Advances in Intelligent Systems and Computing

Volume 307

Series editor

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Dependability Problems of Complex Information Systems

Springer

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ISSN 2194-5357 ISSN 2194-5365 (electronic)
ISBN 978-3-319-08963-8 ISBN 978-3-319-08964-5 (eBook)
DOI 10.1007/978-3-319-08964-5

Library of Congress Control Number: 2014943647

Springer Cham Heidelberg New York Dordrecht London

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

Preface

We are pleased and honoured to present the monograph on *Dependability problems of complex information systems* that includes some original approaches to the selected problems of complex systems dependability.

Contemporary technical systems are integrated compositions of technical, information, organization, software and human (users, administrators and management) resources. Their complexity stems from the applied technical and organizational structures (comprising both hardware and software resources), but even more, from the complexity of the information processes (processing, monitoring, management, etc.) realized in their operational environment. With system resources being dynamically allocated to the on-going tasks, the flow of system events comprising incoming and/or on-going tasks, management decisions, system faults, defensive system reactions, etc. is modelled as a deterministic or/and probabilistic event stream.

Complexity and multiplicity of processes, their concurrency and their reliance on the in-system intelligence (human and artificial) significantly impedes the construction of strict mathematical models and limits the evaluation of adequate system measures. In many cases, analysis of modern complex systems is confined to quantitative studies (e.g. Monte Carlo simulations) which prevent development of appropriate methods of system design and selection of policies for system exploitation. Security and confidentiality of information processing introduce further complications into the system models and the evaluation methods.

The three basic concepts characterizing the newest approach to modelling and evaluation of dependability properties of contemporary systems are discussed in the monograph:

- modelling of the system and its components,
- tasks (functionalities) performed by the system,
- dependability of the system, which is understood as the correct realization of the tasks in the system and in its environment.

Systems - Complex Systems - Computer Systems

Components of the considered class of systems include devices (hardware), procedures for task realization (software), procedures for the system management

(operating/management system), and people (users, administrators, operators, service technicians). The system performs tasks set by the users. Each task is defined as the performance of some work or service on time under the prevailing operating conditions. The necessary system resources are allocated to tasks. The process of system resources allocation is dynamic and depends on various system events, such as start of a new task, end of a running one, device failure, program error, decision of the management system, human fault, etc. The system operates in an environment that also is a source of events, such as hostile attacks on the system.

In these terms we define the model of a complex system that can be used to describe a number of modern entities: computer systems, logistics of a discrete transport system, or even such complex systems as a network of web services.

Tasks - Functionalities

A complex system described above, or more precisely its mathematical model, is built to meet specific user-generated tasks. User requests determine the tasks to be realized. In turn, these tasks are realized by invoking a sequence of functionalities necessary to achieve the desired effect. To perform these functions, the system allocates appropriate resources.

Involvement of system resources and system functionalities in the task is time-varying and depends on various system events.

Reliability - Performability - Dependability

The system is reliable if the user tasks are carried out according to the requirements. Complexity of the system structures enables the correct execution of tasks with different efficiencies. Damages to equipment (hardware) and faults (due to software or human errors) interfere with the correct execution of tasks. In many cases, the system incorporates some measures (hardware redundancy, functional redundancy, time redundancy, repair teams or reconfiguration capabilities) to improve system efficient operation and to minimize its losses caused by faults.

Reliability theory focuses on the elements represented as operational/inoperational blocks. In this approach, system is described by a series-parallel structure. Some years ago, an extension to this reliability model was introduced by including consideration of the functional and performance properties of the system components. In this way the class of functional-reliability models was defined. Performability measures reflect both the functional and performance properties (perform-), and reliability (ability) of the system. In recent years, the term "dependability" has become popular, becoming a better known replacement of performability.

Dependability tries to deal with all the mentioned above challenges by employing a multi-disciplinary approach to theory, technology and maintenance of systems working in a real (and very often unfriendly) environment. Dependability studies investigate the system as a multifaceted and sophisticated amalgamation of technical, information and also human resources concentrating on efficient realization of services in such an environment.

The monograph consists of 11 chapters, representing different approaches to the modeling, analysis and evaluation of the dependability properties of the complex

information systems. We hope that the collected works will be valuable to scientists, researchers, practitioners and students who work on problems of dependability. We would like to express our sincere gratitude to the authors of the selected works for their excellent research approach and results.

We are very grateful to the Wrocław University of Technology for their support and funding, which made this monograph possible. It sums up the long years of research initiated at Wrocław by Professor Wojciech Zamojski, aimed at adapting the reliability approach to complex computer-based systems. A substantial part of the monograph presents the results of research done under his guidance within the project N N516 475940 “Dependability improvement of complex information systems by reconfiguration”, supported by the Polish National Science Centre.

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Contents