2024 International Conference on Neuromorphic Systems (ICONS 2024)

Arlington, Virginia, USA
30 July – 2 August 2024

IEEE

IEEE Catalog Number: CFP24VN6-POD
ISBN: 979-8-3503-6866-6

Copyright © 2024 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: CFP24VN6-POD
ISBN (Print-On-Demand): 979-8-3503-6866-6
ISBN (Online): 979-8-3503-6865-9

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

2024 International Conference on Neuromorphic Systems (ICONS)

ICONS 2024

Table of Contents

Steering Committee ..... **xiii**
Organizing Committee ..... **xiv**
Program Committee ..... **xv**
Sponsors ..... **xvii**

2024 International Conference on Neuromorphic Systems

Edge Device CNN Classification Using Eventized RF Fingerprints 1
Michael J. Smith (US Air Force Institute of Technology (AFIT), USA), Michael A. Temple (US Air Force Institute of Technology (AFIT), USA), and James W. Dean (US Air Force Institute of Technology (AFIT), USA)

Real-Time Supervised Spiking Neural Network for Cerebellar Purkinje Cells Spike Detection and Classification 9
Alireza Raisiardali (Delft University of Technology, The Netherlands), Ali Siddiqi (Delft University of Technology, The Netherlands), Christos Strydis (Delft University of Technology, The Netherlands), Said Hamdioui (Delft University of Technology, The Netherlands), Dante Gabriel Muratore (Delft University of Technology, The Netherlands), and Rajendra Bishnoi (Delft University of Technology, The Netherlands)

Neuromorphic Wireless Device-Edge Co-Inference via the Directed Information Bottleneck 16
Yuzhen Ke (Fraunhofer Heinrich Hertz Institute Berlin, Germany), Zoran Utkovski (Fraunhofer Heinrich Hertz Institute Berlin, Germany), Mehdi Heshmati (Fraunhofer Heinrich Hertz Institute Berlin, Germany), Osvaldo Simeone (King's College London, UK), Johannes Dommel (Fraunhofer Heinrich hertz Institute Berlin, Germany), and Slawomir Stanczak (Fraunhofer Heinrich Hertz Institute Berlin, Germany)

Stochastic Spiking Neural Networks with First-to-Spike Coding 24
Yi Jiang (Penn State University, USA), Sen Lu (Penn State University, USA), and Abhronil Sengupta (Penn State University, USA)

Variation-Aware Non-Linear Mapping for Honey-Memristor Based Neuromorphic System 32
Harshvardhan Uppaluru (University of South Alabama, USA), Mehedi Hasan Tanim (Washington State University, USA), Omar Faruque (University of South Alabama, USA), Mohammed Rafeeq Khan (University of South Alabama, USA), Zoe Templin (Washington State University, USA), Feng Zhao (Washington State University, USA), and Jinhui Wang (University of South Alabama, USA)

Neuromorphic Computing for the Masses 39
Shadi Matinizadeh (Drexel University, USA), Arghavan Mohammadhassani (Drexel University, USA), Noah Pacik-Nelson (Accenture Labs, USA), Ioannis Polykretis (Accenture Labs, USA), Krupa Tishbi (Drexel University, USA), Suman Kumar (Drexel University, USA), M. L. Varshika (Drexel University, USA), Abhishek Kumar Mishra (Drexel University, USA), Nagarajan Kandasamy (Drexel University, USA), James Shackleford (Drexel University, USA), Eric Gallo (Accenture Labs, USA), and Anup Das (Drexel University, USA)

Solving Minimum Spanning Tree Problem in Spiking Neural Networks: Improved Results 47
Simon Janssen (Radboud University Nijmegen, The Netherlands), Stijn Groenen (Radboud University Nijmegen, The Netherlands), Simon Reichert (Radboud University Nijmegen, The Netherlands), and Johan Kwisthout (Donders Institute for Brain, Cognition, and Behaviour Nijmegen, The Netherlands)

Asynchronous Multi-Fidelity Hyperparameter Optimization Of Spiking Neural Networks 55
Thomas Firmin (Universite de Lille, France), Pierre Boulet (Universite de Lille, France), and El-Ghazali Talbi (Universite de Lille, France)

Neuro-Spark: A Submicrosecond Spiking Neural Networks Architecture for In-Sensor Filtering..... 63
Narasinga Rao Miniskar (Oak Ridge National Laboratory, USA), Aaron Young (Oak Ridge National Laboratory, USA), Kazi Asifuzzaman (Oak Ridge National Laboratory, USA), Shruti Kulkarni (Oak Ridge National Laboratory, USA), Prasanna Date (Oak Ridge National Laboratory, USA), Alice Bean (The University of Kansas, USA), and Jeffrey S. Vetter (Oak Ridge National Laboratory, USA)

