PROCEEDINGS OF SPIE

International Conference on Sensors and Instruments (ICSI 2021)

Wei Wei Fengjie Cen Editors

28-30 May 2021 Qingdao, China

Organized by AEIC Academic Exchange Information Centre (China)

Sponsored by Xi'an University of Technology (China)

Published by SPIE

Volume 11887

The papers in this volume were part of the technical conference cited on the cover and title page. Papers were selected and subject to review by the editors and conference program committee. Some conference presentations may not be available for publication. Additional papers and presentation recordings may be available online in the SPIE Digital Library at SPIEDigitalLibrary.org.

The papers reflect the work and thoughts of the authors and are published herein as submitted. The publisher is not responsible for the validity of the information or for any outcomes resulting from reliance thereon.

Please use the following format to cite material from these proceedings:

Author(s), "Title of Paper," in *International Conference on Sensors and Instruments (ICSI 2021)*, edited by Wei Wei, Fengjie Cen, Proc. of SPIE 11887, Seven-digit Article CID Number (DD/MM/YYYY); (DOI URL).

ISSN: 0277-786X

ISSN: 1996-756X (electronic)

ISBN: 9781510646216

ISBN: 9781510646223 (electronic)

Published by

SPIE

P.O. Box 10, Bellingham, Washington 98227-0010 USA Telephone +1 360 676 3290 (Pacific Time)

SPIE.org

Copyright © 2021 Society of Photo-Optical Instrumentation Engineers (SPIE).

Copying of material in this book for internal or personal use, or for the internal or personal use of specific clients, beyond the fair use provisions granted by the U.S. Copyright Law is authorized by SPIE subject to payment of fees. To obtain permission to use and share articles in this volume, visit Copyright Clearance Center at copyright.com. Other copying for republication, resale, advertising or promotion, or any form of systematic or multiple reproduction of any material in this book is prohibited except with permission in writing from the publisher.

Printed in the United States of America by Curran Associates, Inc., under license from SPIE.

Publication of record for individual papers is online in the SPIE Digital Library.



Paper Numbering: A unique citation identifier (CID) number is assigned to each article in the Proceedings of SPIE at the time of publication. Utilization of CIDs allows articles to be fully citable as soon as they are published online, and connects the same identifier to all online and print versions of the publication. SPIE uses a seven-digit CID article numbering system structured as follows:

- The first five digits correspond to the SPIE volume number.
- The last two digits indicate publication order within the volume using a Base 36 numbering system employing both numerals and letters. These two-number sets start with 00, 01, 02, 03, 04, 05, 06, 07, 08, 09, 0A, 0B ... 0Z, followed by 10-1Z, 20-2Z, etc. The CID Number appears on each page of the manuscript.

Contents

SENSOR TECHNOLOGY AND REMOTE SENSING POSITIONING APPLICATION

11887 02	Research on fault simulation technology of rail transit sensor based on FMEA analysis [11887-48
11887 03	Optimal sensor placement method based on IMBPSO algorithm [11887-10]
11887 04	Preparation of TiO _{2-x} film with a high TCR performance for uncooled thermal sensor [11887-77]
11887 05	Structure simulation analysis design of 20kN·m shaft torque measurement sensor [11887-15]
11887 06	Research on sitting posture detection method based on flexible film pressure sensor [11887-37]
11887 07	A high-performance humidity sensor based on in-PCB interdigitated electrodes [11887-11]
11887 08	WSN node localization based on improved sparrow search algorithm optimization [11887-34]
11887 09	Hardware circuit design of compensation type hall high-current sensor [11887-52]
11887 0A	Research on influence of grooving parameters on intelligent water-lubricated bearing embedded in thin film sensors [11887-18]
11887 OB	Human abnormal behavior recognition based on two-stream convolutional neural network [11887-71]
11887 0C	Research on the spatial resolution of space-borne one-dimensional multifrequency synthetic aperture microwave radiometer for SST remote sensing [11887-84]
11887 0D	Fault tolerant topology structure for wireless sensor networks with deploying randomly [11887-69]
11887 OE	Remote control design of automatic shooting test system [11887-54]
11887 OF	Fast semantic segmentation for images with complex backgrounds based on reuse of the feature map [11887-25]
11887 0G	Research on temperature characteristics of fiber Bragg grating sensors with aluminum alloy packaging [11887-44]
11887 OH	Risk modelling and probability analysis of civil aircraft operation in suborbital disintegration accident [11887-41]
11887 OI	Analysis of the influence of wireless channel environment on LTE-V2X communication performance [11887-90]

