

2023 IEEE MIT Undergraduate Research Technology Conference (URTC 2023)

**Cambridge, Massachusetts, USA
6-8 October 2023**



**IEEE Catalog Number: CFP23E50-POD
ISBN: 979-8-3503-0966-9**

**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:	CFP23E50-POD
ISBN (Print-On-Demand):	979-8-3503-0966-9
ISBN (Online):	979-8-3503-0965-2

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

TABLE OF CONTENTS

Classifying Schizophrenia Disorder Through EEG Signal Analysis and Machine Learning	1
<i>Nivashini Nattudurai</i>	
Image Super Resolution for Scanning Tunneling Microscopy and Atomic Force Microscopy	5
<i>Rockwell T. Li, Marjorie Cenese, Yuan Zhang</i>	
Comparing Traditional Computer Vision Algorithms and Deep Convolutional Neural Networks as Self Driving Algorithms for Use in Dynamic Conditions	10
<i>Shilpi Shah, Brendan Franz, Travis Forgach, Milan Jostes, Joshua Siegel, Chan-Jin Chung</i>	
Integrating Audio-Visual Features for Multimodal Deepfake Detection	15
<i>Sneha Muppalla, Shan Jia, Siwei Lyu</i>	
Development of a Low-Cost Vibration Sensor for Structural Health Monitoring: A Case Study on the Golden Gate Bridge	20
<i>Jonathan Lee</i>	
Path Synthesis of Planar Linkage Mechanisms Using Deep Generative Models	25
<i>Abhay Bhaskar, Anar Nurizada, Anurag Purwar</i>	
Wearable Wellness: Depression Screening Via Fitbit Data Collected During COVID-19 Pandemic	30
<i>Nikola Grozdani, America Muñoz, Alexander Pietrick, Ricardo Flores, Avantika Shrestha, Xingtong Guo, Shichao Liu, Elke A. Rundensteiner</i>	
Towards Data-Driven Methods for Decarbonizing Reverse Osmosis Desalination	35
<i>Om Sanan, Joshua Sperling, David Greene, Ross Greer</i>	
A Fourier Dot Product Analog Circuit	40
<i>Jack Adiletta, Ulkuhan Guler</i>	
A Novel Fault Tolerant Dual-Loop Control System for Autonomous Quadcopter Navigation	45
<i>Anish Anand</i>	
A Fast Machine Learning Algorithm for the MaxCut Problem	50
<i>Allison Jin, Xiao-Yang Liu</i>	
Analyzing the Discourse in the UN for Crisis Response in Post-Colonial Africa	55
<i>Alvan Caleb Arulandu, Brian Zhou</i>	
Outlier Detection and Removal Signal Processing for Wearable Transcutaneous Oxygen Sensor	60
<i>Abigail Leonardi, Ciara Murphy, Sydney Hobson, Vanshika Rohera, Ulkuhan Guler</i>	
Characterization of Temperature Distribution and Design of a Battery Thermal Management System for Lithium-Polymer Batteries	65
<i>Ajay Raj, Vibhav Chaturvedi, Juliette Cheng, Jonathan McAveety, Amin Reihani</i>	
Autonomous Roof Solar Potential Estimation Using UAV Photogrammetry	70
<i>Nicholas Meng, Diego Pasini, Marie-Pierre Jolly</i>	
High Speed Neural Network Tsunami Wave Simulator with Multiple Adjustable Parameters	75
<i>Pramyia Surapaneni</i>	

