

# Preface

Maritime transportation is a major conduit of international trade. In terms of cost, maritime transport is very competitive against land and airborne transport, increasing only by a few percent the total product cost. On the other hand, it takes longer and may cause harbor congestion which may further increase the voyage time. Furthermore, there are difficulties in integrating this transportation mode efficiently with other transport or distribution options. On top of these, the safety and the environmental impact of maritime transportation, in particular in the case of sea accidents, are always two challenging issues.

Recent advances on maritime transportation require the synergy of both computer and maritime science. Computational intelligence, data mining and knowledge discovery/representation, risk assessment methodologies, as well as combinatorial optimization are the IT fields that have gained significant interest in maritime studies because of their potential in giving solutions for effective sea transportation. This edited volume focuses on research works related to the latest developments of IT methodologies for maritime transportation, and it comes after the successful organization of the 1st and 2nd Workshop on Modeling, Computing and Data Handling for Marine Transportation (MCDMT 2015 and MCDMT 2016) which were held in association with the 6th and 7th International Conference on Information, Intelligence, Systems and Applications (IISA 2015 and IISA 2016). Seven chapters describing modeling tools, methodologies, algorithms, and systems comprise this edited volume as follows:

Chapters 1 and 2 consider two important problems in maritime logistics pertaining to quayside operational planning. Quayside problems include the Berth Allocation Problem (BAP) which determines the berths that incoming vessels are assigned to, the Quay Crane Assignment Problem, whereby the required cranes are assigned to each ship, and the Quay Crane Scheduling Problem (QCSP) where scheduling of crane tasks takes place. Chapter 1 considers a variation of BAP, namely the Minimum Cost Hybrid BAP (MCHBAP) with fixed handling times of vessels. The objective function to be minimized includes the cost of positioning, the speeding up or waiting, and the tardiness of completion for all vessels. A number of metaheuristics are surveyed, and a general variable neighborhood search

approach is proposed. The metaheuristics are evaluated on real-life and randomly generated instances. Chapter 2 considers the problem of vessel stability during the process of unloading and/or loading containers onto vessels. The quay crane scheduling process determines the operational profile of each quay crane in terms of the container tasks and timing. The literature on the QCSP and related problems pertaining to quayside operational planning is surveyed considering vessel stability constraints to allow for quay crane schedules that can be used in practice, and directions are provided for future work in the area.

Chapters 3 and 4 focus on maritime routing problems. Specifically, Chap. 3 presents an extensive computational study of simple, but prominent metaheuristics to find high-quality ship schedules and inventory policies for a class of maritime inventory routing problems. Several variants of rolling horizon heuristics, K-opt heuristics, local branching, solution polishing, and hybrid metaheuristics are compared. Many of them substantially outperform the commercial mixed-integer programming solvers. Chapter 4 presents evolutionary algorithms for solving the real-time ship weather routing problem. The objectives to be minimized are the mean total risk and the fuel cost incurred along the obtained route while considering the time-varying sea and weather conditions and also a constraint on the total voyage time. The proposed approaches return only solutions compliant with the guidelines of the International Maritime Organization (IMO) and are tested on real data and also compared with an exact algorithm which solves the same problem.

Chapters 5 and 6 present decision support systems for safe shipping and seaport's security. In particular, Chap. 5 describes a decision support tool for environmentally safe shipping focusing on extracting aggregated statistics using spatial analysis of multilayer information, namely vessel trajectories, vessel data, and information regarding environmentally important areas. The proposed system includes preprocessing, clustering of trajectories based on their spatial similarity, and risk assessment employing probabilistic models. Applications are presented in areas such as queries in protected areas and marine traffic monitoring for environmental safety. Chapter 6 presents a decision support system for the assessment of seaports' security employing a flexible approach to evaluate the performance of security measures. A fuzzy analytical hierarchy process is utilized to analyze the complex structure of a seaport system and determine the weights of security measures while evidential reasoning is used to synthesize the risk analysis. The approach may provide analysts with a flexible tool to develop and employ robust resilience strategies aimed at enhancing seaport security in a systematic manner.

Finally, Chap. 7 presents a step-by-step development of a model which simulates maritime traffic in Bosphorus, Turkey. The model demonstrates the relationships between sea traffic rules, number of pilots, and waiting times. It is expected that the presentation of the process for building a simulation model will be a useful guide for model builders in the maritime transportation domain.

From our position, we wish to thank Prof. George Tsichritzis for his constant support and help during the preparation of this volume. We would also like to thank all the authors for their contributions and the reviewers for their assessment of the chapters. We hope that the readers will find the contents of this edited volume interesting and useful.

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