

2023 IEEE 29th International Conference on Embedded and Real-Time Computing Systems and Applications (RTCSA 2023)

**Niigata, Japan
30 August - 1 September 2023**



**IEEE Catalog Number: CFP23066-POD
ISBN: 979-8-3503-3787-7**

**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:	CFP23066-POD
ISBN (Print-On-Demand):	979-8-3503-3787-7
ISBN (Online):	979-8-3503-3786-0
ISSN:	2325-1271

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 International Conference on Embedded and Real-Time Computing Systems and Applications (RTCSA) **RTCSA 2023**

Table of Contents

Message from the Chairs	xi
Organizing Committee	xii
Program Committee	xiii
Steering Committee	xv
Sponsors	xvi

Session 1: Best Paper Candidates

Timing Analysis of Embedded Software Updates	1
<i>Ahmed El Yaacoub (Uppsala University), Luca Mottola (Politecnico di Milano & Uppsala University), Thiemo Voigt (Uppsala University & RISE), and Philipp Rümmer (University of Regensburg & Uppsala University)</i>	
PELSI: Power-Efficient Layer-Switched Inference	12
<i>Ehsan Aghapour (University of Amsterdam), Dolly Sapra (University of Amsterdam), Andy D. Pimentel (University of Amsterdam), and Anuj Pathania (University of Amsterdam)</i>	
Self-Supervised Multi-LiDAR Object view Generation using Single LiDAR	18
<i>Yi-Hung Kuo (National Taiwan University, Taiwan), Chi-Sheng Shih (National Taiwan University, Taiwan), Hsiang-Jui Lin (National Taiwan University, Taiwan), and Shih-Hao Hung (National Taiwan University, Taiwan; Mohamed bin Zayed University of Artificial Intelligence, Abu Dhabi)</i>	

Session 2: Real-Time Systems 1

Hardware Acceleration with Zero-Copy Memory Management for Heterogeneous Computing	28
<i>Oren Bell (Washington University at St Louis, USA), Chris Gill (Washington University at St Louis, USA), and Xuan Zhang (Washington University at St Louis, USA)</i>	

BandWatch: A System-Wide Memory Bandwidth Regulation System for Heterogeneous Multicore . 38
Eric Seals (University of Kansas), Michael Bechtel (University of Kansas), and Heechul Yun (University of Kansas)

IRQ Coloring and the Subtle Art of Mitigating Interrupt-Generated Interference 47
Diogo Costa (Universidade do Minho, Portugal), Luca Cuomo (Huawei Pisa Research Center, Italy), Daniel Oliveira (Universidade do Minho, Portugal), Ida Maria Savino (Huawei Pisa Research Center, Italy), Bruno Morelli (Huawei Pisa Research Center, Italy), José Martins (Universidade do Minho, Portugal), Alessandro Biasci (Huawei Pisa Research Center, Italy), and Sandro Pinto (Universidade do Minho, Portugal)

Session 3: Embedded Systems 1

Memory-Aware DVFS Governing Policy for Improved Energy-Saving in the Linux Kernel 57
Philkyue Shin (Seoul National University, Republic of Korea), Dahun Kim (Seoul National University, Republic of Korea), and Seongsoo Hong (Seoul National University, Republic of Korea)

TEEVseL4: Trusted Execution Environment for Virtualized seL4-Based Systems 67
Borna Blazeovic (Technical University of Munich), Michael Peter (NIO GmbH), Mohammad Hamad (Technical University of Munich), and Sebastian Steinhorst (Technical University of Munich)

Improving Read Performance for LDPC-Based SSDs with Adaptive Bit Labeling on Vth States 77
Jia-Xin Hou (National Yang Ming Chiao Tung University, Taiwan) and Li-Pin Chang (National Yang Ming Chiao Tung University, Taiwan)

Session 4: IoT, CPS, and Emerging Applications 1

Shared Dictionary Compression for Efficient Mobile Software Distribution 85
Jinheng Li (City University of Hong Kong, China), Qiao Li (Xiamen University, China), Qingan Li (Wuhan University, China), and Chun Jason Xue (City University of Hong Kong, China)

A Comparison of Transformer and AR-SI Oracle For Control-CPS Software Fault Localization 95
Shiyu Zhang (The Hong Kong Polytechnic University, China), Wenxia Liu (Nanjing University, China), Qixin Wang (The Hong Kong Polytechnic University, China), Lei Bu (Nanjing University, China), and Yu Pei (The Hong Kong Polytechnic University, China)

Accelerating Scan Transaction with Node Locking 101
Kodai Doki (Keio University), Takashi Hoshino (Cybozu Labs, Inc.), and Hideyuki Kawashima (Keio University)

