

# **2023 IEEE Real-Time Systems Symposium (RTSS 2023)**

**Taipei, Taiwan  
5 – 8 December 2023**



**IEEE Catalog Number: CFP23092-POD  
ISBN: 979-8-3503-2858-5**

**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:	CFP23092-POD
ISBN (Print-On-Demand):	979-8-3503-2858-5
ISBN (Online):	979-8-3503-2857-8
ISSN:	1052-8725

**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](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

CURRAN ASSOCIATES INC.  
**proceedings**  
.com

# 2023 IEEE Real-Time Systems Symposium (RTSS) RTSS 2023

## Table of Contents

Message from the Program, Track and General Chairs .....	xiii
Hot Topics Day .....	xv
Organizers .....	xvi
Program Committee Members .....	xix
List of Secondary Reviewers .....	xxiv
Keynotes .....	xxv

## Main Conference Papers

### Real-Time Scheduling and Analysis

Rethinking Tractability for Schedulability Analysis .....	1
<i>Kunal Agrawal (Washington University in St. Louis), Sanjoy Baruah (Washington University in St. Louis), and Pontus Ekberg (Uppsala University)</i>	
What Really is pWCET? A Rigorous Axiomatic Proposal .....	13
<i>Sergey Bozhko (Max Planck Institute for Software Systems; Saarland University, Germany), Filip Marković (Max Planck Institute for Software Systems, Germany), Georg von der Brüggen (TU Dortmund University, Germany), and Björn B. Brandenburg (Max Planck Institute for Software Systems, Germany)</i>	
Holistically Budgeting Processing Graphs .....	27
<i>Zelin Tong (University of North Carolina at Chapel Hill), Shareef Ahmed (University of North Carolina at Chapel Hill), and James H. Anderson (University of North Carolina at Chapel Hill)</i>	
Stealing Static Slack via WCRT and Sporadic P-Servers in Deadline-Driven Scheduling .....	40
<i>Zhishan Guo (North Carolina State University), Sudharsan Vaidhun (University of Central Florida), Abdullah Al Arafat (North Carolina State University), Nan Guan (City University of Hong Kong), and Kecheng Yang (Texas State University)</i>	

## Security & Blockchain

Who's Afraid of Butterflies? A Close Examination of the Butterfly Attack .....	53
<i>Sanjoy Baruah (Washington University in St Louis), Pontus Ekberg (Uppsala University), Mehdi Hosseinzadeh (Washington State University), Ao Li (Washington University in St Louis), Bryan Ward (Vanderbilt University), and Ning Zhang (Washington University in St Louis)</i>	
Catch You if Pay Attention: Temporal Sensor Attack Diagnosis Using Attention Mechanisms For Cyber-Physical Systems .....	64
<i>Zifan Wang (Syracuse University), Lin Zhang (University of Pennsylvania), Qinru Qiu (Syracuse University), and Fanxin Kong (University of Notre Dame)</i>	
Learn-to-Respond: Sequence-Predictive Recovery from Sensor Attacks in Cyber-Physical Systems .....	78
<i>Mengyu Liu (University of Notre Dame), Lin Zhang (University of Pennsylvania), Vir V. Phoha (Syracuse University), and Fanxin Kong (University of Notre Dame)</i>	
RT-Blockchain: Achieving Time-Predictable Transactions .....	92
<i>Seunghoon Lee (Sungkyunkwan University (SKKU), Republic of Korea), Sukmin Kang (Sungkyunkwan University (SKKU), Republic of Korea), Seungyeon Cho (Sungkyunkwan University (SKKU), Republic of Korea), Hyunwoo Koo (Sungkyunkwan University (SKKU), Republic of Korea), Sungjae Hwang (Sungkyunkwan University (SKKU), Republic of Korea), and Jinkyu Lee (Sungkyunkwan University (SKKU), Republic of Korea)</i>	
AgileShard: Turning the Sharded Blockchain into a Real-Time Transaction Processing System .	105
<i>Jianfeng Shi (University of Chinese Academy of Sciences; Institute of Software, Chinese Academy of Sciences, China), Heng Wu (University of Chinese Academy of Sciences; Institute of Software, Chinese Academy of Sciences; Nanjing institute of software technology, Beijing), Wang Liu (University of Chinese Academy of Sciences; Institute of Software, Chinese Academy of Sciences, China), Heran Gao (University of Chinese Academy of Sciences; Institute of Software, Chinese Academy of Sciences, China), and Wenbo Zhang (University of Chinese Academy of Sciences; Institute of Software, Chinese Academy of Sciences; Nanjing institute of software technology, Beijing)</i>	

