

ISSN 1726-5479

SENSORS & TRANSDUCERS

vol. 112
1 / 10



Sensor Instrumentation, DAQ and Virtual Instruments

International Frequency Sensor Association Publishing





Editors-in-Chief: professor Sergey Y. Yurish,
Phone: +34 696067716, fax: +34 93 4011989, e-mail: editor@sensorsportal.com

Editors for Western Europe

Meijer, Gerard C.M., Delft University of Technology, The Netherlands
Ferrari, Vittorio, Università di Brescia, Italy

Editor South America

Costa-Felix, Rodrigo, Inmetro, Brazil

Editor for Eastern Europe

Sachenko, Anatoly, Ternopil State Economic University, Ukraine

Editors for North America

Datskos, Panos G., Oak Ridge National Laboratory, USA
Fabien, J. Josse, Marquette University, USA
Katz, Evgeny, Clarkson University, USA

Editor for Asia

Ohyama, Shinji, Tokyo Institute of Technology, Japan

Editor for Asia-Pacific

Mukhopadhyay, Subhas, Massey University, New Zealand

Editorial Advisory Board

- Abdul Rahim, Ruzairi**, Universiti Teknologi, Malaysia
Ahmad, Mohd Noor, Northern University of Engineering, Malaysia
Annamalai, Karthigeyan, National Institute of Advanced Industrial Science and Technology, Japan
Arcega, Francisco, University of Zaragoza, Spain
Arguel, Philippe, CNRS, France
Ahn, Jae-Pyoung, Korea Institute of Science and Technology, Korea
Arndt, Michael, Robert Bosch GmbH, Germany
Ascoli, Giorgio, George Mason University, USA
Atalay, Selcuk, Inonu University, Turkey
Atghiaee, Ahmad, University of Tehran, Iran
Augutis, Vygantas, Kaunas University of Technology, Lithuania
Avachit, Patil Lalchand, North Maharashtra University, India
Ayesh, Aladdin, De Montfort University, UK
Bahreyni, Behraad, University of Manitoba, Canada
Baliga, Shankar, B., General Monitors Transnational, USA
Baoxian, Ye, Zhengzhou University, China
Barford, Lee, Agilent Laboratories, USA
Barlingay, Ravindra, RF Arrays Systems, India
Basu, Sukumar, Jadavpur University, India
Beck, Stephen, University of Sheffield, UK
Ben Bouzid, Sihem, Institut National de Recherche Scientifique, Tunisia
Benachaiba, Chellali, Universitaire de Bechar, Algeria
Binnie, T. David, Napier University, UK
Bischoff, Gerlinde, Inst. Analytical Chemistry, Germany
Bodas, Dhananjay, IMTEK, Germany
Borges Carval, Nuno, Universidade de Aveiro, Portugal
Bousbia-Salah, Mounir, University of Annaba, Algeria
Bouvet, Marcel, CNRS – UPMC, France
Brudzewski, Kazimierz, Warsaw University of Technology, Poland
Cai, Chenxin, Nanjing Normal University, China
Cai, Qingyun, Hunan University, China
Campanella, Luigi, University La Sapienza, Italy
Carvalho, Vitor, Minho University, Portugal
Cecelja, Franjo, Brunel University, London, UK
Cerda Belmonte, Judith, Imperial College London, UK
Chakrabarty, Chandan Kumar, Universiti Tenaga Nasional, Malaysia
Chakravorty, Dipankar, Association for the Cultivation of Science, India
Changhai, Ru, Harbin Engineering University, China
Chaudhari, Gajanan, Shri Shivaji Science College, India
Chavali, Murthy, VIT University, Tamil Nadu, India
Chen, Jiming, Zhejiang University, China
Chen, Rongshun, National Tsing Hua University, Taiwan
Cheng, Kuo-Sheng, National Cheng Kung University, Taiwan
Chiang, Jeffrey (Cheng-Ta), Industrial Technol. Research Institute, Taiwan
Chiriac, Horia, National Institute of Research and Development, Romania
Chowdhuri, Arijit, University of Delhi, India
Chung, Wen-Yaw, Chung Yuan Christian University, Taiwan
Corres, Jesus, Universidad Publica de Navarra, Spain
Cortes, Camilo A., Universidad Nacional de Colombia, Colombia
Courtois, Christian, Universite de Valenciennes, France
Cusano, Andrea, University of Sannio, Italy
D'Amico, Arnaldo, Università di Tor Vergata, Italy
De Stefano, Luca, Institute for Microelectronics and Microsystem, Italy
Deshmukh, Kiran, Shri Shivaji Mahavidyalaya, Barshi, India
Dickert, Franz L., Vienna University, Austria
Dieguez, Angel, University of Barcelona, Spain
Dimitropoulos, Panos, University of Thessaly, Greece
Ding, Jianning, Jiangsu Polytechnic University, China
Djordjevic, Alexandar, City University of Hong Kong, Hong Kong
Donato, Nicola, University of Messina, Italy
Donato, Patricio, Universidad de Mar del Plata, Argentina
Dong, Feng, Tianjin University, China
Drljaca, Predrag, Instersema Sensoric SA, Switzerland
Dubey, Venketesh, Bournemouth University, UK
Enderle, Stefan, Univ. of Ulm and KTB Mechatronics GmbH, Germany
Erdem, Gursan K. Arzum, Ege University, Turkey
Erkmen, Aydan M., Middle East Technical University, Turkey
Estelle, Patrice, Insa Rennes, France
Estrada, Horacio, University of North Carolina, USA
Faiz, Adil, INSA Lyon, France
Fericean, Sorin, Balluff GmbH, Germany
Fernandes, Joana M., University of Porto, Portugal
Francioso, Luca, CNR-IMM Institute for Microelectronics and Microsystems, Italy
Francis, Laurent, University Catholique de Louvain, Belgium
Fu, Weiling, South-Western Hospital, Chongqing, China
Gaura, Elena, Coventry University, UK
Geng, Yanfeng, China University of Petroleum, China
Gole, James, Georgia Institute of Technology, USA
Gong, Hao, National University of Singapore, Singapore
Gonzalez de la Rosa, Juan Jose, University of Cadiz, Spain
Grael, Annette, Goteborg University, Sweden
Graff, Mason, The University of Texas at Arlington, USA
Guan, Shan, Eastman Kodak, USA
Guillet, Bruno, University of Caen, France
Guo, Zhen, New Jersey Institute of Technology, USA
Gupta, Narendra Kumar, Napier University, UK
Hadjiloucas, Sillas, The University of Reading, UK
Haider, Mohammad R., Sonoma State University, USA
Hashsham, Syed, Michigan State University, USA
Hasni, Abdelhafid, Bechar University, Algeria
Hernandez, Alvaro, University of Alcalá, Spain
Hernandez, Wilmar, Universidad Politecnica de Madrid, Spain
Homentcovski, Dorel, SUNY Binghamton, USA
Horstman, Tom, U.S. Automation Group, LLC, USA
Hsiai, Tzung (John), University of Southern California, USA
Huang, Jeng-Sheng, Chung Yuan Christian University, Taiwan
Huang, Star, National Tsing Hua University, Taiwan
Huang, Wei, PSG Design Center, USA
Hui, David, University of New Orleans, USA
Jaffrezic-Renault, Nicole, Ecole Centrale de Lyon, France
Jaime Calvo-Galleg, Jaime, Universidad de Salamanca, Spain
James, Daniel, Griffith University, Australia
Janting, Jakob, DELTA Danish Electronics, Denmark
Jiang, Liudi, University of Southampton, UK
Jiang, Wei, University of Virginia, USA
Jiao, Zheng, Shanghai University, China
John, Joachim, IMEC, Belgium
Kalach, Andrew, Voronezh Institute of Ministry of Interior, Russia
Kang, Moonho, Sunmoon University, Korea South
Kaniusas, Eugenijus, Vienna University of Technology, Austria
Katake, Anup, Texas A&M University, USA
Kausel, Wilfried, University of Music, Vienna, Austria
Kavasoglu, Nese, Mugla University, Turkey
Ke, Cathy, Tyndall National Institute, Ireland
Khan, Asif, Aligarh Muslim University, Aligarh, India
Sapozhnikova, Ksenia, D.I.Mendeleyev Institute for Metrology, Russia

