

Preface

Information systems have become an inevitable part of contemporary society and affect our lives every day. With rapid development of the technology, it is crucial to understand how information, usually in the form of sensing and control, influences the evolution of a distributed or networked system, such as social, biological, genetic, and military systems. The dynamic aspect of information fundamentally describes the potential influence of information on the system and how that information flows through the system and is modified in time and space. Understanding this dynamics will help to design a high-performance distributed system for real-world applications. One notable example is the integration of sensor networks and transportation where the traffic and vehicles are continuously moving in time and space. Another example would be applications in the cooperative control systems, which have a high impact on our society, including robots operating within a manufacturing cell, unmanned aircraft in search and rescue operations or military surveillance and attack missions, arrays of microsatellites that form distributed large aperture radar, or employees operating within an organization. Therefore, concepts that increase our knowledge of the relational aspects of information as opposed to the entropic content of information will be the focus of the study of information systems dynamics in the future.

This book presents the state of the art relevant to the theory and practice of the dynamics of information systems and thus lays a mathematical foundation in the field. The first part of the book provides a discussion about evolution of information in time, adaptation in a Hamming space, and its representation. This part also presents an important problem of optimization of information workflow with algorithmic approach, as well as integration principle as the master equation of the dynamics of information systems. A new approach for assigning task difficulty for operators during multitasking is also presented in this part. Second part of the book analyzes critical problems of information in distributed and networked systems. Among the problems discussed in this part are sensor scheduling for space object tracking, randomized multidimensional assignment, as well as various network problems and solution approaches. The dynamics of climate networks and complex network models are also discussed in this part. The third part of the book

provides game-theoretical foundations for dynamics of information systems and considers the role of information in differential games, cooperative control, protocol design, and leader with multiple followers games.

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