11887 OJ	Portable and low-cost humidity sensing platform based on quartz crystal microbalance and Arduino [11887-9]
11887 OK	A method to detect low-frequency ship pressure signal under a low SNR [11887-81]
11887 OL	Design and analysis of a planar quasistatic electric field sensor based on nonlinearity of ferroelectric materials [11887-30]
11887 OM	Remote sensing image fusion based on morphological filter and convolutional sparse representation [11887-91]
	INSTRUMENTATION AND INTELLIGENT MECHANICAL CONTROL
11887 ON	Research on the assembly method of missile based on laser scanning [11887-89]
11887 0O	Hardware-in-the-loop simulation for the service performance testing of industrial robot servo systems [11887-35]
11887 OP	The research on sliding model control of pneumatic muscle driven by high-speed on/off valves [11887-42]
11887 0Q	Lack-tolerant and error-tolerant control of five-phase induction motor based on effective time carrier type PWM [11887-40]
11887 OR	Study on residual gas composition in 316L stainless steel-quartz glass hybrid ultra-high vacuum sealed tube [11887-87]
11887 OS	Design and research on internal mud discharge device of jacket platform legs [11887-63]
11887 OT	Device and control method for automatic loading and unloading of drill rods of underground drilling rig in coal mine [11887-51]
11887 OU	Research on vibration suppression effect of shape memory alloy on thin-walled structure [11887-60]
11887 OV	Design and characteristics of shape memory alloy flexible actuator [11887-29]
11887 OW	Discussion on the maintenance system of TNPM's tobacco leaf threshing and redrying equipment [11887-88]
11887 OX	Study on velocity attenuation of spherical tungsten fragments by comb target [11887-45]
11887 0Y	A convenient method for testing recoil resistance of large caliber artillery [11887-1]
11887 OZ	Research on combined diagnosis of mechanical fault vibration-sound signal of high voltage circuit breaker based on EEMD-energy entropy feature [11887-78]

11887 10	Interactive device design for ecological protection based on extinction of Chinese paddlefish [11887-79]		
11887 11	Design of a performance test system for modular robot joints based on LabVIEW [11887-50]		
11887 12	Application of 5G transmitter in capsule endoscope [11887-82]		
11887 13	Rotation correction method of thread image based on machine vision [11887-4]		
11887 14	Working stage identification of hydraulic excavator [11887-46]		
11887 15	Design of microenvironment control instrument for cultural relic display cabinet [11887-6]		
11887 16	The structure design and kinematic analysis of overhead line inspection robot [11887-33]		
11887 17	Al thermometer: the pioneer coordinating prevention and control of pandemic [11887-72]		
11887 18	Multi-component gas detection device base on embedded system [11887-27]		
11887 19	Research on on-line monitoring and control system of electromagnetic loading device for water lubricated bearing [11887-7]		
11887 1A	Flexible graphene based field effect transistor by the soaking and printing technology [11887-13]		
11887 1B	Development of VCSEL laser detection system for methane gas [11887-59]		
11887 1C	Electric heater controlling system based on power line carrier communication [11887-8]		
	DIGITAL OUTPUT AND PRECISION MEASUREMENT TECHNOLOGY APPLICATION		
11887 1D	Structural optimization design of contact probe for three-dimensional thread measuring machine [11887-38]		
11887 1E	Analysis of key technology in fatigue simulation experiment of torsion beam [11887-70]		
11887 1F	Interior ballistic simulation of Italian B512 torpedo launch [11887-92]		
11887 1G	The application of geometric measurement equipment in industrial engineering measurement [11887-83]		
11887 1H	Superconducting fault current limiter non-inductive coil winding technology and inductance measurement [11887-32]		
11887 1I	Research on density measurement of liquefied natural gas storage tank based on computational fluid dynamics [11887-80]		

11887 1J	Predicting thrust force for drilling fiber reinforced polymers using twist drills [11887-43]
11887 1K	Study of NB-IoT-based unmanned surface vehicle system for water quality monitoring of aquaculture ponds [11887-61]
11887 1L	Human posture estimation and correction based on the CPM and the Pearson correlation coefficient [11887-76]
11887 1M	Analysis of using robot to measure and position the key parts of equipment [11887-85]
11887 1N	Study on cascading of all-process planning sheet [11887-86]
11887 10	Carbon monoxide gas detection system based on VCSEL using TDLAS technology [11887-57]
11887 1P	Design of data acquisition instrument based on 5G technology and local storage [11887-16]
11887 1Q	Research on recognition technology of Caragana korshinskii main stem used to keep stubble at a certain height after cutting [11887-20]
11887 1R	Soil electrical modeling and moisture measurement based on impedance spectroscopy analysis [11887-66]
11887 1S	Network effect measurement model and its explosion attributes for 5G virtual reality fusion [11887-68]
11887 1T	Design of a small marine multi-parameter measurement system based on Rpi [11887-74]
11887 1U	The development of TDLAS CO ₂ gas detection system with VCSEL light source [11887-55]
11887 1V	Research on magnetic field detection methods based on fluxgate principle [11887-75]
11887 1W	Engine multiple faults detection base on bispectrum and convolutional neural network [11887-3]
11887 1X	Two-tier network structure design method for IoT scenarios [11887-67]
11887 1Y	Fibre Bragg grating (FBG) thermal monitoring system for copper windings of electric machines under different duty modes [11887-2]
11887 1Z	Design and development of distributed magnetic measurement system based on hall array [11887-14]
11887 20	Research of distributed acquisition system based on clock synchronization [11887-22]
11887 21	Road users classification technology based on roadside light detection and ranging [11887-26]
11887 22	Research introduction of 3D measurement technology based on grating projection [11887-17]

Research on aircraft cable defect detection technology based on ultrasonic guided waves
[11887-12]

Online impedance detection method for monitoring equipment aging in low voltage distribution system [11887-62]