Computational Optimisation and Learning (COL) Lab

Commodity Routing and Scheduling at Ningbo Port, China

As the 5th largest port in the world, Ningbo Port, China is faced with a short-haul multi-shift commodity routing problem, starting from the depot, to serve all the geographically distributed ports within a network in the area.

This new problem shares properties in the well investigated Vehicle Routing problem with Time Windows and Service Network Design problem, subject to constraints including capacity, time window and pick-up vs. drop off, etc.

Objectives in the optimisation problem include to maintain a consistent performance and running at the lowest cost at a specified service level, and reducing environmental impact from modern transportation, i.e. to reduce rate of empty loads.

Figure 1. Map of ports at Ningbo Port, China

Advanced Intelligent Algorithms for Commodity Routing

COL Lab at University of Nottingham and University of Nottingham Ningbo Campus investigates a range of advanced computational algorithms [1,2] and their hybridisations [3] for the problem. It is estimated that the heavy load rate has been improved by 10-15%, reducing empty load mileage by 50,000km annually.

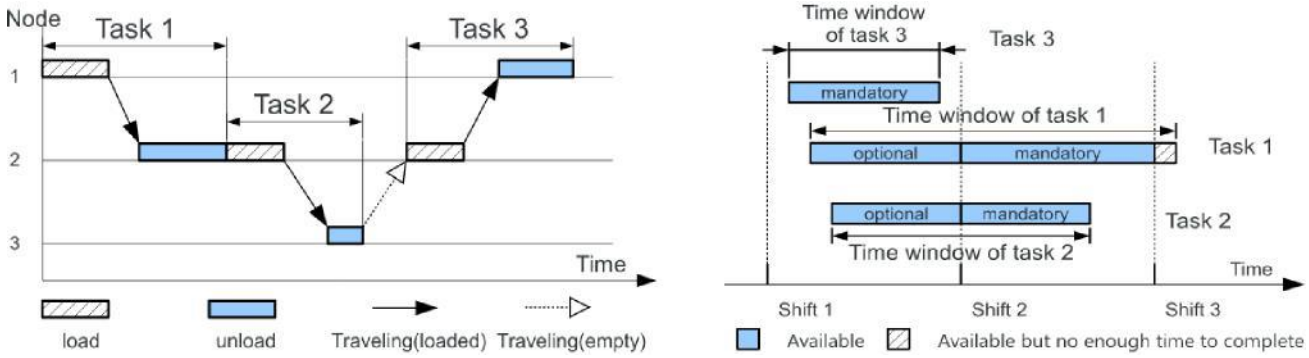

Figure 2. Left: Completing several tasks by a truck with load or empty loaded; Right: Three tasks within four shifts

- R. Bai, G. Kendall, R. Qu, J. Atkin. "Tabu assisted guided local search approaches for freight service network design." Information Sciences, 189: 266-281, 2012. doi: 10.1016/j.ins.2011.11.028
- J. Chen, R. Bai, R. Qu, G. Kendall, "A Task Based Approach for A Real-World Commodity Routing Problem", 2013 IEEE Symposium Series on Computational Intelligence (SCCI 2013), 16-19 April, Singapore
- B. Chen, R. Qu, R. Bai, H. Ishibuchi. "A Variable Neighbourhood Search Algorithm with Compound Neighbourhoods for VRPTW", The 2016 International Conference on Operations Research and Enterprise Systems (ICORES'16), 23-25 Feb 2016

COL Lab
School of Computer Science, Jubilee Campus
University of Nottingham, Nottingham, NG8 1BB

Web: https://www.nottingham.ac.uk/research/groups/col/

Contact: Dr Rong Qu, rong.qu@nottingham.ac.uk

Extended Commodity Routing with Dry Ports

The integrated commodity routing problem includes 10 more dry ports around Ningbo Port, requiring advanced robust algorithms. A new extended Open VRPTW model is established to formulate new types of shifts of different length with associated drivers in the new integrated problem.

Figure 3. Ningbo Port with inland dry ports

Dynamic Truck Dispatching at Marine Container Terminal

At Ningbo Port, containers are transferred between yard blocks and vessels by a fleet of trucks. To service more vessels, quay crane operations to load and unload containers are optimised to minimise the idle time of the container transfer process. Uncertain situations demand real time operations.

A new mathematical model is built to minimise both the quay crane makespan and the truck travelling time. Intelligent dynamic algorithms developed at ASAP group offer robust real time scheduling at Ningbo Port, China.

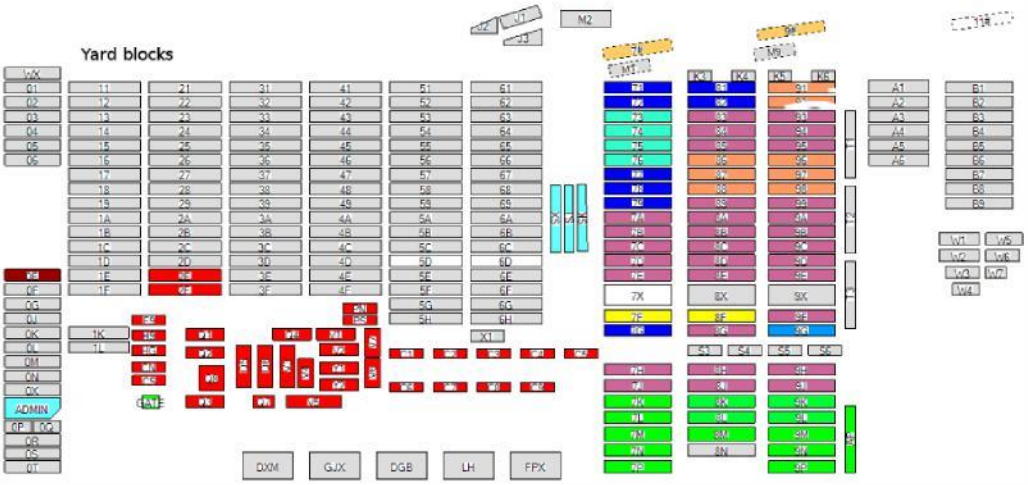

Figure 4. Ningbo Port container terminal yard

- B Chen, R Qu, R Bai and W Laesanklang. "A Reinforcement Learning Based Variable Neighborhood Search Algorithm for Open Periodic Vehicle Routing Problem with Time Windows", under review at Networks, November 2016.
- J Chen, R Bai, H Dong, R Qu and G Kendall. "A Dynamic Truck Dispatching Problem in Marine Container Terminal". The 2016 Symposium on Computational Intelligence in Scheduling and Network Design (IEEE CISND'16), December 6-9, 2016.