## Machine Learning with Timing Constraints

Progressive Neural Compression for Adaptive Image Offloading under Timing Constraints .....	118
<i>Ruiqi Wang (Washington University in St. Louis, USA), Hanyang Liu (Washington University in St. Louis, USA), Jiaming Qiu (Washington University in St. Louis, USA), Moran Xu (Washington University in St. Louis, USA), Roch Guérin (Washington University in St. Louis, USA), and Chenyang Lu (Washington University in St. Louis, USA)</i>	

RA3: On-device Real-Time Deep Reinforcement Learning for Autonomous Robotics .....	131
<i>Zexin Li (University of California, Riverside), Aritra Samanta (University of California, Riverside), Yufei Li (University of California, Riverside), Andrea Soltoggio (Loughborough University), Hyoseung Kim (University of California, Riverside), and Cong Liu (University of California, Riverside)</i>	
GitFL: Uncertainty-Aware Real-Time Asynchronous Federated Learning using Version Control	145
<i>Ming Hu (Nanyang Technological University, Singapore), Zeke Xia (East China Normal University, China), Dengke Yan (East China Normal University, China), Zhihao Yue (East China Normal University, China), Jun Xia (East China Normal University, China), Yihao Huang (Nanyang Technological University, Singapore), Yang Liu (Nanyang Technological University, Singapore), and Mingsong Chen (East China Normal University, China)</i>	
RT-LM: Uncertainty-Aware Resource Management for Real-Time Inference of Language Models ...	158
<i>Yufei Li (University of California, Riverside), Zexin Li (University of California, Riverside), Wei Yang (University of Texas at Dallas), and Cong Liu (University of California, Riverside)</i>	

## ROS & Robotic Systems

SEAM: An Optimal Message Synchronizer in ROS with Well-Bounded Time Disparity .....	172
<i>Jinghao Sun (Dalian University of Technology, China), Tianyi Wang (Dalian University of Technology, China), Yang Li (Dalian University of Technology, China), Nan Guan (City University of Hong Kong, China), Zhishan Guo (North Carolina State University, USA), and Guozhen Tan (Dalian University of Technology, China)</i>	
Worst-Case Latency Analysis of Message Synchronization in ROS .....	185
<i>Ruoxiang Li (City University of Hong Kong, Hong Kong SAR; City University of Hong Kong Shenzhen Futian Research Institute, China), Xu Jiang (Northeastern University, China), Zheng Dong (Wayne State University, USA), Jen-Ming Wu (Hon Hai Research Institute, Taiwan), Chun Jason Xue (City University of Hong Kong, Hong Kong SAR), and Nan Guan (City University of Hong Kong, Hong Kong SAR)</i>	
Modeling and Analysis of Inter-Process Communication Delay in ROS 2 .....	198
<i>Xiantong Luo (University of Electronic Science and Technology of China; Northeastern University, China), Xu Jiang (University of Electronic Science and Technology of China, China), Nan Guan (City University of Hong Kong, Hong Kong SAR), Haochun Liang (Northeastern University, China), Songran Liu (Northeastern University, China), and Wang Yi (Northeastern University, China; Uppsala University, Sweden)</i>	
RED: A Systematic Real-Time Scheduling Approach for Robotic Environmental Dynamics .....	210
<i>Zexin Li (University of California, Riverside), Tao Ren (University of California, Riverside), Xiaoxi He (University of Macau), and Cong Liu (University of California, Riverside)</i>	

## Cache Optimization

Co-Optimizing Cache Partitioning and Multi-core Task Scheduling: Exploit Cache Sensitivity or Not? .....	224
<i>Binqi Sun (Technical University of Munich, Germany), Debayan Roy (Technical University of Munich, Germany), Tomasz Kloda (LAAS-CNRS, Université de Toulouse, INSA, France), Andrea Bastoni (Technical University of Munich, Germany), Rodolfo Pellizzoni (University of Waterloo, Canada), and Marco Caccamo (Technical University of Munich, Germany)</i>	
Leveraging LLVM's ScalarEvolution for Symbolic Data Cache Analysis .....	237
<i>Valentin Touzeau (Saarland University, Germany) and Jan Reineke (Saarland University, Germany)</i>	
Co-located Parallel Scheduling of Threads to Optimize Cache Sharing .....	251
<i>Corey Tessler (University of Nevada, USA), Prashant Modekurthy (University of Nevada, USA), Nathan Fisher (Wayne State University, USA), Abusayeed Saifullah (Wayne State University, USA), and Alleyn Murphy (University of Nevada, USA)</i>	

