Tactical optimization strategies to adapt urban transport networks

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TACTICAL OPTIMIZATION STRATEGIES TO ADAPT URBAN TRANSPORT NETWORKS

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Introduction

According to the Global Health Observatory (GHO), more than half of the total population lived in urban areas in 2010. This proportion is expected to reach 60% by 2030 and 70% by 2050. The increasing concentration of population and the unplanned extension of urban areas raise several challenges, among which the management of the urban network infrastructures.

The **TOAST project** (Tactical OptimizAtion Strategies to adapt urban Transportation networks) aims at investigating a new set of emerging tactical optimization problem [1]. It consists in setting directions on each street to improve the global transport system. This research has been funded in 2013 by the DRRT (*Délégation Régionale à la Recherche et à la Technologie*, Champagne-Ardennes region, France).

Decision Making System

An optimization framework core has been developed to deal with a class of tactical optimization problems [2], where two objectives are optimized independently:

(i) **Allow fast origin-destination transportation requests**

(ii) **Prevent drivers from entering critical areas such as city centers or touristic points**.

The ongoing work will include the computation of the global congestion and address several other settings (such as lanes) to deal with promising applications. The optimization core can be embedded in a support decision systems as shown in Figure 1.

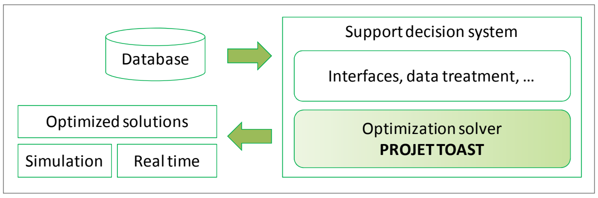

Figure 1 : Overview on the positioning of the TOAST Project

The core TOAST encloses sophisticated heuristics and metaheuristics such as Iterated Local Search (ILS) and Relaxed ILS (RILS), Evolutionary Local Search (ELS) and Relaxed ESL (RELS), Variable Neighborhood Search (VNS) and Intelligent VNS (IVNS), applied to produce high quality results for different networks structures.

Results

The methods were tested on Manhattan graphs (grid structure) instances, as well as on real instances from the Clermont-Ferrand and Troyes cities, France. The first results are presented in [3].

Figure 2 illustrates the relation between the convergence and the trade-off between the solutions quality and the running time, using a medium-sized instance for the Clermont-Ferrand city, France.

Figure 3 shows a typical output from our solver for the center of Troyes, France.

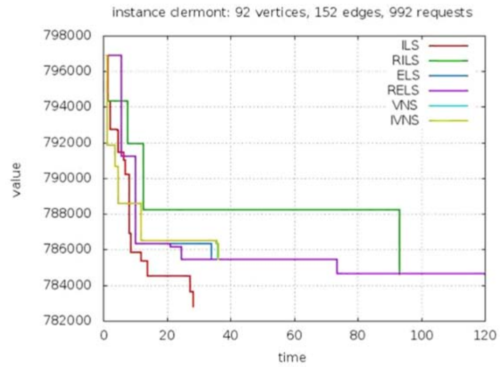

Figure 2: Convergence and time-quality trade-off.

Figure 3: Center city of Troyes, France.

Conclusions

The proposed framework is able to solve the core problem of setting directions and evaluating the global impact on an urban network for the goals **(i)** and **(ii)**. We are currently extending it:

- To manage the global congestion
- To quickly provide good traffic redirections when some streets are blocked due to maintenance, natural perils (freezing rain, hail storm, flood, fire, etc), road accidents, manifestations (fairs, etc.), …

Main references

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3. A. C. Santos, C. Duhamel, C. Prins. Heuristics for setting directions in urban networks. *In proceedings of the X Metaheuristics International Conference*, Singapore, 298-300, 2013.