Kim, Min Young, Kyungpook National University, Korea South
Ko, Sang Choon, Electronics. and Telecom. Research Inst., Korea South
Kockar, Hakan, Balikesir University, Turkey
Kotulska, Malgorzata, Wroclaw University of Technology, Poland
Kratz, Henrik, Uppsala University, Sweden
Kumar, Arun, University of South Florida, USA
Kumar, Subodh, National Physical Laboratory, India
Kung, Chih-Hsien, Chang-Jung Christian University, Taiwan
Lacnjevac, Caslav, University of Belgrade, Serbia
Lay-Ekuakille, Aime, University of Lecce, Italy
Lee, Jang Myung, Pusan National University, Korea South
Lee, Jun Su, Amkor Technology, Inc. South Korea
Lei, Hua, National Starch and Chemical Company, USA
Li, Genxi, Nanjing University, China
Li, Hui, Shanghai Jiaotong University, China
Li, Xian-Fang, Central South University, China
Liang, Yuanchang, University of Washington, USA
Liawruangrath, Saisune, Chiang Mai University, Thailand
Liew, Kim Meow, City University of Hong Kong, Hong Kong
Lin, Hermann, National Kaohsiung University, Taiwan
Lin, Paul, Cleveland State University, USA
Linderholm, Pontus, EPFL - Microsystems Laboratory, Switzerland
Liu, Aihua, University of Oklahoma, USA
Liu Changgeng, Louisiana State University, USA
Liu, Cheng-Hsien, National Tsing Hua University, Taiwan
Liu, Songqin, Southeast University, China
Lodeiro, Carlos, University of Vigo, Spain
Lorenzo, Maria Encarnacio, Universidad Autonoma de Madrid, Spain
Lukaszewicz, Jerzy Pawel, Nicholas Copernicus University, Poland
Ma, Zhanfang, Northeast Normal University, China
Majstorovic, Vidosav, University of Belgrade, Serbia
Marquez, Alfredo, Centro de Investigacion en Materiales Avanzados, Mexico
Matay, Ladislav, Slovak Academy of Sciences, Slovakia
Mathur, Prafull, National Physical Laboratory, India
Maurya, D.K., Institute of Materials Research and Engineering, Singapore
Mekid, Samir, University of Manchester, UK
Melnyk, Ivan, Photon Control Inc., Canada
Mendes, Paulo, University of Minho, Portugal
Mennell, Julie, Northumbria University, UK
Mi, Bin, Boston Scientific Corporation, USA
Minas, Graca, University of Minho, Portugal
Moghavvemi, Mahmoud, University of Malaya, Malaysia
Mohammadi, Mohammad-Reza, University of Cambridge, UK
Molina Flores, Esteban, Benemérita Universidad Autónoma de Puebla, Mexico
Moradi, Majid, University of Kerman, Iran
Morello, Rosario, University "Mediterranea" of Reggio Calabria, Italy
Mounir, Ben Ali, University of Sousse, Tunisia
Mulla, Imtiaz Sirajuddin, National Chemical Laboratory, Pune, India
Neelamegam, Periasamy, Sastra Deemed University, India
Neshkova, Milka, Bulgarian Academy of Sciences, Bulgaria
Oberhammer, Joachim, Royal Institute of Technology, Sweden
Ould Lahoucine, Cherif, University of Guelma, Algeria
Pamidighanta, Sayanu, Bharat Electronics Limited (BEL), India
Pan, Jisheng, Institute of Materials Research & Engineering, Singapore
Park, Joon-Shik, Korea Electronics Technology Institute, Korea South
Penza, Michele, ENEA C.R., Italy
Pereira, Jose Miguel, Instituto Politecnico de Setebal, Portugal
Petsev, Dimiter, University of New Mexico, USA
Pogacnik, Lea, University of Ljubljana, Slovenia
Post, Michael, National Research Council, Canada
Prance, Robert, University of Sussex, UK
Prasad, Ambika, Gulbarga University, India
Prateepasen, Asa, Kingmoungut's University of Technology, Thailand
Pullini, Daniele, Centro Ricerche FIAT, Italy
Pumera, Martin, National Institute for Materials Science, Japan
Radhakrishnan, S. National Chemical Laboratory, Pune, India
Rajanna, K., Indian Institute of Science, India
Ramadan, Qasem, Institute of Microelectronics, Singapore
Rao, Basuthkar, Tata Inst. of Fundamental Research, India
Raouf, Kosai, Joseph Fourier University of Grenoble, France
Reig, Candid, University of Valencia, Spain
Restivo, Maria Teresa, University of Porto, Portugal
Robert, Michel, University Henri Poincare, France
Rezazadeh, Ghader, Urmia University, Iran
Royo, Santiago, Universitat Politècnica de Catalunya, Spain
Rodriguez, Angel, Universidad Politécnica de Catalunya, Spain
Rothberg, Steve, Loughborough University, UK
Sadana, Ajit, University of Mississippi, USA
Sadeghian Marnani, Hamed, TU Delft, The Netherlands
Sandacci, Serghei, Sensor Technology Ltd., UK
Saxena, Vibha, Bhabha Atomic Research Centre, Mumbai, India
Schneider, John K., Ultra-Scan Corporation, USA
Seif, Selemeni, Alabama A & M University, USA
Seifter, Achim, Los Alamos National Laboratory, USA
Sengupta, Deepak, Advance Bio-Photonics, India
Shearwood, Christopher, Nanyang Technological University, Singapore
Shin, Kyuho, Samsung Advanced Institute of Technology, Korea
Shmaliy, Yuriy, Kharkiv National Univ. of Radio Electronics, Ukraine
Silva Girao, Pedro, Technical University of Lisbon, Portugal
Singh, V. R., National Physical Laboratory, India
Slomovitz, Daniel, UTE, Uruguay
Smith, Martin, Open University, UK
Soleymanpour, Ahmad, Damghan Basic Science University, Iran
Somani, Prakash R., Centre for Materials for Electronics Technol., India
Srinivas, Talabattula, Indian Institute of Science, Bangalore, India
Srivastava, Arvind K., Northwestern University, USA
Stefan-van Staden, Raluca-Ioana, University of Pretoria, South Africa
Sumridetchka, Sarun, National Electronics and Computer Technology Center, Thailand
Sun, Chengliang, Polytechnic University, Hong-Kong
Sun, Dongming, Jilin University, China
Sun, Junhua, Beijing University of Aeronautics and Astronautics, China
Sun, Zhiqiang, Central South University, China
Suri, C. Raman, Institute of Microbial Technology, India
Sysoev, Victor, Saratov State Technical University, Russia
Szewczyk, Roman, Industrial Research Inst. for Automation and Measurement, Poland
Tan, Ooi Kiang, Nanyang Technological University, Singapore
Tang, Dianping, Southwest University, China
Tang, Jaw-Luen, National Chung Cheng University, Taiwan
Teker, Kasif, Frostburg State University, USA
Thumbavanam Pad, Kartik, Carnegie Mellon University, USA
Tian, Gui Yun, University of Newcastle, UK
Tsiantos, Vassilios, Technological Educational Institute of Kaval, Greece
Tsigara, Anna, National Hellenic Research Foundation, Greece
Twomey, Karen, University College Cork, Ireland
Valente, Antonio, University, Vila Real, - U.T.A.D., Portugal
Vaseashta, Ashok, Marshall University, USA
Vazquez, Carmen, Carlos III University in Madrid, Spain
Vieira, Manuela, Instituto Superior de Engenharia de Lisboa, Portugal
Vigna, Benedetto, STMicroelectronics, Italy
Vrba, Radimir, Brno University of Technology, Czech Republic
Wandelt, Barbara, Technical University of Lodz, Poland
Wang, Jiangping, Xi'an Shiyou University, China
Wang, Kedong, Beihang University, China
Wang, Liang, Advanced Micro Devices, USA
Wang, Mi, University of Leeds, UK
Wang, Shinn-Fwu, Ching Yun University, Taiwan
Wang, Wei-Chih, University of Washington, USA
Wang, Wensheng, University of Pennsylvania, USA
Watson, Steven, Center for NanoSpace Technologies Inc., USA
Weiping, Yan, Dalian University of Technology, China
Wells, Stephen, Southern Company Services, USA
Wolkenberg, Andrzej, Institute of Electron Technology, Poland
Woods, R. Clive, Louisiana State University, USA
Wu, DerHo, National Pingtung Univ. of Science and Technology, Taiwan
Wu, Zhaoyang, Hunan University, China
Xiu Tao, Ge, Chuzhou University, China
Xu, Lisheng, The Chinese University of Hong Kong, Hong Kong
Xu, Tao, University of California, Irvine, USA
Yang, Dongfang, National Research Council, Canada
Yang, Wuqiang, The University of Manchester, UK
Yang, Xiaoling, University of Georgia, Athens, GA, USA
Yaping Dan, Harvard University, USA
Ymeti, Aurel, University of Twente, Netherland
Yong Zhao, Northeastern University, China
Yu, Haihu, Wuhan University of Technology, China
Yuan, Yong, Massey University, New Zealand
Yufera Garcia, Alberto, Seville University, Spain
Zakaria, Zulkarnay, University Malaysia Perlis, Malaysia
Zagnoni, Michele, University of Southampton, UK
Zamani, Cyrus, Universitat de Barcelona, Spain
Zeni, Luigi, Second University of Naples, Italy
Zhang, Minglong, Shanghai University, China
Zhang, Quintao, University of California at Berkeley, USA
Zhang, Weiping, Shanghai Jiao Tong University, China
Zhang, Wenming, Shanghai Jiao Tong University, China
Zhang, Xueji, World Precision Instruments, Inc., USA
Zhong, Haoxiang, Henan Normal University, China
Zhu, Qing, Fujifilm Dimatix, Inc., USA
Zorzano, Luis, Universidad de La Rioja, Spain
Zourob, Mohammed, University of Cambridge, UK