## Multicore and Embedded Systems

Improving Timing-Related Guarantees for Main Memory in Multicore Critical Embedded Systems..	265
<i>Asier Fernández de Lecea (Universitat Politècnica de Catalunya, Spain), Mohamed Hassan (McMaster University, Canada), Enrico Mezzetti (Barcelona Supercomputing Center, Spain), Jaume Abella (Barcelona Supercomputing Center, Spain), and Francisco J. Cazorla (Barcelona Supercomputing Center, Spain)</i>	
RTISM: Real-Time Inter-VM Communication based on Shared Memory for Mixed-Criticality Flows..	279
<i>Zonghong Li (Hunan University; Research Institute of Hunan University in Chongqing, China), Guoqi Xie (Hunan University; Research Institute of Hunan University in Chongqing, China), Wenhong Ma (Hunan University; Research Institute of Hunan University in Chongqing, China), Xiongren Xiao (Hunan University; Nanjing University of Posts and Telecommunications, China), Yong Xie (Nanjing University of Posts and Telecommunications, China), Wei Ren (Huawei Technologies, China), and Wanli Chang (Hunan University; Huawei Technologies, China)</i>	
SMG: A System-level Modality Gating Facility for Fast and Energy-Efficient Multimodal Computing .....	291
<i>Xiaofeng Hou (Shanghai Jiao Tong University, China), Peng Tang (Shanghai Jiao Tong University, China), Chao Li (Shanghai Jiao Tong University, China), Jiacheng Liu (The Chinese University of Hong Kong, China), Cheng Xu (Shanghai Jiao Tong University, China), Kwang-Ting Cheng (Hong Kong University of Science and Technology, China), and Minyi Guo (Shanghai Jiao Tong University, China)</i>	
CollabVR: Reprojection-based Edge-Client Collaborative Rendering for Real-Time High-Quality Mobile Virtual Reality .....	304
<i>Zhihui Ke (Tianjin University, China), Xiaobo Zhou (Tianjin University, China), Dadong Jiang (Tianjin University, China), Hao Yan (Tianjin University, China), and Tie Qiu (Tianjin University, China)</i>	

## Real-Time Scheduling and Analysis 2

CTA: A Correlation-Tolerant Analysis of the Deadline-Failure Probability of Dependent Tasks .....	317
<i>Filip Marković (Max Planck Institute for Software Systems (MPI-SWS), Germany), Pierre Roux (ONERA/DTIS, Université de Toulouse, France), Sergey Bozhko (Max Planck Institute for Software Systems (MPI-SWS); Saarland University, Germany), Alessandro V. Papadopoulos (Mälardalen University (MDU), Sweden), and Björn B. Brandenburg (Max Planck Institute for Software Systems (MPI-SWS), Germany)</i>	
Soft Real-Time Gang Scheduling .....	331
<i>Shareef Ahmed (University of North Carolina at Chapel Hill, USA) and James H. Anderson (University of North Carolina at Chapel Hill, USA)</i>	
RTailor: Parameterizing Soft Error Resilience for Mixed-Criticality Real-Time Systems .....	344
<i>Shao-Yu Huang (Purdue University, USA), Jianping Zeng (Purdue University, USA), Xuanliang Deng (Virginia Tech, USA), Sen Wang (Virginia Tech, USA), Ashrarul Sifat (Virginia Tech, USA), Burhanuddin Bharmal (Virginia Tech, USA), Jia-Bin Huang (University of Maryland, USA), Ryan Williams (Virginia Tech, USA), Haibo Zeng (Virginia Tech, USA), and Changhee Jung (Purdue University, USA)</i>	
Minimizing AoI of Non-uniform Multi-source Real-time Data Updates: Model Generalization, Analysis and Performance Evaluation .....	358
<i>Xiaoxing Qiu (Southeast University, China), Weiwei Wu (Southeast University, China), Chenchen Fu (Southeast University, China), Zelin Yun (University of Connecticut, United States), Vincent Chau (Southeast University, China), and Song Han (University of Connecticut, United States)</i>	

