

# **2022 IEEE Sensors Applications Symposium (SAS 2022)**

**Sundsvall, Sweden  
1-3 August 2022**



**IEEE Catalog Number: CFP22SAS-POD  
ISBN: 978-1-6654-0982-7**

**Copyright © 2022 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:	CFP22SAS-POD
ISBN (Print-On-Demand):	978-1-6654-0982-7
ISBN (Online):	978-1-6654-0981-0

**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

# TABLE OF CONTENTS

A Low-Cost, Open-Source, and Distributed Ocean Profiling Sensor Node .....	1
<i>Andres Rico, Suparnamaaya Prasad, Kent Larson</i>	
Hydrogen Induced Dipole Layer in Pd-SiO <sub>2</sub> Based Gas Sensors .....	7
<i>Idan Shem Tov, Anwasha Mukherjee, Joseph Hayon, Laura Hargreaves, Alexander Shluger, Yossi Rosenwaks</i>	
Detection and Thickness Estimation of Oil Under Saline Ice using Machine Learning.....	13
<i>Mahmoud Altrabolsi, Chafic Labaki, Imad H. Elhajj, Daniel Asmar</i>	
Experimental Setup for Evaluation of Medical Ozone Gas Sensors .....	19
<i>Lisa Petani, Dennis Wickersheim, Liane Koker, Markus Reischl, Ulrich Gengenbach, Christian Pylatiuk</i>	
Selection of Optimal Parameters to Predict Fuel Consumption of City Buses using Data Fusion .....	25
<i>Mazhar Hussain, Mattias O’Nils, Jan Lundgren, Marco Carratú, Irida Shallari</i>	
Performance Comparison Between Decawave DW1000 and DW3000 in Low-Power Double Side Ranging Applications .....	31
<i>Tommaso Polonelli, Simon Schläpfer, Michele Magno</i>	
In-Process Tool Deflection Measurement in Incremental Sheet Metal Forming .....	37
<i>Marina Terlau, Axel Von Freyberg, Dirk Stöbener, Andreas Fischer</i>	
The Material Imaging Analyzer MIA.....	43
<i>Benny Thörnberg</i>	
High Accuracy Torque Measurement with Position Measuring Devices.....	49
<i>Christian Brunner, Rainer Hagl</i>	
An Anomaly Detection System for Transparent Objects using Polarized-Image Fusion Technique .....	55
<i>Lixing Yu, Atsutake Kosuge, Mototsugu Hamada, Tadahiro Kuroda</i>	
Improvement of Door Recognition Algorithm using Lidar and RGB-D Camera for Mobile Manipulator .....	61
<i>Taehyeon Kim, Minwoo Kang, Sumin Kang, Donghan Kim</i>	
Modeling of a Bacterial Cellulose-Based Composite in Bending Configuration .....	67
<i>Riccardo Caponetto, Andrea Cincotta, Giovanna Di Pasquale, Salvatore Graziani, Antonino Pollicino, Carlo Trigona</i>	
Plasmonic Sensors Based on 3D-Printed Polymer Waveguides Covered by a Metals Bilayer .....	72
<i>Gianluca Cicala, Francesco Arcadio, Luigi Zeni, Lorena Saitta, Claudio Tosto, Maria Elena Fragalà, Domenico Del Prete, Nunzio Cennamo</i>	
Impact of Face Covering Models on Respiratory Sound Classification Applications.....	76
<i>Madison Cohen-McFarlane, Fatima Hassan, Pengcheng Xi, Bruce Wallace, Rafik Goubran, Frank Knoefel</i>	
Load Cell Force and Direction Sensor System for Push Bars .....	82
<i>Bahareh Chimehi, Bruce Wallace</i>	