Towards Efficient Deployment of Hybrid SNNs on Neuromorphic and Edge AI Hardware 71
James Seekings (University of South Carolina, USA), Peyton Chandarana (University of South Carolina, USA), Mahsa Ardakani (University of South Carolina, USA), MohammadReza Mohammadi (University of South Carolina, USA), and Ramtin Zand (University of South Carolina, USA)

Temporal and Spatial Reservoir Ensembling Techniques for Liquid State Machines 78
Anmol Biswas (Indian Institute of Technology Bombay, India), Sharvari Ashok Medhe (Indian Institute of Technology Bombay, India), Raghav Singhal (Indian Institute of Technology Bombay, India), and Udayan Ganguly (Indian Institute of Technology Bombay, India)

Timing Actions in Games Through Bio-Inspired Reinforcement Learning 82
Irene Ambrosini (Istituto Italiano di Tecnologia, Italy), Luna Gava (Istituto Italiano di Tecnologia, Italy), Massimiliano Iacono (Istituto Italiano di Tecnologia, Italy), Arren Glover (Istituto Italiano di Tecnologia, Italy), Madeline Bartlett (University of Waterloo, Canada), Terrence C. Stewart (University of Waterloo, Canada), and Chiara Bartolozzi (Istituto Italiano di Tecnologia, Italy)

Continuous Learning for Real-Time Auditory Blind Source Separation Applications 90
Erika Schmitt (Cambrya, LLC, USA), Sanchit Gupta (Cambrya, LLC, USA), and Patrick Abbs (Cambrya, LLC, USA)

TRIP: Trainable Region-of-Interest Prediction for Hardware-Efficient Neuromorphic Processing on Event-Based Vision 94
Cina Arjmand (imec, The Netherlands), Yingfu Xu (imec, The Netherlands), Kevin Shidqi (imec, The Netherlands), Alexandra F. Dobrita (imec, The Netherlands), Kanishkan Vadivel (imec, The Netherlands), Paul Detterer (imec, The Netherlands), Manolis Sifalakis (imec, The Netherlands), Amirreza Yousefzadeh (University of Twente, The Netherlands), and Guangzhi Tang (imec the Netherlands, Maastricht University, The Netherlands)

Supervised Radio Frequency Interference Detection with SNNs 102
Nicholas J. Pritchard (University of Western Australia, Australia), Andreas Wicenec (University of Western Australia, Australia), Mohammed Bennamoun (University of Western Australia, Australia), and Richard Dodson (University of Western Australia, Australia)

Natural Language to Verilog: Design of a Recurrent Spiking Neural Network Using Large Language Models and ChatGPT 110
Paola Vitolo (Johns Hopkins University, USA), George Psaltakis (Johns Hopkins University, USA), Michael Tomlinson (Johns Hopkins University, USA), Gian Domenico Licciardo (University of Salerno), and Andreas Andreou (Johns Hopkins University, USA)

Fast Switching Serial and Parallel Paradigms of SNN Inference on Multi-Core Heterogeneous Neuromorphic Platform SpiNNaker2 117
Jiaxin Huang (SpiNNcloud Systems; Technische Universität Dresden), Bernhard Vogginger (Technische Universität Dresden), Florian Kelber (Technische Universität Dresden), Hector Gonzalez (SpiNNcloud Systems; Technische Universität Dresden), Klaus Knobloch (Infineon Technologies Dresden), and Christian Georg Mayr (Technische Universität Dresden)

Scalable Event-by-Event Processing of Neuromorphic Sensory Signals With Deep State-Space Models 124
Mark Schoene (TU Dresden, Germany), Neeraj Mohan Sushma (Ruhr-University Bochum, Germany), Jingyue Zhuge (TU Dresden, Germany), Christian Mayr (TU Dresden, Germany), Anand Subramoney (Royal Holloway, University of London, United Kingdom), and David Kappel (Ruhr-University Bochum, Germany)

Weight Sparsity Complements Activity Sparsity in Neuromorphic Language Models 132
Rishav Mukherji (Birla Institute of Technology and Science Pilani – Goa Campus, India), Mark Schöene (TU Dresden, Germany), Khaleelulla Khan Nazeer (TU Dresden, Germany), Christian Mayr (TU Dresden, Germany), David Kappel (Ruhr-University Bochum, Germany), and Anand Subramoney (Royal Holloway, University of London, United Kingdom)

