Preface

Network flow optimization problems may arise in a wide variety of important fields, such as transportation, telecommunication, computer networking, financial planning, logistics and supply chain management, energy systems, etc. Significant and elegant results have been achieved on the theory, algorithms, and applications, of network flow optimization in the past few decades; See, for example, the seminal books written by Ahuja, Magnanti and Orlin (1993), Bazaraa, Jarvis and Sherali (1990), Bertsekas (1998), Ford and Fulkerson (1962), Gupta (1985), Iri (1969), Jensen and Barnes (1980), Lawler (1976), and Minieka (1978).

Most network optimization problems that have been studied up to date are, however, static in nature, in the sense that it is assumed that it takes zero time to traverse any arc in a network and that all attributes of the network are constant without change at any time. Networks in the real world are, nevertheless, time-varying in essence, in which any flow must take a certain amount of time to traverse an arc and the network structure and parameters (such as arc and node capacities) may change over time. In such a problem, how to plan and control the transmission of flow becomes very important, since waiting at a node, or travelling along a particular arc with different speed, may allow one to catch the best timing along his path, and therefore achieve his overall objective, such as a minimum overall cost or a minimum travel time from the origin to the destination. There are plenty of decision making problems in practice that should be formulated as optimization models on time-varying networks. The main purpose of this monograph is to describe, within a unified framework, a series of models, propositions, and algorithms, that we have developed in this area in recent years. Additional references and discussions on relevant problems and studies that have appeared in the literature will also be provided.

This monograph consists of eight chapters, in which we formulate and study respectively the shortest path problem, minimum-spanning tree problem, maximum flow problem, minimum cost flow problem, maximum capacity path problem, quickest path problem, multi-criteria problem, and generalized flow problem (the time-varying travelling salesman problem and the Chinese postman problem will also be considered in a chapter together with the time-varying generalized problem). While these topics will be described all within the framework of time-varying networks, our plan is to make each chapter relatively self-contained so that they can be read separately. It is hoped that this book is useful for researchers, practitioners, and graduate students and senior undergraduates, as a unified reference and textbook on time-varying network optimization. While we describe in this book only the structure of the algorithms, we have developed the software that implements the algorithms, which is available for academic study purpose upon request.

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