

Preface

This volume is based on the papers presented at the 6th International Conference on Network Analysis held in Nizhny Novgorod, Russia, May 26–28, 2016. The main focus of the conference and this volume is centered around the development of new computationally efficient algorithms as well as underlying analysis and optimization of graph (network) structures induced either by natural or by artificial complex networks. Various applications to social networks, power transmission grids, stock market networks, and human brain networks are also considered. The previous books based on the papers presented at the 1st–5th Conferences International Conference on Network Analysis can be found in [1–5]. The current volume consists of three major parts, namely optimization approaches, network models, and related applications, which we briefly overview next.

Part I of this book is focused on optimization problems in networks. In Chapter “[Linear Max-Min Fairness in Multi-commodity Flow Networks](#),” a linear max-min fairness (LMMF) approach using goal programming is proposed. This model can be applied to max-min fairness (MMF) problems in networks with applications to multicommodity flows in networks. The proposed model provides a high flexibility for the decision maker to determine the level of throughput and the fairness of flow in the network.

In Chapter “[Heuristic for Maximizing Grouping Efficiency in the Cell Formation Problem](#),” Cell Formation Problem in Group Technology with grouping efficiency as an objective function is considered. A heuristic approach for obtaining high-quality solutions is presented. The computational results show the effectiveness of the approach.

In Chapter “[Efficient Methods of Multicriterial Optimization Based on the Intensive Use of Search Information](#),” an efficient approach for solving complex multicriterial optimization problems is developed. In particular, it is based on reducing multicriterial problems to nonlinear programming problems via the minimax convolution of the partial criteria, reducing dimensionality by using Peano evolvents, and applying efficient information-statistical global optimization methods. The results of the computational experiments show that the proposed approach reduces the computational costs of solving multicriterial optimization problems.

In Chapter “[Comparison of Two Heuristic Algorithms for a Location and Design Problem](#),” the special case of the location and design problem is considered. A Variable Neighborhood Search algorithm and a Greedy Weight Heuristic are proposed. In particular, new best known solutions have been found by applying the proposed approaches.

In Chapter “[A Class of Smooth Modification of Space-Filling Curves for Global Optimization Problems](#),” a class of smooth modification of space-filling curves applied to global optimization problems is presented. These modifications make the approximations of the Peano curves (evolvents) differentiable in all points and save the differentiability of the optimized function. Some results of numerical experiments with the original and modified evolvents for solving global optimization problems are discussed.

In Chapter “[Iterative Local Search Heuristic for Truck and Trailer Routing Problem](#),” Site-Dependent Truck and Trailer Routing Problem with Hard and Soft Time Windows and Split Deliveries is considered. A new iterative local search heuristic for solving this problem was developed.

Part II of this book presents several network models. Chapter “[Power in Network Structures](#)” considers an application of power indices, which take into account the preferences of agents for coalition formation proposed for an analysis of power distribution in elected bodies to reveal most powerful (central) nodes in networks. These indices take into account the parameters of the nodes in networks, a possibility of group influence from the subset of nodes to single nodes, and intensity of short and long interactions among the nodes.

In Chapter “[Do Logarithmic Proximity Measures Outperform Plain Ones in Graph Clustering?](#),” a number of graph kernels and proximity measures as well as the corresponding distances were applied for clustering nodes in random graphs and several well-known datasets. In the experiments, the best results are obtained for the logarithmic Communicability measure. However, some more complicated cases are indicated in which other measures, typically Communicability and plain Walk, can be the winners.

In Chapter “[Analysis of Russian Power Transmission Grid Structure: Small World Phenomena Detection](#),” the spatial and topological structure of the Unified National Electricity Grid (UNEG)—Russia’s power transmission grid—is analyzed. The research is focused on the applicability of the small-world model to the UNEG network. For this purpose, geo-latticization algorithm has been developed. As a result of applying the new method, a reliable conclusion has been made that the small-world model is applicable to the UNEG.

In Chapter “[A New Approach to Network Decomposition Problems](#),” a new approach to network decomposition problems is suggested. The suggested approach is focused on construction of a family of classifications. Based on this family, two numerical indices are introduced and calculated. This approach was applicable to political voting body and stock market.

In Chapter “[Homogeneity Hypothesis Testing for Degree Distribution in the Market Graph](#),” the problem of homogeneity hypothesis testing for degree distribution in the market graph is studied. Multiple hypotheses testing procedure is

proposed and applied for China and India stock markets. The procedure is constructed using bootstrap method for individual hypotheses and Bonferroni correction for multiple testing.

Chapter “[Stability Testing of Stock Returns Connections](#)” considers the testing problem of connection stability which is formulated as homogeneity hypothesis testing of several covariance matrices for multivariate normal distributions of stock returns. New procedure is proposed and applied for stability testing of connections for French and German stock markets.

Part III of this book is focused on applications of network analysis. In Chapter “[Network Analysis of International Migration](#),” the network approach to the problem of international migration is employed. The international migration can be represented as a network where the nodes correspond to countries and the edges correspond to migration flows. The main focus of the study is to reveal a set of critical or central elements in the network.

In Chapter “[Overlapping Community Detection in Social Networks with Node Attributes by Neighborhood Influence](#),” a fast method for overlapping community detection in social networks with node attributes is presented. The proposed algorithm is based on attribute transfer from neighbor vertices and does not require any knowledge of attributes meaning. Computational results show that the proposed method outperforms other algorithms such as Infomap, modularity maximization, CESNA, BigCLAM, and AGM-fit.

In Chapter “[Testing Hypothesis on Degree Distribution in the Market Graph](#),” the problem of testing hypotheses on degree distribution in the market graph is discussed. Research methodology of power law hypothesis testing is presented. This methodology is applied to testing hypotheses on degree distribution in the market graphs for different stock markets.

In Chapter “[Application of Network Analysis for FMCG Distribution Channels](#),” the approach for multidimensional analysis of marketing tactics of the companies employing network tools is presented. The research suggests omni-channel distribution tactic of a company as a node in eight-dimensional space. Empirical implication is approved on the sample from 5694 distributors from sixteen fast-moving consumer goods-distributing companies from direct selling industry.

In Chapter “[Machine Learning Application to Human Brain Network Studies: A Kernel Approach](#),” a task of predicting normal and pathological phenotypes from macroscale human brain networks is considered. The research focuses on kernel classification methods. It presents the results of performance comparison of the different kernels in tasks of classifying autism spectrum disorder versus typical development and carriers versus non-carriers of an allele associated with an increased risk of Alzheimer’s disease.

In Chapter “[Co-author Recommender System](#),” a new recommender system for finding possible collaborator with respect to research interests is proposed. The recommendation problem is formulated as a link prediction within the co-authorship network. The network is derived from the bibliographic database and enriched by the information on research papers obtained from Scopus and other publication ranking systems.

Chapter “[Network Studies in Russia: From Articles to the Structure of a Research Community](#)” focuses on the structure of a research community of Russian scientists involved in network studies by analysis of articles published in Russian-language journals. It covers the description of method of citation (reference) analysis that is used and the process of data collection from eLibrary.ru resource, as well as presents some brief overview of collected data (based on analysis of 8000 papers).

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