Contents

Volume 112
Issue 1
January 2010

www.sensorsportal.com

ISSN 1726-5479

Research Articles

Design of an Acoustic Displacement Transducer <i>Tariq Al Mograbi, Mohammad A. K. Alia, Mohammad Abuzalata</i>	1
Vibration Analysis Based on Hammer Impact for Fouling Detection using Microphone and Accelerometer as Sensors <i>Jaidilson Silva, Antonio Marcus Lima, Helmut Neff and José Sérgio Rocha Neto</i>	10
Simulation of the Two-Phase Liquid – Gas Flow through Ultrasonic Transceivers Application in Ultrasonic Tomography <i>Zulkarnay Zakaria, Mohd Hafiz Fazalul Rahiman, Ruzairi Abdul Rahim</i>	24
Image Reconstructions of a Portable Optical CT-Scan Using an NIR Light Source <i>Margi Sasono and Hariyadi Soetedjo</i>	39
Statistical Feature Extraction and Recognition of Beverages Using Electronic Tongue <i>P. C. Panchariya and A. H. Kiranmayee</i>	47
Modeling and Verification of Heat Fields by Virtual Instrumentation <i>Libor Hargaš, Dušan Koniar, Miroslav Hrianka, Anna Příkopová</i>	64
PC Based Instrument for the Measurement of Dielectric Constant of Liquids <i>V. V. Ramana C. H. and Malakondaiah K.</i>	73
Development of Laser LEDs Based a Programmable Optical Sensor for Detection of Environmental Pollutants <i>Amit K. Sharma and R. K. Tiwari</i>	80
Performance Evaluation and Robustness Testing of Advanced Oscilloscope Triggering Schemes <i>Shakeb A. Khan, Alka Nigam, A. K. Agarwala, Mini S. Thomas</i>	95
Design and Development of an Embedded System for Testing the Potentiometer Linearity <i>Raghavendra Rao Kanchi, Nagamani Gosala</i>	107
Development of an FPGA Based Embedded System for High Speed Object Tracking <i>Chandrashekar Matham, Nagabhushan Raju Konduru</i>	118
A New Algorithm of Compensation of the Time Interval Error GPS-Based Measurements <i>Jonny Paul Zavala de Paz, Yuriy S. Shmaliy</i>	124
Colour Determination and Change of Sensory Properties of Mayonnaise with Different Contents of Oil depending on Length of Storage <i>Višnja M. Sikimić, Jovanka V. Popov-Raljić, Branislav P. Zlatković, Nada Lakić</i>	138
Dynamically Functioning Structure and Problem of Measurements of Rapidly Time-Varying Processes: Dream or Reality <i>George Abramchuk, Kristina Abramchuk</i>	166

SENSORDEVICES 2010:

The First International Conference
on Sensor Device Technologies and Applications

July 18 - 25, 2010 - Venice, Italy



The inaugural event SENSORDEVICES 2010, The First International Conference on Sensor Device Technologies and Applications, initiates a series of events focusing on sensor devices themselves, the technology-capturing style of sensors, special technologies, signal control and interfaces, and particularly sensors-oriented applications. The evolution of the nano- and microtechnologies, nanomaterials, and the new business services make the sensor device industry and research on sensor-themselves very challenging.