PaQKD: Optimizing Qubit Retention in Quantum Key Distribution Using Packeting	79
<i>Romir G. Sharma, Winston W. Wang</i>	
Application of Nanoimprint Lithography to Conducting Polymers for Infrared Photonics	84
<i>David Man, Matthew Oliveira, Nanda Guntupalli, Riya Sikand, Yuki Wykoff, Haydee Pacheco, Deirdre O'Carroll</i>	
PFAS Incineration: Known Unknowns, Reaction Simulation, and ML to Predict Product Properties	89
<i>Duncan Soiffer, Tuomas Pyorre, David Kenney, Andrew Teixeira</i>	
Aiding Stroke Survivors with 3D Printed Bottle Opener	94
<i>Ralitsa Hovanessianli, Rockwell Li, Nathan He, Tyler Cason</i>	
Results on Vanishing Polynomials and Polynomial Root Counting with Relevant Technological Applications.....	98
<i>Matvey Borodin, Ethan Liu, Justin Zhang</i>	
A Multi-Dimensional Parity-Switched Packet Protocol for Qubit Retention and Mitigating Eavesdropping in Quantum Key Distribution Algorithms.....	103
<i>Pranav Sitaraman, Ishan Mungikar</i>	
SeBRUS: Mitigating Data Poisoning Attacks on Crowdsourced Datasets with Blockchain.....	108
<i>Anusha Iyer, Chloe Lee, Trisha Reddy, Cyrus Rosenberg, Rebekah Wang, Benson Liu</i>	
2D-FACT: Dual-Domain Fake Image Detection Against Text-To-Image Generative Models	113
<i>Eric Ji, Boxiang Dong, Bharath Samanthula, Na Zhou</i>	
A Fundamental Analysis of Stock Returns Using Machine Learning Algorithms.....	118
<i>Andy Qin, Mihai Boicu</i>	
EchoVest: Real-Time Sound Classification and Depth Perception Expressed Through Transcutaneous Electrical Nerve Stimulation.....	123
<i>Jesse Choe, Siddhant Sood, Ryan Park, Vandana Kalia</i>	
A Graph-Theoretic Approach for Creating Non-Gerrymandered Congressional Voting Maps	128
<i>Ethan Rebello, Zachary Li, Jayanth Pandit, Lior Fishman</i>	
Assessment and Quantification of Virtual Reality Induced Sickness in Relation to Age and Gender: A Multi-Modal Approach	133
<i>Abhiram Reddy, Jin Ryong Kim</i>	
CardiAWARE: A Novel ECG-Based Deep Neural Network Algorithm for Early Detection of Cardiac Conditions	137
<i>Eashan Kosaraju</i>	
SMPNet: An Algorithmic Framework for Loneliness Detection and Mitigation in Social Media	141
<i>Venkatesh Sumukh, Yin Jack, Sng Grace, Aggarwal Raghav, Fan Weiguo, Huang Chengyue, Tong Ling</i>	
De Novo Molecular Generation Using Deep Learning for Prioritizing Synthesizability	146
<i>Inamdar, R. Jakhotiya, K. Jakhotiya</i>	
Smart Mattress Pad for Tracking Pressure Injuries in the Geriatric Population	151
<i>Arianne Parvaresh-Rizi, Olivia J. Wojnilo, Joseph Confessore, Kunal Mankodiya, Dhaval Solanki</i>	

