programming, proposed for this problem, but the feasible problem size of such methods is quite restricted, limiting their practical significance. In this paper, we propose as a search-based algorithm a new search method called the abstraction heuristics, which can significantly reduce the search space of this problem. Our computational results confirm that our approach enables instances of practical size to be solved optimally within a reasonable computation time.

3 - Modelling and Multiobjective Optimization for Automated Guided Vehicles at Container Terminals
Anita Gudelj, Maja Krčum

The objective of this study is to model and optimization of an Automated Guided Vehicle System which is embedded in a container terminal. Typical operational and control requirements of such systems include: scheduling AGVs and containers in the terminal, routing of AGVs and controlling of vehicular traffic in the transportation network. In this study, one particular aspect of the terminal operations is considered, that of scheduling AGV jobs. The aim of AGV scheduling is not only reduces the cost of terminal operation but also maximizes the system performance. This study first formulates mathematical model which is focused on the optimization of job scheduling. The model considers two objectives (i.e., AGV traveling time and the number of AGVs involved) and their weighted sum is investigated as the representative example. The moving of vehicles can be described as the set of discrete events and states. In addition to this a Petri net model which represents the transportation of containers from pick-up locations to delivery is introduced. The study is extended to seek optimal, conflict and deadlock free schedules in AGV system using an algorithm which integrates MRF1 class of Petri net with a genetic algorithm which yields improvements in system throughput along with a decrease in the numbers of AGVs. The algorithm deals with multi-constrained scheduling problem with shared resources. The developed model is verified by a computer simulation using MATLAB environment.

4 - A Potential Solution for the Space Limitation Problem of the Container Stacking Yard at Port Klang
Noorul Shaiful Fitri Abdul Rahman

Over the ten years, maritime industry had experience in tremendous growth and provides numerous incomes to Malaysia. The total number of containers handled by Port Klang is keep increasing almost doubled every year because it is the main gateway by sea of Malaysia. Thus, it creates a problem of accommodating the container demand due to the limited size of container yard space owned by Port Klang. Port Klang has ranked as the 12th busiest container port (in year 2012) in the world. Thus, it becomes a serious issue as the container business is the main source of income to this particular port. Now, Port Klang is in the progress of building the third port as a short term solution in order to accommodating the growing container demand due to the existing Northport and Westport are only capable to cater the port users until 2016. The objective of this study is to introduce a new innovation of container stacking storage as a potential solution for overcoming the container yard space problem at Port Klang. The new innovation concept is adopted from the existing application of an Automatic Parking System incorporates with green technology concept. This model is suitable to be implemented in solving the space limitation problem at the container port. Finally, it enables to increase the efficiency and effectiveness of handling containers, and the profit margin of Port Klang as the high level of container stacking storage is almost triple than normal.

■ MD-51

Monday, 14:30-16:00 - Graham Hills GH542, Level 5

Freight Transport

Stream: Traffic and Transportation
Invited session
Chair: *Tsung-Sheng Chang*

1 - Applying the CEN 16258:2012 standard for calculation and auditing of carbon dioxide emissions in city logistics operations
Alexandros Ntzoufas, Vasileios Zeimpekis

Road freight transport is the dominant mode of goods movement across the EU (with a share of 49%) as it represents a cost effective and flexible mode. However, road transport exhibits significant weaknesses contributing to considerable CO2 emissions, accidents, increased noise level, road congestion and wear. The main scope of this paper is twofold: a) to review and assess methodologies and tools for the calculation of carbon footprint in urban freight distribution operations, and b) to adopt the most suitable method for the calculation of CO2 emissions in the fleet of vehicles of a Greek retail company. The CEN 16258:2012 standard was adopted, since it is the only available European standard for carbon footprint calculation in the transport sector and incorporates the energy based methodology (i.e. calculation of CO2 emissions via fuel consumption). The main findings include the calculation of CO2 emissions in monthly and semi-annual basis as well as a comparative assessment of the fleet of vehicles based on the average CO2 emissions per tn-km. The analysis of the findings shows that the most important parameters that affect carbon footprint are the loading factor, the empty running kilometers and the vehicle's engine technology. Certain recommendations were also developed with the most important to be the addition of constraints (i.e. fuel consumption) in vehicle's routing process with the aim to generate more environmental friendly delivery routes.

2 - Comparing cost allocation methods for consolidation in intermodal transport
Katrien Ramaekers, An Caris, Lotte Verdonck

Policy makers at European as well as regional levels express the need to stimulate intermodal transport chains. A growing market share for intermodal transport should mean a shift towards more environmental friendly transport modes, less congestion and a better accessibility of seaports. Consolidation of freight flows is often suggested to improve the efficiency of intermodal operations Shippers attain scale economies and a better utilization of transport equipment through consolidation of freight inside a loading unit. Questions rise how benefits may be allocated among the participants in the cooperation. No studies have yet been performed on cost allocation methods for collaboration between shippers aimed to make use of intermodal transport. In this research, several cost allocation methods are presented to allocate the cost savings of consolidation among the participants in this type of cooperation. While economies of scale are an obvious advantage for the consolidation of freight flows as a whole, the benefits for a single member are not always clear. The allocation of the benefits of consolidation to the individual members may cause lack of commitment and hesitation to take part in the consolidation. Very simple and straightforward cost allocation methods are compared to more advanced methods based on cooperative game theory.

3 - Real-Time Decision Support for Truckload Carriers Participating in Multiple e-Procurement Auctions
Tsung-Sheng Chang

The objective of this paper is to develop decision support to help truckload (TL) carriers participating in multiple e-auctions to tackle bidding-related contingencies (uncertain events) in real time. At the beginning of a day, the TL carriers integrate the bidding information in multiple e-marketplaces with their current fleet statuses to optimize their fleet deployment plans and accordingly make bidding decisions. During the course of the day, new information such as locating new auctioned loads, winning auctioned loads and losing auctioned loads may pop up any time. The TL carriers must therefore have the ability to optimally re-deploy their fleets based on emerging uncertain events and accordingly adjust existing and/or propose new bidding strategies whenever they are necessary in real time. Hence, this research proposes a decision support tool mainly with a built-in scenario-based contingency planning model to enable the TL carriers to possess such ability. To our knowledge, there are no previous contributions proposing bidding decision support for TL carriers in such a dynamic and uncertain environment.

■ MD-52

Monday, 14:30-16:00 - Graham Hills GH554, Level 5

Finance, Insurance and OR

Stream: Financial Mathematics and OR
Invited session
Chair: *Azar Karimov*
Chair: *Gerhard-Wilhelm Weber*
Chair: *Mustafa Pinar*