Conference tracks

Sensor devices
Sensor device technologies
Sensors signal conditioning and interfacing circuits

Medical devices and sensors applications
Sensors domain-oriented devices, technologies, and applications
Sensor-based localization and tracking technologies

Important dates

Submission (full paper): February 20, 2010
Notification: March 25, 2010
Registration: April 15, 2010
Camera ready: April 20, 2010



<http://www.iaria.org/conferences2010/SENSORDEVICES10.html>

SENSORCOMM 2010:

The Fourth International Conference
on Sensor Technologies and Applications

July 18 - 25, 2010 - Venice, Italy



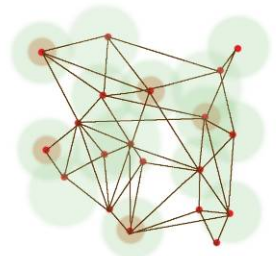
SENSORCOMM 2010 (The Fourth International Conference on Sensor Technologies and Applications) is a multi-track event covering related topics on theory and practice on wired and wireless sensors and sensor networks. The topics suggested can be discussed in term of concepts, state of the art, research, standards, implementations, running experiments, applications, and industrial case studies.

Conference tracks

APASN Architectures, protocols and algorithms of sensor networks
MECSN Energy, management and control of sensor networks
RASQOFT Resource allocation, services, QoS and fault tolerance in sensor networks
PESMOSN Performance, simulation and modelling of sensor networks
SEMOSN Security and monitoring of sensor networks
SECSN Sensor circuits and sensor devices
RIWISN Radio issues in wireless sensor networks
SAPSN Software, applications and programming of sensor networks
DAIPSN Data allocation and information in sensor networks
DISN Deployments and implementations of sensor networks
UNWAT Under water sensors and systems
ENOPT Energy optimization in wireless sensor networks

Important dates

Submission (full paper): February 20, 2010
Notification: March 25, 2010
Registration: April 15, 2010
Camera ready: April 20, 2010



<http://www.iaria.org/conferences2010/SENSORCOMM10.html>

Authors are encouraged to submit article in MS Word (doc) and Acrobat (pdf) formats by e-mail: editor@sensorsportal.com
Please visit journal's webpage with preparation instructions: <http://www.sensorsportal.com/HTML/DIGEST/Submission.htm>

Image Reconstructions of a Portable Optical CT-Scan Using a NIR Light Source

Margi SASONO and *Hariyadi SOETEDJO

Center for Integrated Research and Innovation, The University of Ahmad Dahlan
(CIRNOV–UAD), Jl. Cendana No 9a, Yogyakarta 55166, Indonesia
Dept. of Physics (Electronics and Instrumentations), The University of Ahmad Dahlan,
Jl. Prof. Dr. Soepomo, S. H, Janturan, Yogyakarta 55165, Indonesia
*Tel.: +62-81 8468489, fax: +62-274-564604
E-mail: hariyadi@uad.ac.id

Received: 19 December 2009 /Accepted: 22 January 2010 /Published: 29 January 2010

Abstract: 2D Image reconstructions of some phantoms have been obtained from a portable design of a transversal optical computed tomography (OCT) scan. A laser diode of an NIR (Near-Infrared) peak spectrum at 904 nm has been used as a light source through a standard technique of scanning. The phantoms used for the experiments were of cylinders of gypsum and stainless steel materials. This technique is considerably encouraging for further applications that could introduce some advantages of simply operation and low cost. *Copyright © 2010 IFSA.*

Keywords: optical tomography, phantom, NIR, gypsum, stainless steel

1. Introduction

Optical computed tomography (OCT) scan technology has been used widely in various applications of medical diagnostics, environment, chemical [1-3] as this technique uses light sources that introduces non-invasive detections. Use of optical techniques are expected able to overcome some disadvantages experienced by a common technique based on X-Ray sources such of destructive, impractical and expensive [4, 5]. The efforts to improve OCT scan techniques will be a challenging that able to offer low cost and simply operation of apparatus. Use of optical light source is considered to have more safety as no side-effect introduced because of low energies of radiation used. The use of diode laser and light emitting diode (LED) are also interesting for a design of optical tomography [6, 7]. It is a general knowledge that most of OCT scan equipments have been built-up bases on a sagittal scan

technique by referring to the attenuation of the phantom from the light source. This technique is relatively simple and low cost compare than that of the available technique based on optical diffuse tomography that is more complex in mathematical calculations and optical components used [1]. For this kind of technique, Scheel *et al.* [8] have carried out the work by using a wavelength at 675 nm of laser diode for a medical application. The concept of their works was based on the sagittal scan that will produce 2D scan contours. Hielscher *et al.* [4] and Netz *et al.* [9] have reported their experimental works on the fingers joint for sagittal scans using a laser diode in the red wavelength spectrum (650 nm).

The OCT based on a transversal cross-section scan is found to have a limited number of publications compare than that of the other techniques such of diffusion and coherence. Nevertheless, this technique could introduce more interesting in image reconstructions of phantom with simpler algorithm. Using this technique, a top view of image reconstruction obtained could inform more complete figure in 2D which allows us able to analyze further detail of the physical phenomena. Watanabe *et al.* [10] have reported their work on the phantom of lipid immersed in the water medium to obtain the image reconstruction. They obtained the image with the correction factor introduced by running the measurement using an acrylic material.

In this paper we report the preliminary result of a self-design apparatus performance of OCT scan based on a transversal imaging using an NIR (Near-Infrared) laser diode of 904 nm as a light source. The apparatus design was built-up based on the light attenuation received by a photodetector when this light beam strike the phantom to provide a 2D image reconstruction of cross-sectional area of phantom. The correction factor was introduced by running the measurement for a phantom-free in air medium. This technique is interesting as most of the image reconstruction done through the sagittal scan.