Convolutional Neural Networks: Brain Computer Simulations for Potential Non-Invasive Schizophrenia and Psychiatric Treatment as Alternative to Medication.....	155
<i>Anes Kim, Zizhao Chen, W. Eric Wong</i>	
Kernelytics: Multispectral Drone Imagery and Deep Learning for Early Corn Assessment	160
<i>Oliver Aplin, Kavya Famolari, Sophia Liu, Bhaumik Mehta, Max Xiong, Michael Mesham, Mohsen Jafari</i>	
Soft Robotic Nurse Arm Test-Cases: A Comparative Analysis of Laminar and Granular Jammed Skeletons	165
<i>Aysu Ismayilova, Nihad Habizada</i>	
Conceptual Mechatronic Design of Ankle-Foot Exoskeleton System for Assisted Rehabilitation of Pediatric Patients with Spastic Cerebral Palsy	170
<i>Carol Sandoval, Cesar Martel, Ricardo Palomares, Jeanette Borja Arroyo, Margarita F. Murillo Manrique, José Cornejo</i>	
Preliminary Design and Prototype for a 1P PocketQube Earth Observation Satellite	175
<i>Kieran M. Shanley, Jason R. Rinehart, Trout G. Marnell, Patrick R. Blanchard, Michael C. Sonntag, Noran Jan, Douglas E. Dow, Federica Aveta, Saurav Basnet</i>	
Reducing Noise Pollution with an Adaptive Barrier	183
<i>Olivia Mei, Thomas Liu, Kaavya Kolli, Thomas Wen, Elizabeth Gillen, Sophia Blakely, Benjamin Lee</i>	
Kulkarni-Ahona Corollary for the Newton-Gauss Theorem	188
<i>Pranav Kulkarni, Victor Ahona</i>	
Enhancing DoS Attack Recovery in MQTT Brokers for IoT Systems Through Efficient Scheduling Algorithms.....	190
<i>Pranav Sitaraman</i>	
Orthographic Syllable Pair Encoding for Language Modelling Tasks in Indic Languages	194
<i>Manodnya K H, Animesh Giri</i>	
Detection and Suppression of Parkinson's Disease Tremors	200
<i>Unnati Seshadri</i>	
Enabling Computational Democratization: A Proof-Of-Stake Bounty System for User-Proposed Problems and Solutions	204
<i>Nishka Arora, Sarah Hashash, Kimia Hassibi</i>	
MAC-You-Vision: A Progressive Training Application for Patients with Age-Related Macular Degeneration	208
<i>Alan Tepoxtecatl, Crystal Yang, Max Sehaumpai, William H. Seiple, Zhigang Zhu</i>	
Monitoring, Characterization, and Modeling of Stomatal Dynamic Behavior Under Climate Change	213
<i>Kaitlyn Amanullah, Brianna Campbell, Gokulraj Kumarassamy, Katelyn Petak, Natalia Wolinski, Qingze Zou, Zezhou Zhang</i>	
Securing Quantum Computers: Safeguarding Against Eavesdropping and Side-Channel Attacks	218
<i>Pranav Gani, Ross Greer</i>	
VRGrip: Developing a Grip Strength Training Platform Integrating a Wireless E-Textile Forearm Band with an Adaptive 3D VR Game Environment.....	223
<i>Lohith Chatragadda, Aiden Fletcher, Matthew J. Delmonico, Kunal Mankodiya, Dhaval Solanki</i>	

Chain-Of-Thoughts Prompting with Language Models for Accurate Math Problem-Solving	227
<i>Sze Ching Evelyn Fung, Man Fai Wong, Chee Wei Tan</i>	
A Machine Learning Approach in Predicting Antimicrobial Resistance (AMR) in Escherichia Coli (E. Coli)	232
<i>Sailahari Mullapudi</i>	
Hybrid Quantum-Classical Machine Learning for Dementia Detection	238
<i>Ryan Kim</i>	
Classifying Pothole Severity with Convolutional Neural Networks	243
<i>Sahil Bhatia, Ross Greer</i>	
Towards Sustainable Development: A Novel Integrated Machine Learning Model for Holistic Environmental Health Monitoring.....	247
<i>Anirudh Mazumder, Sarthak R. Engala, Aditya Nallapuraju</i>	
Testing RadiX-Nets: Advances in Viable Sparse Topologies	252
<i>Kevin Kwak, Zack West, Hayden Jananathan, Jeremy Kepner</i>	
Algebraic Conditions on One-Step Breadth-First Search	257
<i>Emma Fu, Hayden Jananathan, Jeremy Kepner</i>	
From Bits to Insights: Exploring Network Traffic, Traffic Matrices, and Heavy-Tailed Data	262
<i>Christopher Howard, Hayden Jananathan, Jeremy Kepner</i>	
Fuzzy Relational Databases Via Associative Arrays	267
<i>Kevin Min, Hayden Jananathan, Jeremy Kepner</i>	
Machine Learning for Neural Decoding: Using EEG Signals to Detect Freezing of Gait in Parkinson's Patients	272
<i>Julia Cho, Ranajoy Gupta, Kaelyn Johnson, Ritvik Sawhney, Daniel Zeltser, Sabar Dasgupta</i>	
Ultrasound Segmentation Using Deep Learning: Training on Musculoskeletal Phantom Data and Testing on Clinical Data	277
<i>Yi Li, Keshi He, Hayoung Cho, Bryan J. Ranger</i>	
Predicting Dosage of Immunosuppressant Drugs After Kidney Transplantation Using Machine Learning	283
<i>Kapil Panda, Anirudh Mazumder</i>	
Blockchain-Powered Supply Chain Management for Kidney Organ Preservation	288
<i>Kapil Panda, Anirudh Mazumder</i>	
Multimodal Ensemble Models for Parkinson's Disease Diagnosis Using Log-Mel Spectrograms and Acoustic Features	293
<i>Samuel Tesfai</i>	
The First Use of Positive and Unlabeled Machine Learning to Identify Fast Radio Burst Repeater Candidates	298
<i>Arjun Sharma</i>	
Understanding Dynamic Human Intentions to Enhance Collaboration Performance for Human-Robot Partnerships	303
<i>Isabel Jacoby, Jesse Parron, Weitian Wang</i>	

