Evsey V. Morozov Alexander S. Rumyantsev Oleg V. Lukashenko (Eds.)

SMARTY 2020 The Second International Workshop on Stochastic Modeling and Applied Research of Technology

Petrozavodsk, Russia, August 16–20, 2020 Proceedings

Copyright © 2020 for the individual papers by the papers' authors. Copyright © 2020 for the volume as a collection by its editors. This volume and its papers are published under the Creative Commons License Attribution 4.0 International (CC BY 4.0). Editors' addresses: Institute of Applied Mathematical Research Karelian Research Centre of the Russian Academy of Sciences 11 Pushkinskaya Str. 185910 Petrozavodsk, Karelia Republic, Russia $\{emorozov\,|\,ar0\,|\,lukashenko\}\,@\,krc.karelia.ru$

Preface

Stochastic modeling and applied probability continue to be a hot topic in the theoretical computer science and mathematics domain. For various cutting-edge applications, such as high performance computing and communications systems, production systems, social networks, healthcare applications, the methods of applied probability, statistics, stochastic simulation join forces with game theory, neural networks and computational advances in order to provide qualitatively new results.

The Second International Workshop on Stochastic Modeling and Applied Research of Technology (SMARTY 2020) was held in Petrozavodsk, Karelia, one of the beautiful places in the North-West Russia, on August 16-20, 2020.

SMARTY workshop aims to bring together researchers working on the theoretical, algorithmic and methodological aspects of queueing theory, stochastic modeling and game theory, focusing on applications of such methods across a broad spectrum of technical systems with primary interest in high-performance and distributed computing systems. We received 26 submissions out of which we selected 18 for inclusion in the digital proceedings. The accepted papers cover a wide range of issues, from theoretical research to practical experience and applications.

We thank the authors, invited and keynote speakers for the submissions as well as for their contribution which have made the Workshop useful and successful in all respects. We thank the Organizing Committee and Technical Program Committee for their hard work.

December 2020

Evsey V. Morozov, Alexander S. Rumyantsev Oleg V. Lukashenko

Organizing Committee

Alexander Rumyantsev Alexandra Borodina Irina Peshkova Ksenia Zhukova Lusine Meykhanadjian Natalia Nikitina Oleg Lukashenko Rostislav Razumchik

Ruslana Nekrasova

Technical Program Committee

Abhijit Datta Banik Achyutha Krishnamoorthy

Agassi Z. Melikov

Alexander N. Dudin

Alexander Veretennikov

Alexander Zeifman

Andrey Pechnikov

Antonis Economou

Balasubramanian Krishna Kumar

Binyamin Oz

Deepak Thazhungal Govindan

Dieter Fiems

Dmitry Kozyrev

Douglas Down

Erol Gelenbe

Evgeny Ivashko

Evsey Morozov

Garimella Rama Murthy

Galina Zverkina

Herwig Bruneel

Ioannis Dimitriou

Janos Sztrik

Konstantin Avrachenkov

Mais Farhadov

Manikandan Rangaswamy

Marian Codreanu

Masakiyo Miyazawa

Michele Pagano

Miklos Telek Oleg A. Osipov Onno Boxma Philippe Robert Rein Nobel Ruslan Krenzler Sabine Wittewrongel Srinivas Chakravarthy Stijn De Vuyst Tuan Phung-Duc Tadeusz Czachórski Udo Krieger Varghese C. Joshua Vladimir Mazalov Vladimir Rykov Yuliya Gaidamaka

Contents

Stochastic Dichotomous Game-Theoretic Model of Technology Efficiency Vladimir Tsyganov	8
Quorum Analysis for the "Pirate Game" Problem Ilya Chernov and Evgeny Ivashko	24
Time Dependent Diffusion Model for Security Driven Software Defined Networks	
Tadeusz Czachórski, Erol Gelenbe, Godlove Suila Kuaban and Dariusz Marek	38
Efficient Computation of Equilibrium/Transient Probability Distribution of Arbitrary Finite State Space Continuous Time Markov Chains Garimella Ramamurthy	57
Optimal Strategy Modelling in an Online Auction for the Rent of Computing Resources	
Anna Ivashko and George Safonov	66
Fork-Join Queueing Systems with Heterogeneous Servers Threshold Control Policy	
Oleg Osipov and Ekaterina Rogachko	76
Queue with Batch Service, Batch Size Determined by Emergency Customers Sinu Lal T. S., A. Krishnamoorthy and V. C. Joshua	89
Prediction of the Optimal Control in a Multi-Server Heterogeneous Queueing System	
Dmitry Efrosinin and Natalia Stepanova	102
Gas Quality Determination Using Neural Network Model-based System Ivan Brokarev and Sergei Vaskovskii	113
On a Linear Polymerisation Process Sergei Zuyev	129

CONTENTS

On the Stationary Remaining Service Time in the Queueing Systems Evsey Morozov and Taisia Morozova	140
Stability Analysis of a Model with General Retrials and Constant Retrial Rate Evsey Morozov and Ruslana Nekrasova	150
Simulation a Modified Erlang Loss System with Multi-type Servers and Multi- type Customers Stepan Rogozin	162
Opinion Dynamics Models with Noise E. Konovalchikova and Yu. Dorofeeva	176
Importance Sampling for the Estimation of the Failure Probability of the Degradation Process Oleg Lukashenko and Alexandra Borodina	191
On Stochastic and Failure Rate Orderings in Systems with Two-Component Service Time Mixture Irina Peshkova and Evsey Morozov	203
Stability of Multiclass Multiserver Models with Automata-type Phase Transitions Alexander Rumyantsev	213
Autocorrelation Function Characterization of Continuous Time Markov Chains G. Rama Murthy, D.G. Down and A. Rumyantsev	226