2. Theory and Experiment

A basic concept of OCT scan refers to the measurement set-up as illustrated in Fig. 1. From that figure, data collected from the detector for different scanning positions of phantom (set of data) are the attenuation of light intensities (one dimensional projection profile) after passed through the phantom. The attenuation intensities include the absorption and any scattering phenomena in the sample [10]. The absorption intensities are considered to introduce the dominant phenomenon of light received by the detector as the active area of this component is relatively small (about 5 mm diameter) which is considered able to minimize any scattering effect may occur. For those phenomena, we assume that light beam intensities will be attenuated by a phantom follows Beer Lambert's law. Therefore the projection data at a certain angle, $P_\theta(r)$ can be expressed as

$$P_\theta(r) = \ln \left(\frac{I_0}{I_t} \right) = \int_{\text{line}(\theta, r)} \mu(x, y) ds, \quad (1)$$

where I_0 and I_t are intensities of incident and attenuation light, respectively. $\mu(x, y)$ is the total attenuation coefficient, and ds is the differential path length along the parallel light beam. In the translational scan, changes in the position of the incident light beam introduce a change in $\mu(x, y)$. In the rotational scan, changes in the angle θ introduce a change in the position of the sample being illuminated. The above movements could be expressed into the equations for each ray (parallel light beam) as

$$r = x \cos \theta + y \sin \theta \quad (2)$$

By using the delta function, equation (1) can be rewritten as

$$P_{\theta}(r) = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \mu(x, y) \delta(x \cos \theta + y \sin \theta - r) dx dy, \quad (3)$$

where $P_{\theta}(r)$ is known as a Radon transform of a function $\mu(x, y)$. This transform will map the data from (x, y) to (r, θ) . In the term of tomography, plotting the Radon transform or scanning data refers to a *sinogram* characteristic due to its sinusoid shape. Therefore, a cross-sectional image of phantom can be reconstructed using an inverse Radon transform. Detail principles of the computed tomography could be found in Thavavel *et al* [11]. For the image reconstruction and back projection methods, the Filtered Back Projection (FBP) algorithm has been used [12]. This algorithm generates the reconstruction of a single projection. A summation of the reconstruction for each single projection forms a complete reconstruction of an image's cross-sectional. In practice, only a finite number of samples will be taken from a projection, so a discrete approximation in practice could be expressed as

$$\mu(x, y) = \frac{\pi}{K} \sum_{i=1}^K (x \cos \theta_i + y \sin \theta_i) \quad (4)$$

From (4) there are K numbers of projection $P_{\theta}(r)$, meanwhile $\frac{\pi}{K}$ is an angle between two projections and i is the data point [7].

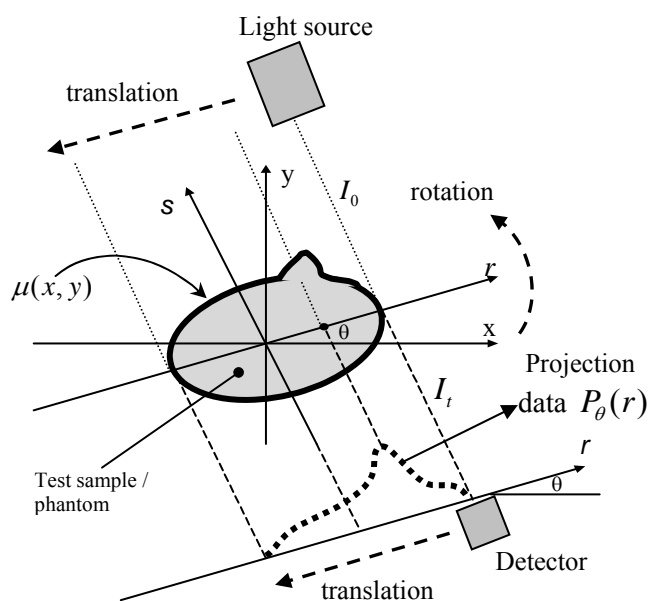


Fig. 1. Illustration of the projection data acquisition.

The OCT scan apparatus used in the measurement consists of a pair of laser diode and photodiode positioned across the phantom. This set-up allows the translation and rotational movements for a transversal cross-section process of a phantom. The distance between the laser diode and the photodetector was fixed for about 7 cm. The schematized diagram of the apparatus set-up is given in Fig. 2. The phantoms used for the measurement were of cylinders of gypsum and stainless steel materials with variation of diameters. During measurement, the phantom was fixed on the stage

meanwhile the motion part consists of laser diode and photodetector did not make any mechanical contact with the phantom. This apparatus set-up introduces a relatively low vibration during measurement. The measurements were done at room temperature at low light intensities of environment.

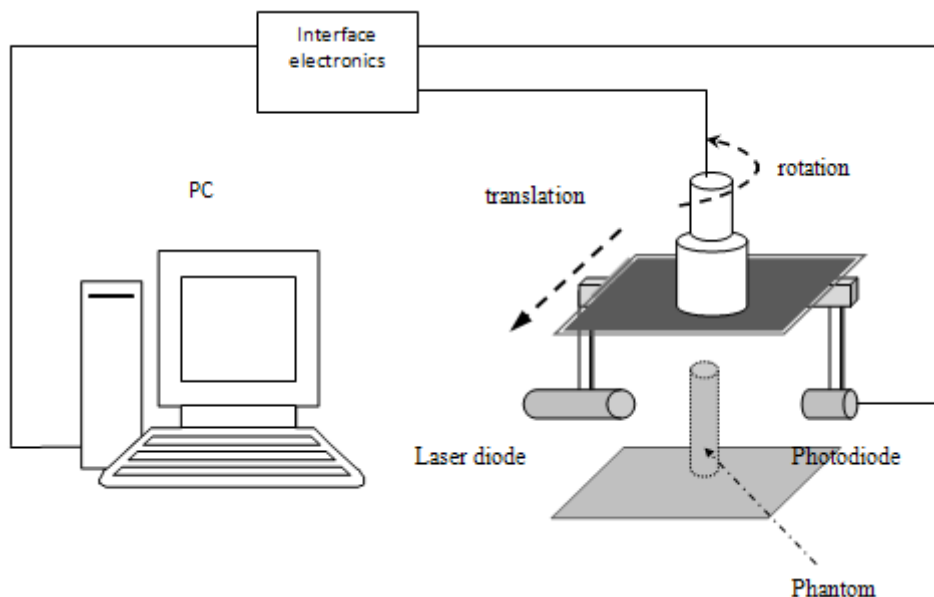


Fig. 2. Schematized diagram of the transversal optical tomography set-up used.

During the experiment, the translation and rotation introduce movement steps for 0.22 mm and 1.8° , respectively through the stepper motor. This movement allows the apparatus to collect the data for 200 projections for a complete scan. Scanning process including data collection of the image reconstruction of the phantom were controlled using a computer through a Delphi software. The measurement results obtained from the data collection were then processed by referring to the concept of computed tomography (CT) by means of the transmission light intensities from the source. With this strategy, the back projection could be done to obtain image reconstructions. By referring to the above points, this technique is suitable for transparent or semi-transparent media. The apparatus is able to perform a self-construction for an image reconstruction of various shapes of phantom based on a back projection method through a data extraction obtained from the measurement. Another side, use of commercialized laser diode at low power (less than 2 mW) is considered able to introduce low power consumption for the apparatus.