Presenting a Novel NDT Eddy Current Probe for Crack Detection on Rough Welds and Steel with Variable Permeability.....	88
<i>Karsten Husby, Christian Eirik Johnsen, Vidar Ringset</i>	
Real-Time LiDAR Module with 64x128-Pixel CMOS SPAD Array and 940-Nm PCSEL.....	94
<i>An-Tai Hsiao, Chun-Hsien Liu, Po-Hsuan Chen, Yao-Lun Liu, Wei-Chi Wang, Tzu-Hsien Sang, Chia-Ming Tsai, Gray Lin, Jiun-In Guo, Sheng-Di Lin</i>	
Active Magnetic Ranging While Drilling: A Down-Hole Surroundings Mapping .....	100
<i>Karsten Husby, Arild Saasen, Jan David Ytrehus, Magnus Hjelstuen, Tor Jan Eriksen, Alessandro Liberale</i>	
Maintaining Synchrony of Dual Machine Learning: A Phase-Locked Loop Approach.....	105
<i>Saif Almhairat, Bruce Wallace, Julien Larivière-Chartier, Ali El-Haraki, Rafik Goubran, Frank Knoefel</i>	
Printed Wireless Battery-Free Sensor Tag for Structural Health Monitoring of Natural Fiber Composites .....	111
<i>Lukas Rauter, Johanna Zikulnig, Lukas Neumaier, Lisa-Marie Faller, Hubert Zangl, Jürgen Kosel</i>	
IoT with a Soft Touch: A Modular Remote Sensing Platform for STE(A)M Applications .....	116
<i>Jona Cappelle, Geoffrey Ottoy, Sarah Goossens, Hanne Deprez, Jarne Van Mulders, Guus Leenders, Gilles Callebaut, Ku Leuven</i>	
Classification of Batteries in Waste Streams using Magnetic Induction Spectroscopy.....	122
<i>Kane C. Williams, Michael D. O'Toole, Liam A. Marsh, Anthony J. Peyton</i>	
Self-Sustainable IoT Wireless Sensor Node for Predictive Maintenance on Electric Motors.....	128
<i>Tommaso Polonelli, Andrea Bentivogli, Guido Comai, Michele Magno</i>	
Metrological Analysis of a Contactless Inductive Position Measurement System.....	134
<i>S. Tagger, M. Neumayer, G. Gruber, H. Wegleiter</i>	
Comparison of Magnetic Field Sensors for Current Distribution Reconstruction Through Barycenter Filament Model.....	140
<i>Gabriele Bandini, Mirko Marracci, Gianluca Caposciutti, Bernardo Tellini</i>	
Three-Coil Sensor for Liquid Level Measurement.....	146
<i>Shilpa Susan George, Jagadeesh Kumar V</i>	
A Neuro-Fuzzy Approach to Assess Postural Sway.....	151
<i>Bruno Andò, Salvatore Baglio, Valeria Di Bilio, Vincenzo Marletta, Michele Marella, Giovanni Mostile, Sreeraman Rajan, Mario Zappia</i>	
Live Migration of a 3D Flash LiDAR System Between Two Independent Data Processing Systems with Redundant Design .....	157
<i>Philipp Stelzer, Sebastian Reicher, Georg Macher, Christian Steger, Raphael Schermann</i>	
Rx Position Effect on Device Free Indoor Localization in the 28 GHz Band .....	163
<i>Verónica Ojeda, Juan C. Aviles</i>	
Effects of Lighting and Window Length on Heart Rate Assessment Through Video Magnification .....	169
<i>Leen Yassin Kassab, Andrew Law, Bruce Wallace, Julien Larivière-Chartier, Rafik Goubran, Frank Knoefel</i>	

Development of a Neural Network to Identify Plastics using Fluorescence Lifetime Imaging Microscopy.....	175
<i>Georgekutty Jose Maniyattu, Eldho Geegy, Nina Leiter, Maximilian Wohlschläger, Martin Versen, Christian Laforsch</i>	
Measurement Setup for Industrial Communication Techniques Under Electromagnetic Interference .....	181
<i>Sebastian Schaffneroth, Hans-Peter Schmidt, Alexander Kölpin</i>	
Water Stress Detection in Pearl Millet Canopy with Selected Wavebands using UAV Based Hyperspectral Imaging and Machine Learning .....	187
<i>Adduru U G Sankararao, P. Rajalakshmi, Sivasakthi Kaliamoorthy, Sunitha Choudhary</i>	
Forestry Crane Automation using Learning-Based Visual Grasping Point Prediction.....	193
<i>Harald Gietler, Christoph Böhm, Stefan Ainetter, Christian Schöffmann, Friedrich Fraundorfer, Stephan Weiss, Hubert Zangl</i>	
Towards Lightweight Deep Neural Network for Smart Agriculture on Embedded Systems.....	199
<i>Pengwei Du, Tommaso Polonelli, Michele Magno, Zhiyuan Cheng</i>	
Techtile: A Flexible Testbed for Distributed Acoustic Indoor Positioning and Sensing.....	205
<i>Daan Delabie, Bert Cox, Lieven De Strycker, Liesbet Van Der Perre</i>	
Design Considerations of Capacitive Sensors for Micro-Droplet Detection .....	211
<i>Om Prakash Maurya, P. Sumathi</i>	
A Parking Spot Occupancy Sensor Based on Commodity Wireless Chipsets.....	217
<i>Gerrit Maus, Wiebke Gerth, Dieter Brückmann</i>	
Integration of Fiber Optic Sensors in Organ-On-A-Chip Devices Towards Label-Free Cell Viability Assays.....	223
<i>Sanzhar Shakarim, Daniele Tosi, Gulsim Kulsharova</i>	
Particle Doped Fiber Based Sensors for the Monitoring of Structures.....	229
<i>Jeanette Ortega, Thomas Gries</i>	
Telemetric QCM-D Based Sensing System with Adaptive Excitation Frequency .....	235
<i>Addabbo Tommaso, Federico Carli, Fort Ada, Federico Micheletti, Enza Panzardi, Valerio Vignoli</i>	
A Simple and Highly Sensitive Force Sensor Based on Modified Plastic Optical Fibers and Cantilevers.....	241
<i>Nunzio Cennamo, Francesco Arcadio, Vincenzo Marletta, Domenico Del Prete, Bruno Andò, Luigi Zeni, Mario Cesaro, Alfredo De Matteis</i>	
On Feature Selection in Automatic Detection of Fitness Exercises using LSTM Models .....	246
<i>Emiliano Sisinni, Alessandro Depari, Paolo Bellagente, Paolo Ferrari, Alessandra Flammini, Marco Pasetti, Stefano Rinaldi</i>	
Assessment of UWB RTLS for Proximity Hazards Management in Construction Sites .....	252
<i>Paolo Bellagente</i>	
Emotion Classification from Electroencephalogram Signals using a Cascade of Convolutional and Block-Based Residual Recurrent Neural Networks.....	258
<i>Sareh Soleimani Gilakjani, Hussein Al Osman</i>	
Sensor Data Communication via Light Guide Body for Monitoring Vehicle Batteries .....	264
<i>Florian Rittweger, Philipp Schiepel, Jonas Ernsting, Karl-Ragmar Riemschneider</i>	

