

2023 IEEE 29th Real-Time and Embedded Technology and Applications Symposium (RTAS 2023)

**San Antonio, Texas, USA
9 – 12 May 2023**



**IEEE Catalog Number: CFP23044-POD
ISBN: 979-8-3503-2177-7**

**Copyright © 2023 by the Institute of Electrical and Electronics Engineers, Inc.
All Rights Reserved**

Copyright and Reprint Permissions: Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

****** This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.***

IEEE Catalog Number:	CFP23044-POD
ISBN (Print-On-Demand):	979-8-3503-2177-7
ISBN (Online):	979-8-3503-2176-0
ISSN:	1545-3421

Additional Copies of This Publication Are Available From:

Curran Associates, Inc
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: (845) 758-0400
Fax: (845) 758-2633
E-mail: curran@proceedings.com
Web: www.proceedings.com

CURRAN ASSOCIATES INC.
proceedings
.com

2023 IEEE 29th Real-Time and Embedded Technology and Applications Symposium (RTAS) **RTAS 2023**

Table of Contents

Message from the Chairs	x
Organizing Committee	xii
Program Committee	xiii

Paper Session 1 – Average-Case and Probabilistic Behaviour

Average Task Execution Time Minimization Under (m, k) Soft Error Constraint	1
<i>Junjie Shi (TU Dortmund University, Germany), Niklas Ueter (TU Dortmund University, Germany), Jian-Jia Chen (TU Dortmund University, Germany), and Kuan-Hsun Chen (University of Twente, The Netherlands)</i>	
Continuous-Emission Markov Models for Real-Time Applications: Bounding Deadline Miss Probabilities	14
<i>Anna Friebe (Mälardalen University, Sweden), Filip Markovic (Max Planck Institute for Software Systems (MPI-SWS), Sweden), Alessandro Vittorio Papadopoulos (Mälardalen University, Sweden), and Thomas Nolte (Mälardalen University, Sweden)</i>	
Minimizing Probabilistic End-to-End Latencies of Autonomous Driving Systems	27
<i>Taeho Han (Soongsil University, Korea) and Kanghee Kim (Soongsil University, Korea)</i>	

Paper Session 2 – Partitioning and Composition

Shedding Light on Static-Partitioning Hypervisors for Arm-Based Mixed-Criticality Systems	40
<i>José Martins (Centro ALGORITMI/LASI, Universidade do Minho) and Sandro Pinto (Centro ALGORITMI/LASI, Universidade do Minho)</i>	
Hardware Compute Partitioning on NVIDIA GPUs	54
<i>Joshua Bakita (University of North Carolina at Chapel Hill) and James H. Anderson (University of North Carolina at Chapel Hill)</i>	

Compositional Mixed-Criticality Systems with Multiple Executions and Resource-Budgets Model	67
<i>Abdullah Al Arafat (North Carolina State University), Sudharsan Vaidhun (University of Central Florida), Liangkai Liu (Wayne State University), Kecheng Yang (Texas State University), and Zhishan Guo (North Carolina State University)</i>	

Paper Session 3 – ROS 2

Real-Time Performance Analysis of Processing Systems on ROS 2 Executors	80
<i>Yue Tang (n/a), Nan Guan (n/a), Xu Jiang (n/a), Xiantong Luo (n/a), and Wang Yi (n/a)</i>	
ROSGM: A Real-Time GPU Management Framework with Plug-In Policies for ROS 2	93
<i>Ruoxiang Li (City University of Hong Kong, SAR), Tao Hu (City University of Hong Kong, SAR), Xu Jiang (Northeastern University, China), Laiwen Li (Northeastern University, China), Wenxuan Xing (Northeastern University, China), Qingxu Deng (Northeastern University, China), and Nan Guan (City University of Hong Kong, SAR)</i>	
Timing Analysis and Priority-Driven Enhancements of ROS 2 Multi-threaded Executors	106
<i>Hoora Sobhani (University of California, Riverside), Hyunjong Choi (San Diego State University), and Hyoseung Kim (University of California, Riverside)</i>	