3. Results and Discussion

From the measurement done using a single phantom of a cylinder shape (gypsum material), the data projection has been successfully collected and then subsequently projected into 2D image reconstructions by means of a transversal (cross-section image) through a back projection method. The results obtained are given in Fig. 3, where the abscissa and ordinates are pixel (arbitrary unit). As we can see from the figure, the image of phantom observed is very bright compare than that of the other contrast levels associate with the background (Fig. 3a). The edge of phantom image shape is not clearly seen. Nevertheless, this distinguishable image shows that the apparatus is working properly to satisfy the optical CT scan technique. After a filtering process, a very bright image could be reduced its gray level to provide more clear image (Fig. 3b). From that figure, the edge of phantom image

could be found to have more clear that is surrounded by a thin ring. This ring is assumed due to the mismatch of refractive index between ambient and phantom media.

The distinguishable images after filtering process obtained have been projected into grey level for a distance along the image profile as given in Fig. 4. From the figure, the image profile after filtering process shows more sensitive variation in gray level respect to the distance. The profiling process was done immediately after the image reconstructed from the scanning process. This mechanism introduces the image reconstruction in relatively quick process. The point of a distinguishable image is very important for the determination the phantom from its background.

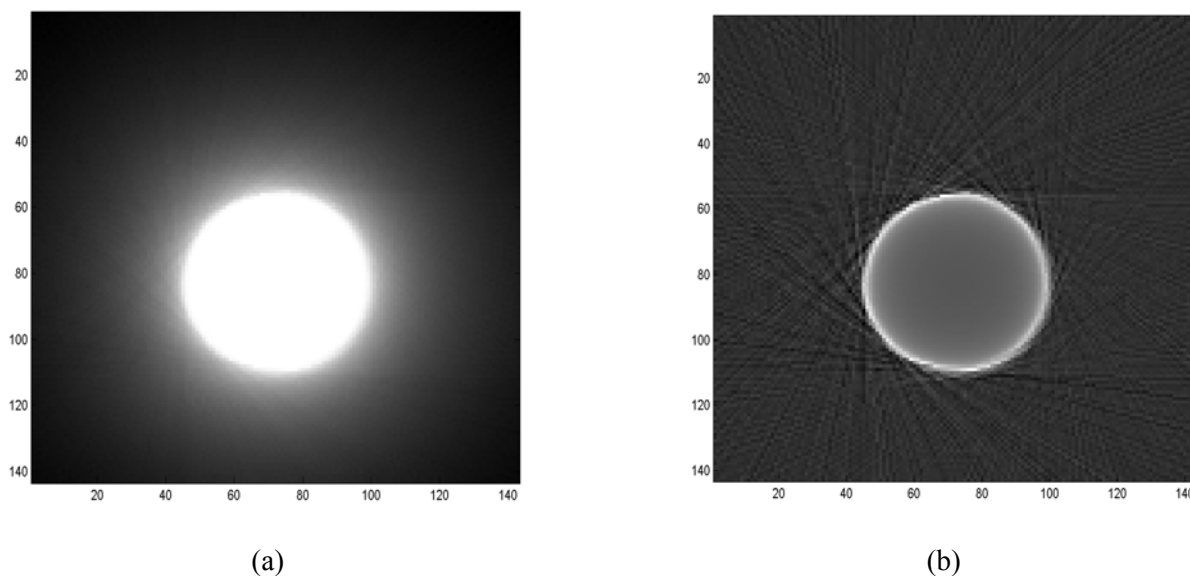


Fig. 3. The 2D image reconstructions of the gypsum cylinder (phantom) at (a) before, and (b) after filtering process.

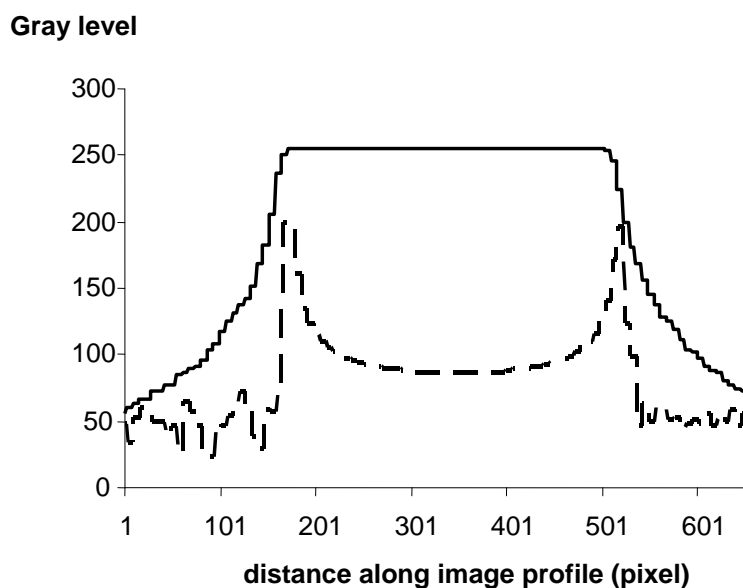


Fig. 4. The image profiles obtained (from Fig. 3) at before (solid line) and after (dashed line) filtering.

Further experiments were carried out using stainless steel cylinders with a variation of diameters for 0.5, 1.0, 1.5, and 2.0 cm. The results obtained are given in Fig. 5 (a-d). The image shapes of phantoms are clearly distinguishable from their backgrounds. The background image observed for a diameter of 1.5 cm looks a bit unsmooth compare than that of the other phantom diameters. This unsmooth image may be due to the quality of cylinder surface being scanned which is not as smooth as the others. Those four images are projected into the image profiles as shown in Fig. 6. From those profiles, the ratios of diameter of image (Fig. 6 b, c and d) respect to Fig. 6a have been calculated and found to be consistent for about 1.7. This result shows that the image reconstruction is reproducible for variation of phantom sizes used.

