

https://dspace.org/

An MILP approach to optimizing capacity on rail lines: a NatCor case study

Ntwana, Nolusindiso

2024
https://hdl.handle.net/10539/37397

Downloaded from a DSpace repository. https://dspace.org/



An MILP approach to optimizing capacity on rail lines: A NatCor case study

Nolusindiso Ntwana (1231115)

Supervisor: Dr Joke Bührmann

A research dissertation submitted to the Faculty of Engineering and the Built Environment, University of the Witwatersrand, in fulfilment of the requirements for the degree of Master of Science in Engineering.

Johannesburg, March 2023

Abstract

Rail capacity planning and management is becoming a topic of interest around the world. Rail companies are now researching ways to increase capacity and are therefore investing resources in architecture expansion, which may result in high capital costs. There has been a lack of research and resources invested in optimising existing capacity, which could save these extra costs.

Using the Natal Corridor (NatCor) as a case study, this research analyses the capacity on the rail line and the effects that optimisation of the line will have on the Durban Container Terminal (DCT). The research investigates the current state of NatCor as a train timetabling problem (TTP). A mathematical model is proposed using mixed integer linear programming (MILP) in order to optimise the line. The TTP is then converted into an equivalent vehicle routing problem with time windows (VRPTW). Current schedules of the NatCor are used as an input to the model and the model is solved using Python and MS Excel Open Solver. The initial feasible solution is improved using the Tabu Search (TS) algorithm.

The results suggest that frequent updates to company data will help keep the train timetables clear of any cancelled trains, which take up capacity on the line. The MILP models provided an optimal maximum travel time that trains could incur on the line without causing any further delays to operations at the DCT. The models will contribute to future research on similar topics and can be further developed to model large rail networks.