Volvo Group Truck Technology

Master thesis proposal

Title: Dynamic transport mission optimization of a fleet of electric and autonomous trucks based on multi-agent models

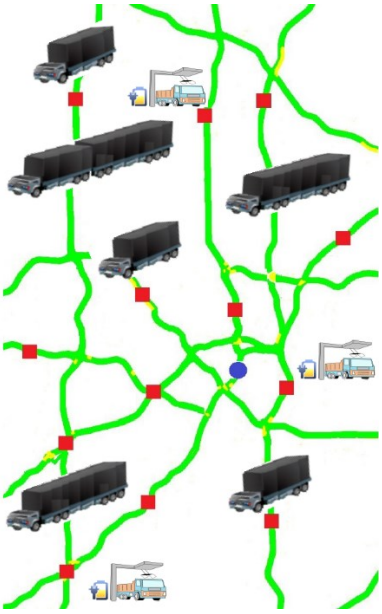

Fig 1. A fleet of heterogeneous autonomous electric trucks within a transportation network.

Description:

In near future, transportation industry faces a substantial change in the way people and goods move by employing Automated Driving Systems-Dedicated Vehicles incorporated with electro-mobility. The feasibility of deploying such systems depends on a careful transport mission management based on optimization models. This thesis aims at finding and implementing suitable real-time optimization models to manage a fleet of heterogeneous, autonomous and electric trucks.

A fleet of vehicles refers to a group of vehicles cooperating/competing to satisfy the overall demand of a transportation network. The transportation demands are dynamic, meaning that vehicles might receive calls for pick-up and delivery of goods while they are already on a mission. Moreover, real-time optimization is necessary since dispatching plans might change due to unexpected, or previously unknown events such as traffic jams, breakdowns, or accidents. Since the systems evolves in time, transport mission optimization should look for a new optimum solution after occurrence an event. The solution of this kind consists of a set of routes including a schedule specifying the times at which the trucks must be at selected locations. Moreover, for electric vehicles, a charging plan and scheduling should be included, integrated with the optimum solution.

Agent-based models showed to be useful when the size of the problem is large, the domain is modular in nature (i.e. it can be divided to sub-domains or sub-problems) and the structure of the domain changes frequently. These features are indeed the features of dynamic transport optimization problem. Thus, solving transportation problems can be distributed among multiple interacting agents (vehicles) in order to achieve scalability of performance with growing sizes of problem as well as to facilitate the handling of local deviations without the need of propagating local changes and re-computing the whole solution.

Agents are interacting with each other, so there should be some coordination strategies between them. These strategies can be categorized in two different approaches: centralized and distributed. In a full-centralized approach, agents are supervised and all workload of optimization is done by a central computer (for example in a control tower) and the dispatching plans are sent to agents. In such an approach the benefits of agent-based models are lost. In a distributed approach, agents are endowed with self-organizing rules for goal pursuing and solving optimization sub-problem. In a distributed approach the benefits of agent-based models can be realized while the disadvantage is expensive agent communications compared to a fully centralized solution.

The research questions that should be answered by the master thesis are according to the followings.

- What are similar researches and methods in literature and industry trying to solve similar problems?
- What is the optimum trade-off between the centralized approach and the distributed approach considering data communication between agents?
- What are the sub-problems that need to be solved in a central computer and which ones should be solved by agents?

Further, the master thesis involves implementation, coding and validation of the suggested models on real-world transportation problems.

Prerequisites:

The thesis work will include various fields such as optimization, vehicle simulation and logistics. The work will be carried out at Volvo Group Trucks Technology and Chalmers University of Technology. The thesis is recommended for two students studying in the last year of Master of Science with programming skills, good knowledge of optimization methods and good mathematical skills.

If you find this proposal interesting, send your application to toheed.ghandriz@chalmers.se and Jonas.hellgren@volvo.com before December 20th 2018.

Contact persons:

Toheed Ghandriz - Chalmers
toheed.ghandriz@chalmers.se
Jonas Hellgren – Volvo GTT
jonas.hellgren@volvo.com
Leo Laine – Volvo GTT
leo.laine@volvo.com