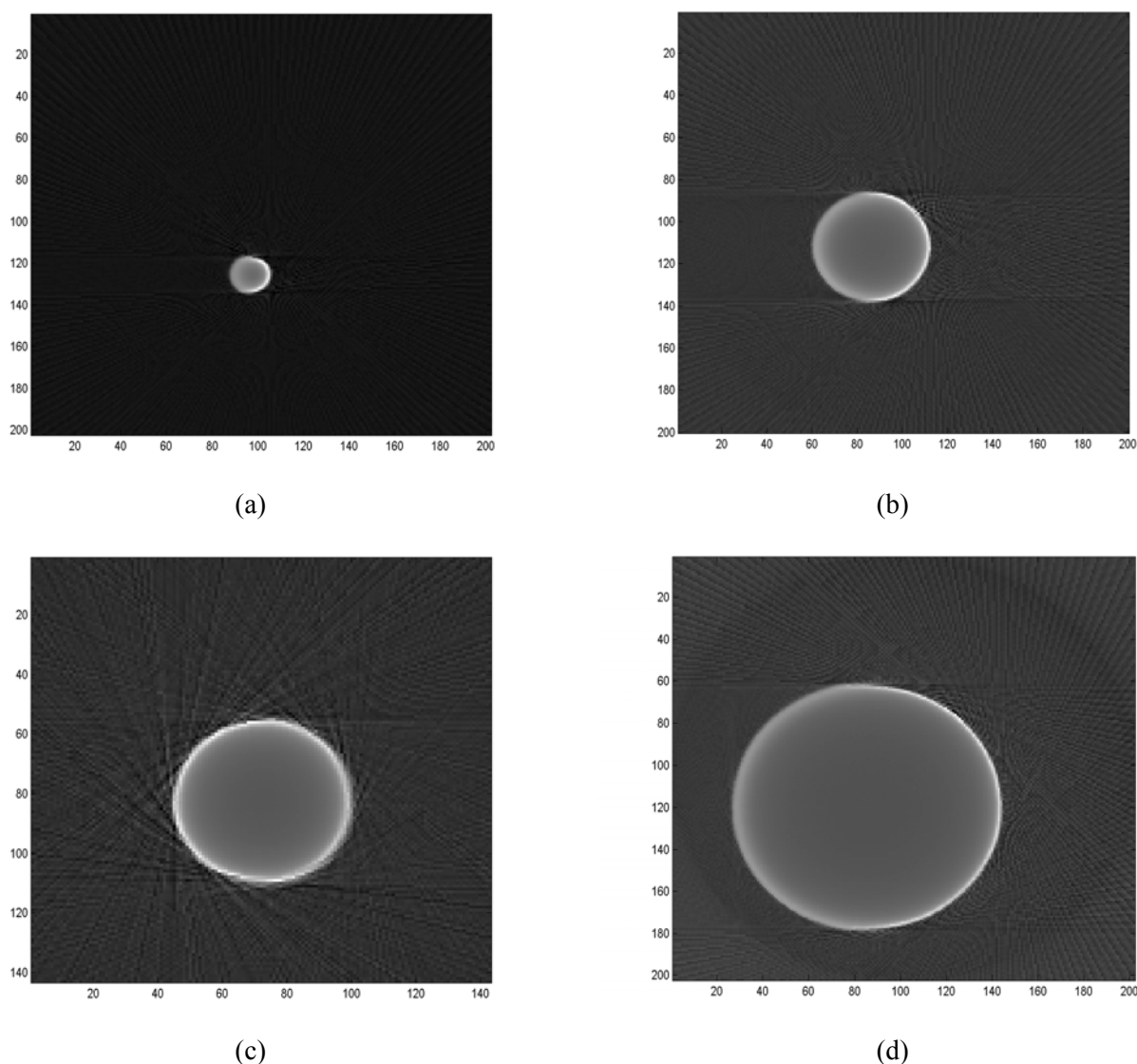


Fig. 5. 2D Image reconstructions of the phantoms of stainless steel cylinder after filtering process for a variation of diameters of (a) 0.5, (b) 1.0, (c) 1.5 and (d) 2.0 cm.

4. Conclusions

The simple operation and portable design of optical tomography has been demonstrated its capability to reconstruct 2D image for variation of phantoms (gypsum and stainless steel materials). The reconstruction was done for a transversal cross-section scan. The image profile obtained indicates the distinguishable profiles of phantom from their background.

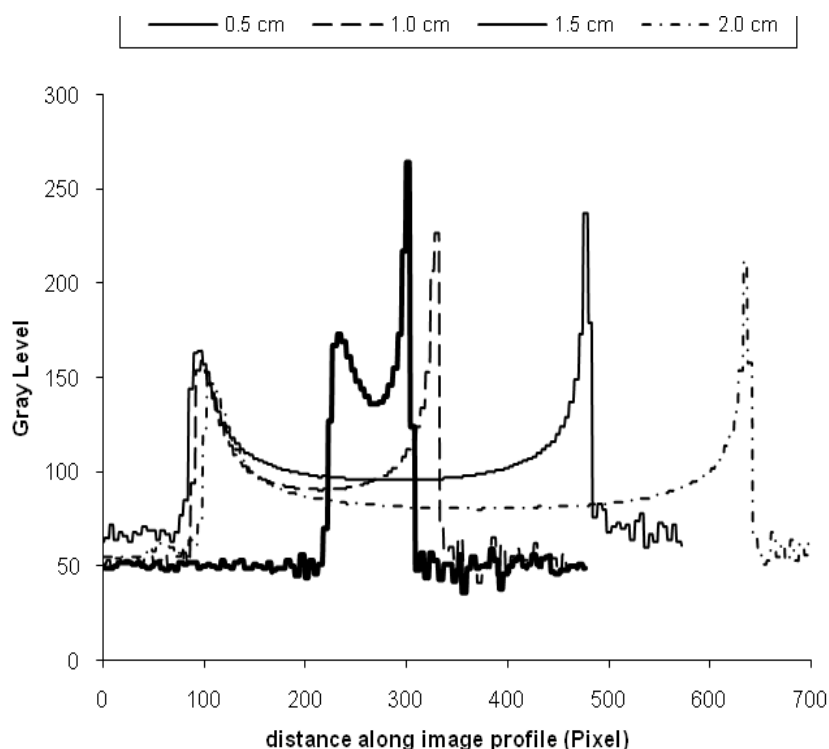


Fig. 6. The image profiles obtained (from Fig. 5.) for a variation of diameters.

These results show that the set-up apparatus with a simply algorithm have been successfully used for image reconstructions by means of the CT-Scan concept. The apparatus is considerably simple and low cost that is suitable for various applications.

References

- [1]. G. Strangman, D. A. Boas, J. P. Sutton, Non-invasive neuroimaging using near-infrared light, *Biol Psychiatry*, Vol. 52, Issue 7, 2002, pp. 679-693.
- [2]. C. Haisch, R. Niessner, Visualisation of transient processes in biofilms by optical coherence tomography, *Water Research*, Vol. 41, Issue 11, 2007, pp. 2467-2472.
- [3]. S. J. Carey, H. McCann, F. P. Hindle, K. B. Ozanyan, D. E. Winterbone, E. Clough, Chemical species tomography by near infra-red absorption, *Chemical Engineering Journal*, Vol. 77, Issues 1-2, 2000, pp. 111-118.
- [4]. A. H. Hielscher, A. D. Klose, A. K. Scheel, B. Moa-Anderson, M. Backhaus, U. Netz, J. Beuthan, Laser optical tomography for imaging of rheumatoid finger joints, *Physics in Medicine and Biology*, Vol. 49, 2004, pp. 1147-1163.
- [5]. J.-B. Kim, S.-H. Jung, J.-S. Kim, Study on industrial gamma ray CT with a single source-detector pair, *Nuclear Engineering and Technology*, Vol. 38, Issue 4, 2006, pp. 383-390.
- [6]. T. S. Yeh, S. S. Tseng, A low cost LED based spectrometer, *Journal of the Chinese Chemical Society*, Vol. 53, 2006, pp. 1067-1072.
- [7]. Q. Zhang, H. Jiang, Three-dimensional diffuse optical imaging of hand joints: System description and phantom studies, *Optics and Lasers in Engineering*, Vol. 43, 2005, pp. 1237- 1251.
- [8]. A. K. Scheel, M. Backhaus, A. D. Klose, B. Moa-Anderson, U. J. Netz, K.-G. A. Hermann, J. Beuthan, G. A. Müller, G. R. Burmester, A. H, First clinical evaluation of sagittal laser optical tomography for detection of synovitis in arthritic finger joints, *Annals of the Rheumatic Diseases*, Vol. 64, 2005, pp. 239-245.
- [9]. U. Netz, J. Beuthan, H.-J. Cappius, H.-C. Koch, A. D. Klose, A. H. Hielscher, *Med. Laser. Appl*, Vol. 16, 2002, pp. 306.