## Networked Systems and End-to-End Latency

Real-Time Flow Scheduling in Industrial 5G New Radio .....	371
<i>Tianyu Zhang (University of Connecticut, USA), Jiachen Wang (University of Connecticut, USA), Xiaobo Sharon Hu (University of Notre Dame, USA), and Song Han (University of Connecticut, USA)</i>	
Resource Virtualization with End-to-End Timing Guarantees for Multi-hop Multi-channel Real-Time Wireless Networks .....	385
<i>Jiachen Wang (University of Connecticut), Tianyu Zhang (University of Connecticut), Xiaobo Sharon Hu (University of Notre Dame), and Song Han (University of Connecticut)</i>	
Link between real-time scheduling and time-triggered networks .....	397
<i>Richard Garreau (LIAS, Université de Poitiers, France), Matheus Ladeira (LIAS, ISAE-ENSMA, France), Emmanuel Grolleau (LIAS, ISAE-ENSMA, France), Henri Bauer (LIAS, ISAE-ENSMA, France), Frédéric Ridouard (LIAS, ISAE-ENSMA, France), and Pascal Richard (LIAS, Université de Poitiers, France)</i>	

Optimizing End-to-End Latency of Sporadic Cause-Effect Chains Using Priority Inheritance .....	411
<i>Yue Tang (Northeastern University, China), Xu Jiang (University of Electronic Science and Technology of China, China), Nan Guan (City University of Hong Kong, Hong Kong SAR), Songran Liu (Northeastern University, China), Xiantong Luo (Northeastern University, China), and Wang Yi (Northeastern University, China; Uppsala University, Sweden)</i>	

## Work-in-Progress (WiP)

Work-in-Progress: Towards an Autonomous Real-Time Scheduling Framework for Multi-core Platforms .....	423
<i>Abdulhakeem Temitope Abdulrahman (CISTER, ISEP, Polytechnic Institute of Porto, Portugal) and Patrick Meumeu Yonsi (CISTER, ISEP, Polytechnic Institute of Porto, Portugal)</i>	
Work-In-Progress: Could Tensorflow applications benefit from a mixed-criticality approach?...	427
<i>Alan Le Boudec (Thales DMS; University of Brest, France), Frank Singhoff (University of Brest, France), Hai Nam Tran (University of Brest, France), Stéphane Rubini (University of Brest, France), Sébastien Levieux (University of Brest, France), and Alexandre Skrznyiarz (Thales DMS, France)</i>	
Work-in-Progress: Towards Real-Time IDS via RNN and Programmable Switches Co-Designed Approach .....	431
<i>Ziming Zhao (Zhejiang University, China), Zhaoxuan Li (SKLOIS, Institute of Information Engineering, Chinese Academy of Sciences, China), Zhuoxue Song (Zhejiang University, China), and Fan Zhang (Zhejiang University, China)</i>	
Work-in-Progress: Algorithms for Canvas-based Attention Scheduling with Resizing .....	435
<i>Yigong Hu (University of Illinois at Urbana-Champaign), Ila Gokarn (Singapore Management University), Shengzhong Liu (Shanghai Jiao Tong University), Archan Misra (Singapore Management University), and Tarek Abdelzaher (University of Illinois at Urbana-Champaign)</i>	
Work-in-Progress: Impacts of Critical-Section Granularity When Accessing Shared Resources ..	439
<i>Tanya Amert (Carleton College) and Catherine Nemitz (Davidson College)</i>	
Work-in-Progress: Federated and Bundled-based DAG Scheduling .....	443
<i>Tomoya Kobayashi (Saitama University, Japan) and Takuya Azumi (Saitama University, Japan)</i>	
Work-in-Progress: Model Dependability Constrained Differentiable Architecture Search for Safety Critical DNN Tasks .....	447
<i>Wensheng Tian (Nanhu Lab, China), Lei Zhang (Nanhu Lab, China), Shuangxi Chen (Jiaxing Vocational and Technical College, China), Hu Wang (Zhejiang Big Data Development Administration, China), and Xiao Luo (Zhejiang University, China)</i>	
Work-in-Progress: Tight Response-time Analysis for Periodic Preemptive Tasks under Global Scheduling .....	451
<i>Pourya Gohari (Eindhoven University of Technology (TU/e), The Netherlands), Jeroen Voeten (Eindhoven University of Technology (TU/e), The Netherlands), and Mitra Nasri (Eindhoven University of Technology (TU/e), The Netherlands)</i>	



