Internship 2018/2019: Routing and staff planning for home services

Keywords: operations research, combinatorial optimization, algorithmic, vehicle routing

Remark: This internship **can be followed by a PhD thesis (a funding is available).**

Structure Mines Saint-Etienne, Manufacturing Sciences and Logistics Department, UMR CNRS 6158 LIMOS (880 route de Mimet, F-13541 Gardanne, France (near Aix-en-Provence in the South of France)

Supervisors: Nabil Absi (absi@emse.fr), Dominique Feillet (feillet@emse.fr), and Thierry Garaix (garaix@emse.fr).

Subject:

The research pursued by the internship will concern the development of new models and original solution methods for the tactical and operational planning of home services. The research work is driven by important applications in healthcare but could also be extended to maintenance services. The models will include complex constraints as: integrated staff planning and vehicle routing, resource synchronization, time windows, regularity, consistency, equity. Considering these constraints in vehicle routing problems is relatively new and still challenging. Adding the staff scheduling dimension makes the problem even harder.

This work is part of the project "Flexible and Intelligent Transportation Systems (FITS)" funded by the French Research Agency (ANR). The project FITS is designed to tackle the scientific challenges raised by the optimization of transportation service platforms that need intelligent tools for responsive large-scale systems. The FITS project is designed to address those issues by taking profits from available data (real-time information and statistics on large data). FITS has to perform a smart assignment between users in order to find the best balance between satisfying customers and covering constraining or less profitable requests with fair dispatching rules among workers in terms of difficulty and profit. Developed algorithms will be tested on real data extracted from an open living lab and obtained from the industrial partner Eovi Mcd (a health insurance company). All developed algorithms will be prototyped in this living lab. Two PhD positions and a two-year Post-doctoral position are assigned to the project.

The scientific challenges of this internship are the following:

• First, provide an update of the scientific and practical state of the art on transportation service systems. The scientific state of the art allows us to provide a survey on problems, models and methods developed in the literature related to deal with transportation service delivery (coupling workforce scheduling and vehicle routing), and to position our project with respect to existing studies. Furthermore, this task aims at identifying the weakness of existing studies, and to list real constraints that should be considered.

• Second, identify and analyze different KPIs (key performance indicators) depending on the optimized objective (fairness between workers, quality of service, costs and profits). These objectives can be optimized in the short-term or the mid-term and will have a high impact on the structure of obtained solutions. The goal is propose different mathematical models to represent all identified objectives and constraints.

•Third, develop new solution methods to deal with the single-period version of the studied problems. The goal is to start first by developing an efficient heuristics approaches (e.g. Adaptive Large Neighborhood Search).

Candidate profile: Applicants should demonstrate good programming skills and a deep knowledge in combinatorial optimization and integer programming.