

# Preface

This book is dedicated to some chosen aspects of an application of graph theory in some fields of engineering. There are plenty of books concerning graph theory (treated from a theoretical point of view) on the worldwide market; however, its application is not too frequently published in a form of separate volumes. In fact, among all recently published books related to the field of graph theory, discrete mathematics and combinatorics, there is probably only a few per cent dedicated to graph application.

On the other hand, there are conference proceedings dedicated to applied or industrial mathematics where graphs' applications are mixed with versatile other mathematical tools suitable for modelling—as for example: differential and integral equations, algebraic equations or geometrical 3D models. The applications of graph theory are versatile, e.g. in chemistry, electrical engineering, network analysis, mechanical engineering, automation, computer science and especially nowadays social sciences as well as social networks modelling and analysis. The very recent book printed by SPRINGER (in 2015), entitled “Graph-Based Representations in Pattern Recognition” is dedicated to the idea of merging graphs with artificial intelligence-related problems.

The present book gives a glimpse on some graph theory application in modelling networks in general and modeling chosen mechanical systems as for example: robot leg, planetary gears and compound gear system consisting of planetary and friction gear. Moreover, some applications of graphs in modelling of production processes as well as design processes are included. Chemistry and electrical engineering topics are not considered at all, but it would be possible in next editions.

A model of a particular system is obtained via a series of activities, e.g. abstraction, simplification, discretization and derivation of relations among the elements of the system. Therefore, the graph models do not represent the system in a holistic way, but on contrary, some of its features or behaviours are grasped and other omitted. Therefore, some approaches are neglected, obviously; however, it allows focusing an attention on some other important aspects.

This book contains also some basics dedicated to bond graphs which are recently most popular due to their generality and possibility to capture different subsystems (mechanical, electrical, hydraulic etc.) in one unified model. Moreover, professional and shareware-type software is available to create the graph-based models for simulation of behaviour of the systems. Therefore, the bond graphs are widely developed and taught at the universities, especially in Holland, Romania and USA as well as Poland.

Besides bond graphs, other types of graphs are utilized in the present book of gathered papers, e.g. Petri nets, contour graphs, linear, directed and mixed graphs as well as logical trees. Despite the fact that the book contains just 18 contributions, it gives a wide spectrum of graph application. Additionally, due to the wide lists of references and based on the contents itself, it allows for understanding the state of art in contemporary graph-based modelling of wide range of systems, networks and engineering tasks as design and decision-making. Graphs are powerful and handy tools for engineers, and number of papers dedicated to their utilization has been increasing in recent years essentially; however, monographs are really rare. We expect that this book would launch the sub-series dedicated to graph theory applications.

This book is included into the series “Mechanisms and Machine Science” edited by Prof. Marco Ceccarelli (Casino, Italy) under patronage of IFToMM (The International Federation for the Promotion of Mechanism and Machine Science). The mission of IFToMM is developing not only the mechanism and machine science itself but also any utilization of modelling tools; moreover, IFToMM propagates multidisciplinary approach, as well.

We do hope that this book would be an inspiration for studying graph theory taking into account its versatile application.

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