Session 5A: Real-Time Systems 2

LAG-Based Analysis for Preemptive Global Scheduling with Dynamic Cache Allocation	107
<i>Yuhan Lin (Northeastern University, China), Jinghao Sun (Dalian University of Technology, China), Qingxu Deng (Northeastern University, China), Meiling Han (Nanjing University of Posts and Telecommunications, China), and Shumo Wang (Northeastern University, China)</i>	
Reducing Response-Time Bounds via Global Fixed Preemption Point EDF-Like Scheduling	117
<i>Joseph Goh (University of North Carolina at Chapel Hill, USA) and James H. Anderson (University of North Carolina at Chapel Hill, USA)</i>	
Dynamic Deterministic Quality of Service Model with Behavior-Adaptive Latency Bounds	127
<i>Robin Laidig (University of Stuttgart, Germany), Frank Dürr (University of Stuttgart, Germany), Kurt Rothermel (University of Stuttgart, Germany), Stefan Wildhagen (University of Stuttgart, Germany), and Frank Allgöwer (University of Stuttgart, Germany)</i>	

Session 5B: Embedded Systems 2

RDMA-Based Deterministic Communication Architecture for Autonomous Driving	137
<i>Hazem Abaza (Huawei Munich Research Center; Technische Universität Dortmund, Germany), Abhinaba Habishyashi (Technische Universität Dresden, Germany), Debayan Roy (Technische Universität Dortmund, Germany), Andrea Bastoni (Technische Universität München, Germany), Zain A. H. Hammad (German Aerospace Center, Germany), Shiqing Fan (Technische Universität Dortmund, Germany), Selma Saidi (Huawei Munich Research Center, Germany), and Sergey Tverdyshchev (Technische Universität Dortmund, Germany)</i>	
Machine Learning Techniques for Understanding and Predicting Memory Interference in CPU-GPU Embedded Systems	147
<i>Alessio Masola (University of Modena and Reggio Emilia, Italy), Nicola Capodieci (University of Modena and Reggio Emilia, Italy), Benjamin Rouxel (University of Modena and Reggio Emilia, Italy), Giorgia Franchini (University of Modena and Reggio Emilia, Italy), and Roberto Cavicchioli (University of Modena and Reggio Emilia, Italy)</i>	
Traffic Injection Regulation Protocol Based on free Time-Slots Requests	157
<i>Yilian Ribot González (CISTER Research Centre, ISEP, IPP, Portugal), Geoffrey Nelissen (Eindhoven University of Technology, The Netherlands), and Eduardo Tovar (CISTER Research Centre, ISEP, IPP, Portugal)</i>	

Session 6: Real-Time Systems 3

Time-Sensitive Networking's Scheduled Traffic Implementation on IEEE 802.11 COTS Devices	167
<i>Pablo Gutiérrez Peón (TTTech Computertechnik AG, Austria; Mälardalen University, Sweden), Paraskevas Karachatzis (TTTech Computertechnik AG, Austria), Wilfried Steiner (TTTech Computertechnik AG, Austria), and Elisabeth Uhlemann (Mälardalen University, Sweden)</i>	

Advanced Modeling and Analysis of Individual and Combined TSN Shapers in OMNeT++	176
<i>Rubi Debnath (Technical University of Munich, Germany), Philipp Hortig (Technical University of Munich, Germany), Luxi Zhao (Beihang University, China), and Sebastian Steinhorst (Technical University of Munich, Germany)</i>	
DDS Implementations as Real-Time Middleware – A Systematic Evaluation	186
<i>Vincent Bode (Technical University of Munich, Germany), Carsten Trinitis (Technical University of Munich, Germany), Martin Schulz (Technical University of Munich, Germany), David Buettner (Siemens AG, Germany), and Tobias Preclik (Siemens AG, Germany)</i>	

Session 7A: IoT, CPS, and Emerging Applications 2

Safety-Aware Implementation of Control Tasks via Scheduling with Period Boosting and Compressing	196
<i>Shengjie Xu (The University of North Carolina at Chapel Hill, USA), Bineet Ghosh (The University of North Carolina at Chapel Hill, USA), Clara Hobbs (The University of North Carolina at Chapel Hill, USA), P.S. Thiagarajan (The University of North Carolina at Chapel Hill, USA; Chennai Mathematical Institute, India), Prachi Joshi (General Motors, USA), and Samarjit Chakraborty (The University of North Carolina at Chapel Hill, USA)</i>	
Timing-Aware ROS 2 Architecture and System Optimization	206
<i>Harun Teper (TU Dortmund University, Germany), Tobias Betz (TU Munich, Germany), Georg von der Brüggen (TU Dortmund University, Germany), Kuan-Hsun Chen (University of Twente, The Netherlands), Johannes Betz (TU Munich, Germany), and Jian-Jia Chen (TU Dortmund University, Germany)</i>	

