Ship Scheduling at a Port

Elena Kelareva (elena.kelareva@gmail.com)

Background: Maritime Scheduling

Maritime transportation makes up 90% of the world's trade.

Draft is the distance between the waterline and the bottom of a ship's keel. Most ports have restrictions on safe sailing draft.

OMC International’s Dynamic Under Keel Clearance (DUKC) software accurately calculates safe sailing drafts, allowing ships to carry more cargo safely. The diagram shows components of DUKC calculation.

Case Study: Port Hedland

Port Hedland is the highest tonnage port in Australia, shipping 150 megatonnes of iron ore annually.

This research will use ship scheduling at Port Hedland as a case study.

Ship numbers are currently around 5 draft-limited ships sailing on each tide.

Scheduling is becoming difficult to do manually.

Port Hedland has a large tidal variation; each centimetre of draft translates into ~$10,000 extra cargo.

The Problem

Tools for scheduling ships between ports exist, but do not account for draft, so ships carry less cargo than they could.

Scheduling at individual ports accounts for draft, but is done manually, which is slow and cumbersome.

Our Solution

We will incorporate draft calculations into an algorithm to schedule ships at a single port, in collaboration with OMC International.

We will extend scheduling to long forecast horizons using probability estimates of weather conditions.

Who Will Benefit?

Shipping companies will be able to carry more cargo with the same number of ships, increasing profits.

Environmental impact of shipping will be reduced by carrying more cargo on each ship.

Ports will be able to provide better schedules to clients, and port staff will free up the time they currently spend on manual scheduling.

Extending this work to longer forecast horizons and to scheduling ships between ports will allow shipping companies to better optimise their fleets of ships, including what ships they hire, ship sailing times, and cargo routing and scheduling.

What Issues Need Research?

Ports often serve competing users. Game theory and mechanism design can identify algorithms that are fair, and that optimise each user's schedule.

Separation time between ships varies depending on the order in which ships sail. See diagram on left.

Scheduling is probabilistic, as it depends on environmental conditions. Recent OMC research allows probability distributions of safe sailing drafts to be calculated months in advance.

Rescheduling in case of delays will often be needed. The rescheduling problem must optimise total throughput, while also minimising disruption to the schedule.