Exploring Neuronal Leakage for Spiking Neural Networks on Event-Driven Hardware 140
Jann Krausse (Infineon Technologies; Karlsruhe Institute of Technology, Germany), Sven Nitzsche (FZI Research Center for Information Technology, Germany; Karlsruhe Institute of Technology, Germany), Brian Pachideh (FZI Research Center for Information Technology; Karlsruhe Institute of Technology, Germany), Carmen Weigelt (Infineon Technologies; Karlsruhe Institute of Technology, Germany), Klaus Knobloch (Infineon Technologies), and Juergen Becker (Karlsruhe Institute of Technology, Germany)

IM-SNN: Memory-Efficient Spiking Neural Network with Low-Precision Membrane Potentials and Weights 148
Ahmed Hasssan (Cornell Tech, USA), Jian Meng (Cornell Tech, USA), Anupreetham Anupreetham (Cornell Tech, USA), and Jae-Sun Seo (Cornell Tech, USA)

Using STACS as a High-Performance Simulation Backend for Fugu 156
Felix Wang (Sandia National Laboratories, USA) and William Severa (Sandia National Laboratories, USA)

Strategic Considerations for Neuromorphic Computing 161
Craig M. Vineyard (Sandia National Laboratories, USA), William M. Severa (Sandia National Laboratories, USA), and James B. Aimone (Sandia National Laboratories, USA)

Per Layer Specialization for Memory-Efficient Spiking Neural Networks 169
Muath Abu Lebdeh (University of Trento, Italy), Kasin Sinan Yildirim (University of Trento, Italy), and Davide Brunelli (University of Trento, Italy)

Digital Computing Continuum Abstraction for Neuromorphic Systems 177
Fredrik Sandin (Lulea University of Technology, Sweden), Ulf Bodin (Lulea University of Technology, Sweden), Anders Lindgren (RISE Research Institutes of Sweden, Sweden), and Olov Schelen (Lulea University of Technology, Sweden)

Versatile CMOS Analog LIF Neuron for Memristor-Integrated Neuromorphic Circuits 185
Nikhil Garg (3IT-LN2, Université de Sherbrooke, Canada; IEMN-CNRS, Université de Lille, France), Davide Florini (3IT-LN2, Université de Sherbrooke, Canada), Patrick Dufour (3IT-LN2, Université de Sherbrooke, Canada), Eloir Muhr (IM2NP-CNRS, Aix-Marseille Université, France), Mathieu C. Faye (IM2NP-CNRS, Aix-Marseille Université, France), Marc Bocquet (IM2NP-CNRS, Aix-Marseille Université, France), Damien Querlioz (C2N-CNRS, Universite Paris-Saclay, France), Yann Beilliard (3IT-LN2, Université de Sherbrooke, Canada), Dominique Drouin (3IT-LN2, Université de Sherbrooke, Canada), Fabien Alibart (3IT-LN2, Université de Sherbrooke, Canada; IEMN-CNRS, Université de Lille, France), and Jean-Michel Portal (IM2NP-CNRS, Aix-Marseille Université, France)

Self-Supervised Mapping and Localization by Predictive Learning 193
G. William Chapman (Sandia National Laboratories, USA), Andrew S. Alexander (University of California, Santa Barbara, USA), Frances S. Chance (Sandia National Laboratories, USA), and Michael E. Hasselmo (Boston University, USA)

Learning to Estimate Regions of Attraction of Autonomous Dynamical Systems Using Bayesian Physics Informed Neural Networks 201
Cody Scharzenberger (Naval Research Laboratory, USA), Shay Snyder (George Mason University, USA), Sumedh R. Risbud (Intel Labs, USA), Joe Hays (Naval Research Laboratory, USA), and Maryam Parsa (George Mason University, USA)

A Suppression-Based STDP Rule Resilient to Jitter Noise in Spike Patterns for Neuromorphic Computing 209
Ashish Gautam (Computer Science and Mathematics Division, Oak Ridge National Laboratory, USA), Takashi Kohno (Institute of Industrial Science, the University of Tokyo, Japan), Prasanna Date (Computer Science and Mathematics Division, Oak Ridge National Laboratory, USA), Robert Patton (Computer Science and Mathematics Division, Oak Ridge National Laboratory, USA), and Thomas Potok (Computer Science and Mathematics Division, Oak Ridge National Laboratory, USA)