Work-in-Progress: Time-Aware Formation Control of Connected and Automated Vehicle Platoon Based on Weighted Graph Theory .....	455
<i>Ying Zhang (Northwestern Polytechnical University, China), Tingyi Zhao (Northwestern Polytechnical University, China), Yingjie Zhang (Hunan University, China), Tao You (Northwestern Polytechnical University, China), Yantao Lu (Northwestern Polytechnical University, China), and Jinchao Chen (Northwestern Polytechnical University, China)</i>	
Work-in-Progress: Generating Counter-Examples to Schedulability Using the Schedule Abstraction .....	459
<i>Yimi Zhao (Eindhoven University of Technology (TU/e), The Netherlands), Srinidhi Srinivasan (Eindhoven University of Technology (TU/e), The Netherlands), Geoffrey Nelissen (Eindhoven University of Technology (TU/e), The Netherlands), and Mitra Nasri (Eindhoven University of Technology (TU/e), The Netherlands)</i>	

## Industry Session

Brief Industry Paper: Latency-driven Optimization of Instruction Blocks Orchestration on Memory .....	463
<i>Hui Chen (Huawei Technologies, China), Xiaoqiang Wu (Huawei Technologies, China), Lei Dai (Huawei Technologies, China), and Yang Liu (Huawei Technologies, China)</i>	
Brief Industry Paper: Evaluating Robustness of Deep Learning-based Recommendation Systems Against Hardware Errors: A Case Study .....	468
<i>Xun Jiao (Villanova University; Meta Platforms, Inc.), Fred Lin (Meta Platforms, Inc.), Matt Xiao (Meta Platforms, Inc.), Alban Desmaison (Meta Platforms, Inc.), Daniel Moore (Meta Platforms, Inc.), and Sriram Sankar (Meta Platforms, Inc.)</i>	
Brief Industry Paper: RTLight: Digital Twin-based Real-Time Federated Traffic Signal Control .....	473
<i>Yutong Ye (East China Normal University), Zhiwei Ling (East China Normal University), Yaning Yang (East China Normal University), Xian Wei (East China Normal University), Chen Cheng (Wuxi Huiwang Smart Technology Co., Ltd., China), Su Chen (China Mobile IOT Co., Ltd., China), and Mingsong Chen (East China Normal University)</i>	
Brief Industry Paper: Real-Time Image Dehazing for Automated Vehicles .....	478
<i>Yanjie Tan (Hunan University, China), Yifu Zhu (Hunan University, China), Zhaoyang Huang (Hunan University, China), Huailiang Tan (Hunan University; Hanbowei Microelectronics Technology Co., Ltd, China), and Wanli Chang (Hunan University, China)</i>	
Brief Industry Paper: Towards Efficient Task Scheduling for AUTOSAR using Parallel Pruning...	484
<i>Yanxin Yang (East China Normal University), Nan Zhang (East China Normal University), Dengke Yan (East China Normal University), Xian Wei (East China Normal University), Junlong Zhou (Nanjing University of Science and Technology), Hong Liu (Shanghai Uni-Sentry Intelligent Technology Co., Ltd., China), and Mingsong Chen (East China Normal University, China)</i>	

Brief Industry Paper: Response Time Evaluation of Cross-Domain Communication in CAN-FD and TSN .....	489
<i>Wenhong Ma (Hunan University, China), Xiaoyi Huang (Hunan University, China), Dongsheng Wei (Hunan University, China), Renfa Li (Hunan University, China), Yunfei Zhang (Tencent Corporation, China), Guoqi Xie (Hunan University, China), and Wanli Chang (Hunan University, China)</i>	
Brief Industry Paper: Directed Kernel Fuzz Testing on Real-time Linux .....	495
<i>Yuheng Shen (Tsinghua University), Shijun Chen (Central South University), Jianzhong Liu (Tsinghua University), Yiru Xu (Tsinghua University), Qiang Zhang (Hunan University), Runzhe Wang (Alibaba Group), Heyuan Shi (n/a), and Yu Jiang (Tsinghua University)</i>	
Brief Industry Paper: Retention-based Energy-Efficient Scheduling of Arbitrary-Deadline DAG Tasks on Multicore Platforms .....	500
<i>Xiangzhen Xiao (Hunan University, China), Weijie Wang (Hunan University, China), Wenhong Ma (Hunan University, China), and Wanli Chang (Hunan University, China; Huawei Technologies, China)</i>	
Brief Industry Paper: A DAG Generator with Full Topology Coverage .....	506
<i>Yinjie Fang (Hunan University, China), Shuai Zhao (Sun Yat-Sen University, China), Yili Guo (Hunan University, China), and Wanli Chang (Hunan University; Huawei Technologies, China)</i>	
<b>Author Index .....</b>	<b>513</b>