to 6 month internships with a starting date earlier than December 31, 2018)

<table>
<thead>
<tr>
<th>Start: (from)</th>
<th>03/09/2018</th>
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<tbody>
<tr>
<td>End: (to)</td>
<td>28/02/2019</td>
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</table>
**Scientific and academic objectives of the internship**

(detailed description of the internship content, work expected from the intern and expected outcomes)

Air Pollution is known to be one of the major contributors to climate change. Moreover, in several studies—e.g., in [1]—the World Health Organization mentioned that Air Suspended Particles are a major risk for population health. Consequently, explaining the mechanisms that generate this pollution will help to fight the causes with efficient actions and to reduce its impact.

The topic of this master thesis aims at identifying the contribution and the origin of different sources. It starts from a matrix of concentrations over time and species which is provided by chemist experts. This data matrix is then decomposed into 2 matrix factors based on receptor modelling [2]. The first factor (the contribution matrix) details the contribution of the different sources at different time samples while the second factor (called the profile matrix) explains the different proportions of emitted chemical species.

Historical methods performing this decomposition are based on Positive Matrix Factorization (PMF) [3] and the reference software from EPA is PMF 5.0 [10]. Later, alternative methods based on Non-Negative Matrix Factorization (NMF) emerged, and recently, we developed some novel informed NMF methods which incorporate extra prior information in classical NMF methods [4-10]. In our work, we took into consideration (i) the expert’s knowledge—i.e., known or bounded entries—into the profile matrix [4,6-10], and (ii) atmospheric models to cancel the activity of some sources in the contribution matrix at some time samples [5]. These methods have been already implemented in different programming languages, i.e., Matlab and C++.

However, an intensive comparison of the new methods and the reference software (PMF) has not been yet performed. We here propose to carry out a comparison, firstly on “small-” and “medium-sized” synthetic datasets—allowing to investigate the effect of noise and outliers in the data on the separation enhancement—and to numerically evaluate the performance of each method by using reference indices. Some extensions of our proposed informed NMF techniques might be conducted as well.

The second step is to conduct a comparison on 2 distinct real data campaigns, the first one to check the algorithms on already analysed dataset, last one is the main campaign to study.

The first campaign results from a project named ECUME conducted with different academic and institutional partners, and mainly focuses on data obtained in Calais harbor, simultaneously with a rural site. This project was trying to explain the influence of boat traffic on the whole pollution level. Results are expected to be compared by using chemical expertise.

The second campaign is located in an urban site under the influence of different types of punctual or diffuses polluting activities, either in the near field or in a more distant field to the chemical sensor. This context enables to use a physical model in order to define the sources which may be not sensed at some time samples. The comparison with PMF should be performed using this prior information together with additional profile information into the informed NMF methods.

**References:**


**Name of industrial partner**

*(participation of an industrial partner is highly recommended)*

ATMO Hauts de France, 55 place Rihour, 59044 Lille, France. ATMO Hauts de France (ATMO HdF) is the authoritative Regional Air Quality Monitoring Agency in the North of France. His mission is to provide air quality assessments (measurements and air quality modeling) in order to inform authorities and the general public with full transparency. ATMO HdF also helps stakeholders in air planning tools. Monitoring is mainly carried out with stationary or mobile measuring stations network equipped with analyzers. In addition to the measure, other tools have been developed, i.e., emission inventory and air quality modeling, thus enabling the public to be informed at every point of the territory. In addition to these missions, ATMO HdF also develops his activities in order to meet the needs of observation, deploys expertise and tools to serve the action, engages on emerging themes, develops a mobilizing and innovative communication, activates and animates local networks. ATMO HdF is part of the national federation of regional agencies called ATMO France.

**Main contact at the French industrial partner**

Benoît Rocq, vice director b rocq@atmo-hdf.fr +333 59 08 37 30

**Main contact at the French industrial partner’s branch in Australia** *(if applicable)*

No partner’s branch in Australia, but it is the equivalent of the Australian EPA (Environmental Protection Agency).

**Role of the industrial partner in the internship project**

The industrial partner is the data provider of the studies, and has physical-chemistry and fields skills of the atmospheric context on the region.
Australian partner university

Is the internship project proposed in the framework of an existing collaboration with an Australian partner university?*  ☑ YES ☐ NO

If yes: name of institution  Cliquez ici pour taper du texte.

Name of lab/research team in collaboration  Cliquez ici pour taper du texte.

Main contact  Cliquez ici pour taper du texte.

Function  Cliquez ici pour taper du texte.

E-mail  Cliquez ici pour taper du texte.

Contact ph  Cliquez ici pour taper du texte.

SECTION 3 : Expected profile of applicant

Level of study *
(priority will be given to Bachelor’s degree Honours students and Master’s students)

Master of science students

Discipline *
Mathematical and statistics, or Environmental Science or Physical Science, Computer Science.

Required qualities, knowledge and skills *
An interest for applied sciences, such as computer science, computer engineering, mathematics, physical or atmospheric chemistry would be strongly appreciated.

Other specific eligibility criteria *
(such as citizenship requirements, language requirements...)

A French language certificate (e.g., DELF B1) would be appreciated but it is not mandatory.