In-Memory Computation Using CMOS-Integrated Resistive RAM for Robotic Navigation 217
Jeelka Solanki (University at Albany, NY), Jacob Pelton (University at Albany, NY), Rocco Febbo (University of Tennessee, TN), Maximilian Liehr (University at Albany, Y), Andrew DeCandia (Olin College of Engineering, MA), Karsten Beckmann (University at Albany, NY.; NY CREATES, NY), Garrett Rose (University of Tennessee, TN), and Nathaniel Cady (University at Albany, Albany, NY)

SNNPG: Using Spiking Neural Networks to Detect Attacks in the Power Grid 224
Kendric Hood (Kent State University, USA), Ang Li (Pacific Northwest National Laboratory, USA), and Qiang Guan (Kent State University, USA)

Black-Box Adversarial Attacks on Spiking Neural Network for Time Series Data 229
Jack Hutchins (University of Tennessee, USA), Diego Ferrer (University of Tennessee, USA), James Fillers (University of Tennessee, USA), and Catherine Schuman (University of Tennessee, USA)

Spatiotemporal Dendritic Processing In Superconducting Optoelectronic Networks 234
Ryan O'Loughlin (NIST; University of Colorado Boulder, Boulder), Bryce Primavera (NIST; University of Colorado Boulder, Boulder), and Jeffrey Shainline (National Institute of Standards and Technology, Boulder)

Competitive Co-Evolution with Spiking Neural Networks 242
Luke McCombs (University of Tennessee, USA), Drew Friend (University of Tennessee, USA), Luke Whatley (University of Tennessee, USA), and Catherine D. Schuman (University of Tennessee, USA)

Modeling Spiking Neurons Without Spikes 247
Jeffrey M. Shainline (National Institute of Standards and Technology), Bryce A. Primavera (National Institute of Standards and Technology), and Ryan O'Loughlin (National Institute of Standards and Technology)

SNNAX - Spiking Neural Networks in JAX 251
Jamie Lohoff (Juelich Research Center, RWTH Aachen, Germany), Jan Finkbeiner (Juelich Research Center, RWTH Aachen, Germany), and Emre Neftci (Juelich Research Center, RWTH Aachen, Germany)

Hardware-Algorithm Re-Engineering of Retinal Circuit for Intelligent Object Motion Segmentation 256
Victoria Clerico (George Mason University, USA), Jason Sinaga (University of Wisconsin—Madison, USA), Md Abdullah-Al Kaiser (University of Wisconsin—Madison, USA), Shay Snyder (George Mason University, USA), Arya Lohia (Ideaventions Academy, USA), Gregory Schwartz (Northwestern University, USA), Maryam Parsa (George Mason University, USA), and Akhilesh Jaiswal (University of Wisconsin—Madison, USA)

Estimating Post-Synaptic Effects for Online Training of Feed-Forward SNNs 264
Thomas M. Summe (University of Notre Dame), Clemens JS Schaefer (University of Notre Dame), and Siddharth Joshi (University of Notre Dame)

Exploring Extreme Quantization in Spiking Language Models 272
Malyaban Bal (Penn State University), Yi Jiang (Penn State University), and Abhronil Sengupta (Penn State University)

Programmable Synapses and Dendritic Circuits for Superconducting Optoelectronic Neuromorphic Computing 277
Bryce Primavera (National Institute of Standards and Technology, University of Colorado Boulder, USA), Saeed Khan (National Institute of Standards and Technology, University of Colorado Boulder, USA), Samuel Adler (National Institute of Standards and Technology, USA), and Jeffrey Shainline (National Institute of Standards and Technology, USA)

Exploration of Novel Neuromorphic Methodologies for Materials Applications 282
Derek Gobin (George Mason University, USA), Shay Snyder (George Mason University, USA), Guojing Cong (Oak Ridge National Laboratory, USA), Shruti R. Kulkarni (Oak Ridge National Laboratory, USA), Catherine Schuman (University of Tennessee - Knoxville, USA), and Maryam Parsa (George Mason University, USA)

Watermarking Neuromorphic Brains: Intellectual Property Protection in Spiking Neural Networks 287
Hamed Poursiami (George Mason University, USA), Ihsen Alouani (Queen's University Belfast, UK), and Maryam Parsa (George Mason University, USA)