Session 7B: Short Presentations

An Integrated Real-Time and Security Scheduling Framework for CPS	216
<i>Kriti Kansal (Virginia Tech), Thidapat Chantem (Virginia Tech), Nathan Fisher (Wayne State University), and Sanjoy Baruah (Washington University in St. Louis)</i>	
Efficient Response Time Bound for Typed DAG Tasks	226
<i>Qingqiang He (The Hong Kong Polytechnic University, China), Yongzheng Sun (The Hong Kong Polytechnic University, China), Mingsong Lv (The Hong Kong Polytechnic University, China), and Weichen Liu (Nanyang Technological University, Singapore)</i>	
Parameterized Workload Adaptation for Fork-Join Tasks with Dynamic Workloads and Deadlines	232
<i>Marion Sudvarg (Washington University in St. Louis), Jeremy Buhler (Washington University in St. Louis), Roger D. Chamberlain (Washington University in St. Louis), Chris Gill (Washington University in St. Louis), Jim Buckley (Washington University in St. Louis), and Wenlei Chen (University of Minnesota)</i>	

Improved Bus Contention Analysis for 3-Phase Tasks	243
<i>Jatin Arora (CISTER, ISEP, Portugal), Syed Aftab Rashid (CISTER, ISEP; VORTEX CoLab, Portugal), Geoffrey Nelissen (Eindhoven University of Technology, The Netherlands), Cláudio Maia (CISTER, ISEP, Portugal), and Eduardo Tovar (CISTER, ISEP, Portugal)</i>	
Accelerating Permute and N-Gram Operations for Hyperdimensional Learning in Embedded Systems	253
<i>Pere Vergés (University of California), Igor Nunes (University of California), Mike Heddes (University of California), Tony Givargis (University of California), and Alexandru Nicolau (University of California)</i>	

Poster Presentations

Parameter Optimization for EDF-Like Scheduling of Self-Suspending Tasks	261
<i>Mario Günzel (TU Dortmund University) and Jian-Jia Chen (TU Dortmund University)</i>	
Response-Time Analysis of Fault-Tolerant Hard Real-Time Systems Under Global Scheduling	263
<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>	
Investigating Requirements and Expectations of Wearable Telexistence Robotic Systems	265
<i>Abdullah Iskandar (Waseda University, Japan), Mohammed Al-Sada (Qatar University, Qatar), Osama Halabi (Qatar University, Qatar), and Tatsuo Nakajima (Waseda University, Japan)</i>	
Designing a 3D Human Pose Estimation-Based VR Tennis Training System	267
<i>Yuichiro Hiramoto (Waseda University, Japan), Mohammed Al-Sada (Qatar University, Qatar), and Tatsuo Nakajima (Waseda University, Japan)</i>	
Visualization System using Virtual Reality for Work Improvement in Small and Medium Manufacturing Industries	269
<i>Shogo Ogihara (Toyama Prefectural University, Japan), Tetsuro Kato (IoTry, Inc., Japan), Takafumi Kawasaki (Toyama Prefectural University, Japan), Yuki Okura (Toyama Prefectural University, Japan), and Takeshi Iwamoto (Toyama Prefectural University, Japan)</i>	
A Robot Arm-Based Haptic Feedback System for Augmented Reality Applications	271
<i>Daichi Watanabe (Waseda University, Japan), Mohammed Al-Sada (Qatar University, Qatar), Kodai Fuchino (Waseda University, Japan), and Tatsuo Nakajima (Waseda University, Japan)</i>	
Make PLOR Real-Time and Fairly Decentralized	273
<i>Tung Nguyen (Keio University, Japan) and Hideyuki Kawashima (Keio University, Japan)</i>	
T2Remoter: a Remote Table Tennis Coaching System Combining VR and Robotics	275
<i>Kodai Fuchino (Waseda University, Japan), Mohammed Al-Sada (Qatar University, Qatar), and Tatsuo Nakajima (Waseda University, Japan)</i>	

Extending ROS Transform Library for Massive Autonomous Robots	277
<i>Yushi Ogiwara (Keio University) and Hideyuki Kawashima (Keio University)</i>	
Analyzing Digital Services Across the Compute Continuum using iFogSim	279
<i>Saeedeh Baneshi (University of Amsterdam, The Netherlands), Ana Lucia Varbanescu (University of Amsterdam, The Netherlands), Anuj Pathania (University of Amsterdam, The Netherlands), Benny Akesson (University of Amsterdam; TNO-ESI, The Netherlands), and Andy Pimentel (University of Amsterdam, The Netherlands)</i>	
ILP Based Mapping for Elastic CGRAs	281
<i>Makoto Saito (The University of Tokyo, Japan), Takuya Kojima (The University of Tokyo, Japan), Hideki Takase (The University of Tokyo, Japan), and Hiroshi Nakamura (The University of Tokyo, Japan)</i>	
Author Index	283