



**Offer #2024-07608**

## **PhD Position F/M Integration of forecasting methods into the optimization models: an application to city logistics**

**Contract type :** Fixed-term contract

**Level of qualifications required :** Graduate degree or equivalent

**Fonction :** PhD Position

### **About the research centre or Inria department**

The Inria University of Lille centre, created in 2008, employs 360 people including 305 scientists in 15 research teams. Recognised for its strong involvement in the socio-economic development of the Hauts-De-France region, the Inria University of Lille centre pursues a close relationship with large companies and SMEs. By promoting synergies between researchers and industrialists, Inria participates in the transfer of skills and expertise in digital technologies and provides access to the best European and international research for the benefit of innovation and companies, particularly in the region. For more than 10 years, the Inria University of Lille centre has been located at the heart of Lille's university and scientific ecosystem, as well as at the heart of Frenchtech, with a technology showroom based on Avenue de Bretagne in Lille, on the EuraTechnologies site of economic excellence dedicated to information and communication technologies (ICT).

### **Context**

A central issue in city logistics is to design systems that move goods to, from, and within urban areas while meeting sustainability goals. Such city logistics systems are generally based on new business models, cooperation among stakeholders, resource sharing, consolidation, synchronization of operations, multi and intermodality. Here, we consider an orchestrator that manages a system involving freight transporters which can be carriers or logistics service providers. One of the critical activities of the orchestrator in coordinating and managing the resources offered by the freight transporters is to distribute the transportation demand among them. However, this task is complicated by the fact that transportation demand is uncertain.

To help the orchestrator in his decision process, we address the associated planning problem: the Allocation Resource Problem in city logistics with Demand Uncertainty (ARPDU). The ARPDU is an operational problem that typically has to be solved the day before the resources are deployed. Given the solution of the ARPDU, the orchestrator can inform the freight providers. They can then plan their activities for the next day by including the requests of the orchestrator in the set of the other logistics tasks they have to perform.

The ARPDU aims to determine what logistics facilities should be used and when and where the vehicles of the carriers should be assigned to cover the demand over the planning period in the most efficient way. More precisely, the ARPDU aims to select the facilities (crossdock platform, storage area, parking spaces...) to be used, the types and the numbers of vehicles (vans, cargo-bicycles,...), to determine what are their starting points and during which periods they are used. Additional operational constraints can be considered according

to the products delivered and to the logistics means.

A key feature of the ARPDU is that demand and its characteristics (quantity, origin, destination, time slots when the freight becomes available or may be delivered) is uncertain, i.e., unknown or partially known. In practice, the orchestrator must estimate the demand on the urban area for the considered time horizon using historical data. This demand forecast is based on a model of the urban territory that must be built first.

This thesis is performed in the context of the ANR project Adele.

## Main activities

This thesis is part of the general field of decisions-focused predictions. It will address the scientific challenge related to the integration of forecasting methods into the optimization models and solution methods. This implies determining useful information in available data, developing some ad-hoc forecasting methods, managing their integration into decision models, and developing innovative optimization algorithms in which the selection of the best demand estimators is part of the decision process.

The main steps of the thesis will be:

- . Demand modeling and design of forecasting methods;
- . Mathematical modeling;
- . Development (design and implementation) of innovative ad-hoc optimization algorithms based on mathematical modeling;

## Skills

Technical skills and level required :

Good knowledge in combinatorial optimization, Stochastic optimization, machine learning

Coding: C++, Java

## Benefits package

- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

## General Information

- **Theme/Domain** : Optimization, machine learning and statistical methods  
Scientific computing (BAP E)
- **Town/city** : Villeneuve d'Ascq
- **Inria Center** : [Centre Inria de l'Université de Lille](#)
- **Starting date** : 2024-09-01
- **Duration of contract** : 3 years
- **Deadline to apply** : 2024-05-23

## Contacts

- **Inria Team** : [INOCS](#)

- **PhD Supervisor :**  
Brotcorne Luce / [Luce.Brotcorne@inria.fr](mailto:Luce.Brotcorne@inria.fr)

## About Inria

Inria is the French national research institute dedicated to digital science and technology. It employs 2,600 people. Its 200 agile project teams, generally run jointly with academic partners, include more than 3,500 scientists and engineers working to meet the challenges of digital technology, often at the interface with other disciplines. The Institute also employs numerous talents in over forty different professions. 900 research support staff contribute to the preparation and development of scientific and entrepreneurial projects that have a worldwide impact.

**Warning :** you must enter your e-mail address in order to save your application to Inria. Applications must be submitted online on the Inria website. Processing of applications sent from other channels is not guaranteed.

## Instruction to apply

Please send your CV and cover letter.

### **Defence Security :**

This position is likely to be situated in a restricted area (ZRR), as defined in Decree No. 2011-1425 relating to the protection of national scientific and technical potential (PPST). Authorisation to enter an area is granted by the director of the unit, following a favourable Ministerial decision, as defined in the decree of 3 July 2012 relating to the PPST. An unfavourable Ministerial decision in respect of a position situated in a ZRR would result in the cancellation of the appointment.

### **Recruitment Policy :**

As part of its diversity policy, all Inria positions are accessible to people with disabilities.