A Lagrangian Approach to Loss Function Optimization on Traffic Network Regularity.....	309
<i>Advay Vyas, Ethan Rebello, Jianguo Liu</i>	
Charged Particle Motion in Neutron Star Magnetic Fields: A Comparison Between the Boris Algorithm and the Guiding Center Approximation	314
<i>Minghao Zou, Bart Ripperda</i>	
Enhancing Photometric Redshift Predictions and Uncertainty Quantification Using Deep Learning Methods.....	319
<i>Rushat Aboti</i>	
A Novel Web App Based on a Computational Linguistic Approach to Deliver Primary Sentiment Stimuli for Music-Induced Analgesia in 30 Languages.....	324
<i>Ryka C. Chopra</i>	
A Computer Vision Approach to Radial Velocity Extraction for Exoplanet Detection	329
<i>Katelyn Gan, Vinesh Maguire Rajpaul</i>	
The Fallibility of AI Content Detectors	334
<i>Ethan Phoenix Zhou</i>	
Building User-Centered ASL Communication Technologies for Parent-Child Interactions.....	338
<i>Ashley Bao, Kaleb Newman, Madeleine Mann, Ekram Hossain, Chigusa Kurumada, Zhen Bai</i>	
Simulating Molecular Markers in Acute Myeloid Leukemia Using Quantum Computing	343
<i>Akshita Tiwari</i>	
Semi-Supervised Pulmonary Auscultation Analysis with Cross Pseudo Supervision	347
<i>Jieruei Chang, Ching-Chun Huang</i>	
Proportional-Integrative-Derivative Based Dynamic Controller for Soft Robots	352
<i>Anirudh Mazumder</i>	
A Quantitative Method for Comparing Shipboard MVAC and MVDC Power Transmission	357
<i>Spencer Margosian</i>	
Evaluation of Entanglement-Based Quantum Key Distribution for Genome Data Transmission	361
<i>Hyunjo Kim</i>	
Transforming Architectural Visualizations for Generative xR Renderings Using Fine-Tuned AI Models.....	364
<i>Carina Kim, Sungyoon Cho, Yujin Park, Luke Lee, Jin-Kook Lee</i>	
Exoskeleton Hand for the Management of Hypermobility Ehlers Danlos Syndrome.....	369
<i>Emily A. Oman, Scholz Jessica, Bun Timothy, Kiapour Ali</i>	
Developing a Group Performance Prediction System from In-The-Wild Video Data Using Machine Learning	377
<i>Aarav Patel, Peter Gloor</i>	
Devising Overtraining Curriculum Learning Techniques to Enhance Autonomous Navigation Reinforcement Learning	382
<i>Aarav Patel, Peter Gloor</i>	
Toward Faster Search and Rescue: Understanding Terrains with Reeb Graphs	387
<i>Maxwell Simpson, Jory Denny</i>	

