Special issue on the Workshop on TOols for Stochastic Modeling and Evaluation (TOSME 2021)

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This special issue collects the contributions of the *Workshop on TOols for Stochastic Modeling and Evaluation*, held virtually on November 12, 2021, in conjunction with the 30^{th} *IFIP WG 7.3 Performance conference, Performance 2021.*

Tools for stochastic modelling and evaluation play an important role in understanding the complexity of nowadays applications. Whether based on simulation, approximate or exact model solution, they should be part of the expertise of any computer scientist while designing new systems, or in understanding unforeseen behaviour of existing ones. Tools play also an important role in teaching, as they allow to experiment on real cases the theory taught in our performance evaluation or system verification classes. It is not by chance that this workshop comes right after Performance 2021, and right before the 1^{st} *International Workshop on Teaching Performance Analysis of Computer Systems.*

The aim of TOSME was to take stock of the tools for stochastic modelling and evaluation: as such we have solicited presentations of both new and well established tools and libraries. The program includes 11 papers, peer-reviewed by three PC members and collected in this volume, and three short presentations. The first four papers present tools implementing advanced analysis techniques: Almousa et al. present a Numerical Inverse Laplace Transfom tool based on the Concentrated Matrix Geometrics method that avoids Gibbs oscillation, and preserves the monotonicity of functions. Allmeier et al. present rmf_tool, a Python library for computing meanfield and refined meanfield approximations of density dependent population processes or heterogeneous population processes. Masetti et al. present TAPAS, a Matlab library for performability and dependability evaluation of systems modeled as Stochastic Activity Networks, representing many interacting components. Using Kronecker Algebra, Tensor trains and Exponential sums, it can solve models with huge state spaces through implicit representation of both the transition matrix and the solution vector. Marzolla presents the Octave *queueing* package for numerical solution of product form Queueing Networks and Discrete and Continuous Time Markov chains. On the applications side, Cortellessa et. al present PADRE, a tool for detection and removal of performance flaws. It supports UML models profiled with MARTE and Queueing Networks for performance evaluation. The next three papers concern simulation tools. Budde presents the tool FIG (Finite Improbability Generator): implemented in C++, it estimates transient and steady state reachability properties in stochastic automata and features rare event simulation. Ballarini et al. present COSMOS, a statistical model checker of Hybrid Automata Stochastic Logic to analyze execution paths of Discrete Event Stochastic Processes. It is implemented in C++ and supports rare event simulation and hybrid systems. Sheldon et al. propose TauSSA, a discrete event simulator of extended queueing networks implemented in Java; it exploits the Tau-leap method to speed up the simulation: the paper compares different strategies to overcome the problem of possibly reaching illegal states. The last three papers propose tools that analyze different flavours of Petri nets. Lladò presents PIPE 2.7, a tool based on the Generalized Stochastic Petri Net (GSPN) formalism, with several distinctive features, e.g. the possibility of importing PMIF models and an experimenter module compliant with the Experiment Schema Extension Specification. Carnevali et al. present ORIS and the SIRIO library for transient and steady state analysis of Stochastic Time Petri Net models and non-deterministic analysis of Time Petri Nets. Amparore presents GreatSPN, a framework supporting the GSPN formalism and its colored extension, incorporating more than 60 tools grouped in categories: composition and translation, structural analysis, Markov Decision Processes support, temporal logic model checking and stochastic solution through state space, simulation or differential equations; most tools are accessible through a GUI.

The workshop invited talk, entitled "Competing with Probabilities: Challenges and Outcomes of QComp" was given by Arnd Hartmanns: he focused on the need for reproducibility in Computer Science research, and how it can be reached through artifact evaluation initiatives, tool competitions, and standardised benchmark sets. He has shared the lessons learned in the QComp 2019 and 2020 competitions of tools for the analysis of quantitative formal models.

We warmly thank all the speakers and co-authors, the developers of all tools presented in TOSME 2021, and all the workshop attendees. The workshop took great advantage of the work of a small and very competent program committee, including researchers with significant previous experience on tools development and use: Elvio Amparore, Peter Buchholz, Giuliano Casale, Davide Cerotti, Leana Golubchik, Marco Gribaudo, Catalina Lladò, and David Parker. We thank the workshop and general chairs, Evgenia Smirni and Danilo Ardagna, for their continuous support, the webmaster Federica Filippini for timely publishing all the required information on the TOSME 2021 website, and Zhenhua Liu for the assistance with this special issue of PER.

TOSME2021 – Tools for stochastic modelling and evaluation