Paper Session 4 – Optimization and Trade-off

A General and Scalable Method for Optimizing Real-Time Systems with Continuous Variables	119
<i>Sen Wang (Virginia Tech, USA), Ryan K. Williams (Virginia Tech, USA), and Haibo Zeng (Virginia Tech, USA)</i>	
ISC-FLAT: On the Conflict Between Control Flow Attestation and Real-Time Operations	133
<i>Antonio Joia Neto (Rochester Institute of Technology) and Ivan De Oliveira Nunes (Rochester Institute of Technology)</i>	

Paper Session 5 – Scheduling

Schedulability Analysis of Non-Preemptive Sporadic Gang Tasks on Hardware Accelerators	147
<i>Binqi Sun (Technical University of Munich, Germany), Tomasz Kloda (LAAS-CNRS, Université de Toulouse, INSA, France), Jiyang Chen (Technical University of Munich, Germany), Cen Lu (Technical University of Munich, Germany), and Marco Caccamo (Technical University of Munich, Germany)</i>	
Scheduling Periodic Segmented Self-Suspending Tasks Without Timing Anomalies	161
<i>Ching-Chi Lin (Technical University of Dortmund, Germany), Mario Günzel (Technical University of Dortmund, Germany), Junjie Shi (Technical University of Dortmund, Germany), Tristan Taylan Seidl (Technical University of Dortmund, Germany), Kuan-Hsun Chen (University of Twente, Netherlands), and Jian-Jia Chen (Technical University of Dortmund, Germany)</i>	

Precise Response Time Analysis for Multiple DAG Tasks with Intra-Task Priority Assignment 174
Nan Chen (University of York, UK), Shuai Zhao (Sun Yat-Sen University, China), Ian Gray (University of York, UK), Alan Burns (University of York), Siyuan Ji (University of York, UK), and Wanli Chang (Hunan University, China)

Real-Time Scheduling of Autonomous Driving System with Guaranteed Timing Correctness 185
Jinghao Sun (Dalian University of Technology, China), Kailu Duan (Dalian University of Technology, China), Xisheng Li (Dalian University of Technology, China), Nan Guan (City University of Hong Kong, Hong Kong), Zhishan Guo (North Carolina State University, U.S), Qingxu Deng (Northeastern University, China), and Guozhen Tan (Dalian University of Technology, China)

Paper Session 6 – Safety and Security

Cache Bank-Aware Denial-of-Service Attacks on Multicore ARM Processors 198
Michael Bechtel (University of Kansas, USA) and Heechul Yun (University of Kansas, USA)

Real-Time Data-Predictive Attack-Recovery for Complex Cyber-Physical Systems 209
Lin Zhang (Syracuse University), Kaustubh Sridhar (University of Pennsylvania), Mengyu Liu (Syracuse University), Pengyuan Lu (University of Pennsylvania), Xin Chen (University of Dayton), Fanxin Kong (Syracuse University), Oleg Sokolsky (University of Pennsylvania), and Insup Lee (University of Pennsylvania)

ATLAS: Aging-Aware Task Replication for Multicore Safety-Critical Systems 223
Mohsen Ansari (Sharif University of Technology), Sepideh Safari (Institute for Research in Fundamental Sciences), Amir Yeganeh-Khaksar (Sharif University of Technology), Roozbeh Siyadatzeleh (Sharif University of Technology), Pourya Gohari-Nazari (Sharif University of Technology), Heba Khdr (Karlsruhe Institute of Technology), Muhammad Shafique (New York University Abu Dhabi, United Arab Emirates), Jörg Henkel (Karlsruhe Institute of Technology), and Alireza Ejlali (Sharif University of Technology)

Paper Session 7 – Memory and Middleware

MemPol: Policing Core Memory Bandwidth from Outside of the Cores 235
Alexander Zuepke (Technical University of Munich), Andrea Bastoni (Technical University of Munich), Weifan Chen (Boston University), Marco Caccamo (Technical University of Munich), and Renato Mancuso (Boston University)

ZeroCost-LLC: Shared LLCs at No Cost to WCL 249
Zhuanhao Wu (University of Waterloo, Canada), Anirudh Kaushik (Intel Corporation, Canada), and Hiren Patel (University of Waterloo, Canada)

MultISSE: Static Syscall Elision and Specialization for Event-Triggered Multi-core RTOS 262
Gerion Entrup (Leibniz Universität Hannover), Björn Fiedler (Leibniz Universität Hannover), and Daniel Lohmann (Leibniz Universität Hannover)