Parallelized Multi-Agent Bayesian Optimization in Lava 295
Shay Snyder (George Mason University, USA), Derek Gobin (George Mason University, USA), Victoria Clerico (George Mason University, USA), Sumedh Risbud (Intel Labs, USA), and Maryam Parsa (George Mason University, USA)

Mimicking Associative Learning of Rats via a Neuromorphic Robot in Open Field Maze Using Spatial Cell Models 299
Tianze Liu (Michigan Technological University, USA), Md Abu Bakr Siddique (Michigan Technological University, USA), and Hongyu An (Michigan Technological University, USA)

Neuromorphic Monte Carlo Tree Search Methods for Shortest Path Interdiction 307
Yang Ho (Sandia National Laboratories, USA), Armida Carbajal (Sandia National Laboratories, USA), Leonardo Escamilla (Sandia National Laboratories, USA), and Ali Pinar (Sandia National Laboratories, USA)

Scaling SNNs Trained Using Equilibrium Propagation to Convolutional Architectures 312
Jiaqi Lin (Penn State University, USA), Malyaban Bal (Penn State University, USA), and Abhronil Sengupta (Penn State University, USA)

Spiking Neural Networks as a Controller for Emergent Swarm Agents 319
Kevin Zhu (George Mason University, USA), Connor Mattson (University of Utah, USA), Shay Snyder (George Mason University, USA), Ricardo Vega (George Mason University, USA), Daniel S. Brown (University of Utah, USA), Maryam Parsa (George Mason University, USA), and Cameron Nowzari (George Mason University, USA)

SNNVis: Visualizing Graph Embedding of Evolutionary Optimization for Spiking Neural Networks 327
Junghoon Chae (Oak Ridge National Laboratory), Seung-Hwan Lim (Oak Ridge National Laboratory), Shruti Kulkarni (Oak Ridge National Laboratory), and Catherine Schuman (University of Tennessee)

Towards Scalable and Efficient Spiking Reinforcement Learning for Continuous Control Tasks..... 331
Tokey Tahmid (University of Tennessee Knoxville, USA), Mark Gates (University of Tennessee Knoxville, USA), Piotr Luszczek (University of Tennessee Knoxville, USA; MIT Lincoln Lab, USA), and Catherine Schuman (University of Tennessee Knoxville, USA)

The Lynchpin of In-Memory Computing: A Benchmarking Framework for Vector-Matrix Multiplication in RRAMs 336
Tawsif Rahman Chowdhury (Wayne State University, USA), Huynh Quang Nguyen Vo (Oklahoma State University, USA), Paritosh Ramanan (Oklahoma State University, USA), Murat Yildirim (Wayne State University, USA), and Gozde Tutuncuoglu (Wayne State University, USA)

Bio-Inspired Active Silicon Dendrite for Direction Selectivity 343
Luke Parker (Baylor University, USA), Suma G. Cardwell (Sandia National Labs, USA), Frances S. Chance (Sandia National Labs, USA), and Scott Koziol (Baylor University, USA)

A Spiking Neuromorphic Algorithm for Markov Reward Processes 350
Sarah Luca (The University of Arizona, Arizona; Sandia National Laboratories, New Mexico), Felix Wang (Sandia National Laboratories, New Mexico), and Srideep Musuvathy (Sandia National Laboratories, New Mexico)

Neuromorphic Programming: Emerging Directions for Brain-Inspired Hardware 358
Steven Abreu (University of Groningen, Netherlands) and Jens Pedersen (KTH Royal Institute of Technology, Sweden)

Unsupervised Learning of Spatio-Temporal Patterns in Spiking Neuronal Networks 366
Florian Feiler (Forschungszentrum Julich, Germany), Emre Neftci (Forschungszentrum Julich, Germany), and Younes Bouhadjar (Forschungszentrum Julich, Germany)

Realtime Person Identification via Gait Analysis Using IMU Sensors on Edge Devices 371
Shanmuga Venkatachalam (Carnegie Mellon University), Harideep Nair (Carnegie Mellon University), Prabhu Vellaisamy (Carnegie Mellon University), Yongqi Zhou (Carnegie Mellon University), Ziad Youssfi (Carnegie Mellon University), and John Paul Shen (Carnegie Mellon University)

Accurate Mapping of RNNs on Neuromorphic Hardware with Adaptive Spiking Neurons 376
Gauthier Boeshertz (ETH Zurich, Switzerland), Giacomo Indiveri (University of Zurich and ETH Zurich, Switzerland), Manu Nair (Synthara, Switzerland), and Alpha Renner (Forschungszentrum Jülich, Germany)

Author Index **381**