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# Liner shipping speed optimization with synchronization and port call restrictions

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## Abstract

Speed optimization for Liner shipping operations under emission control policies and canal and port workshifts is presented. Clearly speed optimization produces a win-win situation where companies save money on fuel and the environment benefits from the resulting reduced emissions. Liner shipping routes are periodic and transshipment between routes frequently occurs. Clearly speed optimization is not applicable to real life situations if canal and port workshifts are not satisfied in the solution delivered. Therefore it is very important to ensure the existing canal and port workshifts are introduced into model. Moreover the cost found when speed optimizing must also reflect the different fuel types and their costs to ensure over all savings for the company and to ensure compliance with the different environmental regulations. In this paper we expand the Liner shipping speed optimization problem with transit times to the real-life situation with canal and port workshifts and emission control areas and the fuel types required. Moreover we introduce services with alternative frequency. The transit times, limits the length of a journey on the network. The routes are not considered in the model, but the model could be used in a two phase heuristic for routing problems with transshipment and transit time requirements. Test results are shown on real-life instances from a major liner shipping company.

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