EchoSense: Acoustic Sensing for Enclosed Structure Monitoring and Recognition	392
<i>Michael Rothstein, Zhuolin Liu, Islam Bashima</i>	
A Novel Approach to Facilitate Peripheral Nerve Regeneration: An Electrospun Conduit, Hydrogel Filling, and Internal Microchannels.....	398
<i>Shrey Agarwal, Bridget Heffernan, Cassandra Miller, Sareena Naganand, Derek Wang, Jeremy M. Perrelle, Thomas Emge, Sanjeeva Murthy</i>	
3D Neural Network Model for the Transient Heating of Icy Mountains Due to Foehn Winds	403
<i>Sophia Wang</i>	
A Novel CNN-Informer Model for Electrocardiogram Time Series Forecasting.....	407
<i>Jiya Patil, Xinyi Wu, Zouheir Rezki</i>	
A Modern Real-Time Audio Encryption System Featuring Chaos Maps and Wavelet Transforms	412
<i>Eshaan Debnath, Evan Merkov, Kavya Venkatesan, Riya Pawar, Rohan Bhatia, Sabar Dasgupta</i>	
A Secure Friend Recommendation Framework for Online Social Networks Using OpenAI Embeddings	417
<i>Mohit Singh, Bharath K. Samanthula</i>	
Insights into the Impact of Age and Sex on Mutational Signatures in Pediatric Brain Tumors.....	422
<i>Erin Yoo</i>	
Serum Bilirubin Prediction for Neonates Using Segmentation-Guided Neural Networks	427
<i>Om Shah, Michael Koenig, Richard P. Wennberg</i>	
Mechanics of a Drone-Based System for Algal Bloom Detection Utilizing Deep Learning and LLMs.....	433
<i>Andrea Balcacer, Brendan Hannon, Yulia Kumar, Kuan Huang, Joseph Sarnoski, Shuting Liu, J. Jenny Li, Patricia Morreale</i>	
Towards Detecting Cascades of Biased Medical Claims on Twitter	438
<i>Libby Tiderman, Juan Sanchez Mercedes, Fiona Romanoschi, Fabricio Murai</i>	
Quantitative Feasibility of Predictive Machine-Learning Optimization Algorithms for Refugee Routing.....	443
<i>Pranav Kulkarni, Luke Jeon</i>	
Converting Biological Neural Networks to DAGs: Evaluation of Customized Algorithms on C. Elegans	447
<i>Benjamin Li</i>	
How Private is Your Browsing? Detecting GDPR Violations Through Robust Natural Language Processing and Thorough Static Program Analysis Techniques	452
<i>Gary Song, Joshua Zhu, Andrew Kuai, Ben Chen, Savannah Alanis</i>	
Multi-Task Breast Ultrasound Image Segmentation and Classification Using Convolutional Neural Network and Transformer.....	456
<i>Joanna Loja, Armando Mendez, Kuan Huang</i>	
A Novel Series Elastic Actuation Method in a Semi-Soft Robotic Rehabilitation Glove.....	461
<i>Amisha Sao, Mohit Pathak</i>	
A Novel Machine Learning Approach for Flood Prediction with Local Interpretable Explanations.....	466
<i>Joseph Tso, Hailey Pan</i>	

Turning Food Waste into Bioactive Glass: A Simulation	471
<i>Anika Reddy Chapalapalli, Maxwell Duerr, Adrian Reyes, Tessa Weaver, Sera Wong, Ashutosh Goel, Nedgine Joseph</i>	
A Comparative Analysis of Hybrid Quantum Neural Networks in Binary Credit Defaulting Tasks.....	476
<i>Aditya Sengar, Arya Vijayaraghavan, Jiwoo Hwang</i>	
Accessible Framework for Automation in Precision Agriculture Leveraging Boston Dynamics' SPOT	481
<i>Anthony Boyle, Rebecca Cui, William Dougherty, Ryan Lalani, Apurva Parasher, Mohsen Jafari, Patrick Rudawski</i>	
Propensity Score Matching for Evaluating Flashbang Effects in Counter-Strike.....	486
<i>Charles Wheaton</i>	
Increasing Sulfur Solubility for More Efficient Nuclear Waste Vitrification	491
<i>Mariah Groff, Alex Harvey, Geoffrey Tillisch, Patricia Leoniuk, Caden Niziol</i>	
Soldier Activity Recognition	496
<i>Andrew Zhang, Maria R. Ebling</i>	

Author Index