- [10].Y. Watanabe, T Yuasa, T. Akatsuka, B. Devaraj, H. Inaba, Enhancement of laser CT image contrast by correction of artefacts due to surface effects, *Optics Express*, Vol. 3, No. 3, 1998, pp. 104-110.
- [11].V. Thavavel, R. Murugesan, Regularized computed tomography using complex wavelets, *International Journal of Magnetic Resonance Imaging*, 2007, Vol. 01, No. 01, pp. 027-032.
- [12].M. Gombia, D. Bollini, J. E. Fernandez, M. Gambaccini, V. Molinari, Improving tomographic images with a filtered projection in real space, *Radiation Physics and Chemistry*, Vol. 61, No. 3, 2001, pp. 451-453.

2010 Copyright ©, International Frequency Sensor Association (IFSA). All rights reserved.
(<http://www.sensorsportal.com>)

**Easy and quick
sensors systems development**

**Evaluation Kit CD
EVAL UFDC-1/UFDC-1M-16**

International Frequency
Sensor Association
IFSA

OPTYS Corporation
**OPTYS
CORPORATION**

- 16 measuring modes
- Frequency range from 0.05 Hz up to 7.5 MHz (120 MHz)
- Programmable accuracy from 1 % up to 0.001 %
- RS232 (USB optional)

sales@sensorsportal.com
http://www.sensorsportal.com/HTML/E-SHOP/PRODUCTS_4/Evaluation_board.htm

Guide for Contributors

Aims and Scope

Sensors & Transducers Journal (ISSN 1726-5479) provides an advanced forum for the science and technology of physical, chemical sensors and biosensors. It publishes state-of-the-art reviews, regular research and application specific papers, short notes, letters to Editor and sensors related books reviews as well as academic, practical and commercial information of interest to its readership. Because it is an open access, peer review international journal, papers rapidly published in *Sensors & Transducers Journal* will receive a very high publicity. The journal is published monthly as twelve issues per annual by International Frequency Association (IFSA). In addition, some special sponsored and conference issues published annually. *Sensors & Transducers Journal* is indexed and abstracted very quickly by Chemical Abstracts, IndexCopernicus Journals Master List, Open J-Gate, Google Scholar, etc.

Topics Covered

Contributions are invited on all aspects of research, development and application of the science and technology of sensors, transducers and sensor instrumentations. Topics include, but are not restricted to:

- Physical, chemical and biosensors;
- Digital, frequency, period, duty-cycle, time interval, PWM, pulse number output sensors and transducers;
- Theory, principles, effects, design, standardization and modeling;
- Smart sensors and systems;
- Sensor instrumentation;
- Virtual instruments;
- Sensors interfaces, buses and networks;
- Signal processing;
- Frequency (period, duty-cycle)-to-digital converters, ADC;
- Technologies and materials;
- Nanosensors;
- Microsystems;
- Applications.

Submission of papers

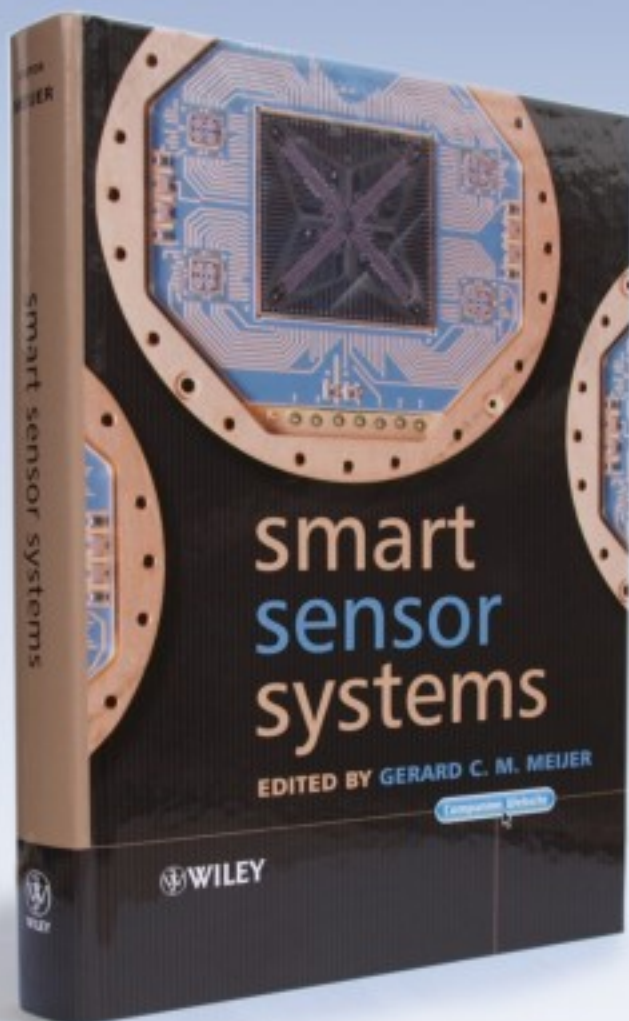
Articles should be written in English. Authors are invited to submit by e-mail editor@sensorsportal.com 8-14 pages article (including abstract, illustrations (color or grayscale), photos and references) in both: MS Word (doc) and Acrobat (pdf) formats. Detailed preparation instructions, paper example and template of manuscript are available from the journal's webpage: <http://www.sensorsportal.com/HTML/DIGEST/Submission.htm> Authors must follow the instructions strictly when submitting their manuscripts.

Advertising Information

Advertising orders and enquires may be sent to sales@sensorsportal.com Please download also our media kit: http://www.sensorsportal.com/DOWNLOADS/Media_Kit_2009.pdf

 **WILEY**
1807-2007

KNOWLEDGE FOR GENERATIONS



'Written by an internationally-recognized team of experts, this book reviews recent developments in the field of smart sensors systems, providing complete coverage of all important systems aspects. It takes a multidisciplinary approach to the understanding, design and use of smart sensor systems, their building blocks and methods of signal processing.'



Order online:

http://www.sensorsportal.com/HTML/BOOKSTORE/Smart_Sensor_Systems.htm

www.sensorsportal.com