Apprenticeships & Theses

DEVELOPMENT OF A HEURISTIC MODEL FOR SCHEDULING AUTONOMOUS TORPEDO MOVEMENTS

KEY WORDS OF ASSIGNMENT:

- ✓ Development of dedicated scheduling heuristics
- ✓ Modeling of logistic processes
- ✓ Programming – Software development

SUMMER APPRENTICESHIP ☐ MASTER THESIS ■

CONTENT OF ASSIGNMENT:

ArcelorMittal Gent is a steel production company which is situated alongside the canal Gent-Terneuzen in the port of Gent. It produces flat steel products, used amongst others in the automotive industry.

In the blast furnaces of ArcelorMittal Gent, hot metal is produced from cokes and sinter mixtures. The hot metal is tapped from the furnaces and captured in torpedo-shaped wagons. Human drivers in locomotives move these torpedo ladles from the blast furnaces to the Polysius station for a desulphurization treatment, and finally to the hot metal center of the steel shop. There the hot metal in the torpedo ladles is emptied into large hot metal ladles. After this emptying operation, loco drivers return the torpedo ladles back to the blast furnace for a new filling cycle.
The current torpedo ladle model schedules these three main activities (filling, desulphurizing, emptying) of all the torpedo ladles and optimizes the schedule. For example, the order of emptying activities couples the torpedo ladles to the planned hot metal heats in the ladles, which sets the required sulphur level of each torpedo after the desulphurization treatment to meet the sulphur requirement in the ladles. The model schedules sufficient idle time between each activity as it must wait until the locomotive is available to transport the torpedo to its next destination.

Up to this point, this way of operation is feasible. However, studies have pointed out that this approach cannot be sustained if the hot metal production increases. One of the options to debottleneck the torpedo logistics is to eliminate human loco drivers and replace them with individual automated guided vehicles (AGV's), permanently attached to each torpedo. These AGV's ensure that a torpedo can move autonomously and as such does not have to wait until it gets transported by a locomotive. This also means that the torpedo scheduling heuristic should be modified to model this new way of torpedo logistics. Additional transport activities should be incorporated into the schedule of each torpedo. An added complexity is the entanglement of all activities as each installation (e.g. a railroad switch) can only accommodate a single torpedo at each time. To summarize, the new model should focus on the movement of each individual torpedo instead of the current torpedo transportation by locomotives.

In this master thesis, you will develop several optimization heuristics to schedule the logistics of the entire torpedo fleet. You will start by performing a literature study to define some appropriate heuristics or you might need to develop a custom heuristic yourself. You will test the heuristics using historical production data. You will assess the "best" heuristic based on its performance and whether it is computationally feasible to run in a production environment.

This master dissertation provides the opportunity to get hands-on experience in a state-of-the-art steel plant, to work together with industry specialists in optimizing techniques and to contribute to technological innovation.

OBJECTIVES:

- ➢ Implement several heuristics suitable for the problem
- ➢ Evaluate their performance using a set of realistic input data
- ➢ Make founded conclusions based on your computational results

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EXPECTED COMPETENCES (KEY WORDS):

- ✓ General knowledge of optimization techniques/ operations research
- ✓ General programming skills (Python, C#, C++...)
- ✓ Data analysis and statistics

NUMBER OF STUDENTS:

- 1

TARGET GROUP: BACHELOR/MASTER/ … & SPECIALISATION(S):

- Master of science in engineering (computer science, operations research, …)

LOCATION:

- Systems and Models ArcelorMittal Gent, John Kennedylaan 51, 9042 Gent

PROMOTORS:

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