A Lightweight Convolutional Neural Network Model for Concrete Damage Classification using Acoustic Emissions .....	270
<i>Yuxuan Zhang, Sebastian Bader, Bengt Oelmann</i>	
Pupil Detection for Augmented and Virtual Reality Based on Images with Reduced Bit Depths .....	276
<i>Gernot Fiala, Zhenyu Ye, Christian Steger</i>	
Magnetic Sensor Array for Determining the Assembly Torsion and Preload of a Bolted Joint.....	281
<i>Thorben Schüthe, Karl-Ragmar Riemschneider, Andreas Meyer-Eschenbach</i>	
Method to Improve Gait Speed Assessment for Low Frame Rate AI Enabled Visual Sensor .....	287
<i>Ashi Agarwal, Bruce Wallace, Rafik Goubran, Frank Knoefel, Neil Thomas</i>	
A Three-Electrode Capacitive Based Sensing System to Determine the Direction of Motion of Humans.....	293
<i>Poojitha Makireddy, Prashanth Vooka</i>	
Towards the Future Generation of Railway Localization and Signaling Exploiting Sub-Meter RTK GNSS.....	299
<i>Carla Amatetti, Tommaso Polonelli, Enea Masina, Charles Moatti, Denis Mikhaylov, Davide Amato, Alessandro Vanelli-Coralli, Michele Magno, Luca Benini</i>	
Feasibility of Measuring Shot Group using LoRa Technology and YOLO V5 .....	305
<i>Sanghyun Park, Dongheon Lee, Jisoo Choi, Dohyeon Ko, Minji Lee, Zack Murphy, Nowf Binhowidy, Anthony Smith</i>	
Evaluation of the Quality of LiDAR Data in the Varying Ambient Light.....	311
<i>Bhaskar Anand, Harshal Verma, Abhishek Thakur, Parvez Alam, P. Rajalakshmi</i>	
A Bending Angle Sensor Based on Magnetic Coupling Suitable for Soft Robotic Finger .....	316
<i>Debasrita Kar, Bobby George, K. Sridharan</i>	
Automatic Extraction of Muscle Fascicle Pennation Angle from Raw Ultrasound Data.....	321
<i>Soley Hafthorsdottir, Sergei Vostrikov, Andrea Cossetini, Michael Rieder, Christoph Leitner, Michele Magno, Luca Benini</i>	
Cough Classification using Audio Spectrogram Transformer .....	326
<i>Karim Habashy, Julio Valdés, Madison Cohen-McFarlane, Pengcheng Xi, Bruce Wallace, Rafik Goubran, Frank Knoefel</i>	
Ensemble Learning in the Estimation of Flow Types and Velocities of Individual Phases in Multiphase Flow using Non-Intrusive Accelerometers' and Process Pressure Data.....	332
<i>Ru Yan, Håkon Viumdal, Kjetil Fjalestad, Saba Mylvaganam</i>	
Interpretable CNN for Single-Channel Artifacts Detection in Raw EEG Signals.....	338
<i>Francesco Paissan, Velu Prabhakar Kumaravel, Elisabetta Farella</i>	
Comparing Optimal and Commercially Available Bipolar and Tripolar Concentric Ring Electrode Configurations using Finite Element Method Modeling Based on Their Finite Dimensions Models.....	344
<i>Oleksandr Makeyev, Yiyao Ye-Lin, Gema Prats-Boluda, Javier Garcia-Casado</i>	

## Author Index