Paper Session 8 – Networks and Communication

G(IP)2C: Temporally Isolated Multiprocessor Real-Time IPC with Server-to-Server Invocations	276
<i>Cedric Courtaud (Max Planck Institute for Software Systems, Germany) and Björn B. Brandenburg (Max Planck Institute for Software Systems, Germany)</i>	
On the QNX IPC: Assessing Predictability for Local and Distributed Real-Time Systems	289
<i>Matthias Becker (KTH Royal Institute of Technology, Sweden), Dakshina Dasari (Robert Bosch GmbH, Germany), and Daniel Casini (Scuola Superiore Sant’Anna, Italy)</i>	
Efficient and Accurate Handling of Periodic Flows in Time-Sensitive Networks	303
<i>Seyed Mohammadhossein Tabatabaee (EPFL, Switzerland), Marc Boyer (ONERA, France), Jean-Yves Le Boudec (EPFL, Switzerland), and Jörn Migge (RealTime-at-Work (RTaW), France)</i>	
Virtualized DDS Communication for Multi-domain Systems: Architecture and Performance Evaluation of Design Alternatives	316
<i>Andrea Stevanato (Scuola Superiore Sant’Anna, Italy; Huawei Research Center, Italy), Alessandro Biondi (Scuola Superiore Sant’Anna, Italy), Alessandro Biasci (Huawei Research Center, Italy), and Bruno Morelli (Huawei Research Center, Italy)</i>	

Brief Presentations

Work in Progress: Response Time Analysis of Real-Time Quantum Computing Systems	329
<i>Albert Mo Kim Cheng (University of Houston, USA)</i>	
Work in Progress: Towards a Statistical Worst-Case Energy Consumption Model	333
<i>Marwan Wehaiba El Khazen (Inria Paris & StatInf, France), Slim Ben Amor (StatInf, France), Kossivi Koungblenou (StatInf, France), Adriana Gogonel (StatInf, France), and Liliana Cucu-Grosjean (Inria Paris, France)</i>	
Work In Progress: A New Task Model for Real-Time DNNs over GPU	337
<i>Mourad Dridi (Univ Gustave Eiffel, LIGM, CNRS, France), Yasmina Abdeddaim (Univ Gustave Eiffel, LIGM, CNRS, France), and Chiara Daini (INRIA, Paris, France)</i>	
Work in Progress: Real-Time Transformer Inference on Edge AI Accelerators	341
<i>Brendan Reidy (University of South Carolina, USA), Mohammadreza Mohammadi (University of South Carolina, USA), Mohammed Elbtity (University of South Carolina, USA), Heath Smith (University of South Carolina, USA), and Ramtin Zand (University of South Carolina, USA)</i>	

Work-in-Progress: Securing Safety-Critical Control Tasks with Attack-Aware Multi-rate Scheduling	345
<i>Arkaprava Sain (Indian Institute of Technology, India), Suraj Singh (Indian Institute of Technology, India), Sunandan Adhikary (Indian Institute of Technology, India), Ipsita Koley (Indian Institute of Technology, India), and Soumyajit Dey (Indian Institute of Technology, India)</i>	
Work in Progress: Schedulability Analysis of CAN and CAN FD Authentication	349
<i>Omolade Ikumapayi (University of Colorado Colorado Springs), Habeeb Olufowobi (University of Texas at Arlington), Jeremy Daily (Colorado State University), Tingting Hu (University of Luxembourg), Ivan Cibrario Bertolotti (National Research Council of Italy), and Gedare Bloom (University of Colorado Colorado Springs)</i>	
Work-in-Progress: Deadline-Aware Named Data Networking for Time-Sensitive IoT Applications.	353
<i>Afia Anjum (The University of Texas at Arlington, USA), Sena Hounsinou (Metropolitan State University, USA), and Habeeb Olufowobi (The University of Texas at Arlington, USA)</i>	
Demo: Simulation and Security Toolbox for Cyber-Physical Systems	357
<i>Lin Zhang (Syracuse University, USA), Mengyu Liu (Syracuse University, USA), and Fanxin Kong (Syracuse University, USA)</i>	
Author Index	359