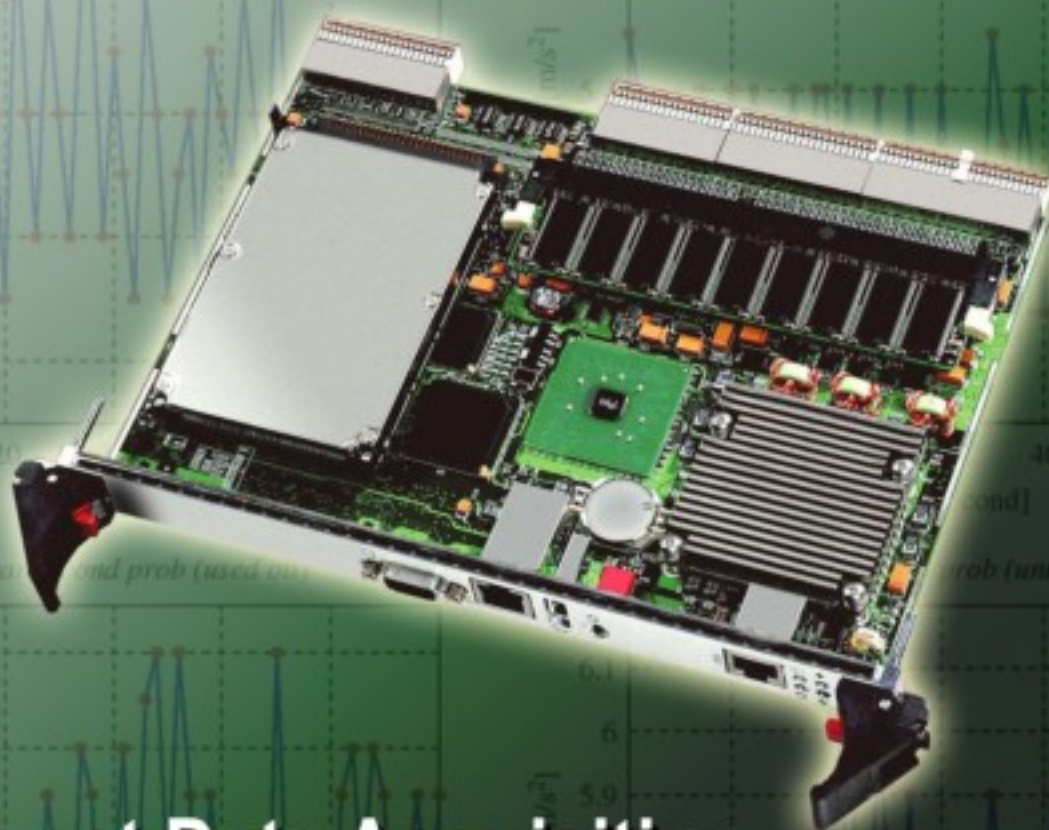


ISSN 1726-5479

SENSORS & TRANSDUCERS

11

vol. 16
Special
/12



**Intelligent Data Acquisition
and Information Process Technologies
and Their Applications**

International Frequency Sensor Association Publishing



Guest Editors: Gongfa Li, Tinggui Chen and Hegen Xiong

Editors for Western Europe

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

Editors for North America

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

Editor South America

Costa-Felix, Rodrigo, Inmetro, Brazil

Editor for Eastern Europe

Sachenko, Anatoly, Ternopil State Economic University, Ukraine

Editor for Asia

Ohyama, Shinji, Tokyo Institute of Technology, Japan

Editor for Africa

Maki K.Habib, American University in Cairo, Egypt

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, Karthikeyan, 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, Vygtantas, Kaunas University of Technology, Lithuania
Avachit, Patil Lalchand, North Maharashtra University, India
Ayeshe, Aladdin, De Montfort University, UK
Azamimi, Azian binti Abdullah, Universiti Malaysia Perlis, Malaysia
Bahreyni, Behraad, University of Manitoba, Canada
Baliga, Shankar, B., General Motors 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
Benachiba, Chellali, Université 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
Bouchikhi, Benachir, University Moulay Ismail, Morocco
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
Calvo-Gallego, Jaime, Universidad de Salamanca, Spain
Campanella, Luigi, University La Sapienza, Italy
Carvalho, Vitor, Minho University, Portugal
Cecelja, Franjo, Brunel University, London, UK
Cerdà 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, N.I. Center for Higher Education, (N.I. University), 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, Université 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
Dighavkar, C. G., M.G. Vidyamandir's L. V.H. College, India
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, Intersema 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
Granel, 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 Alcala, Spain
Hernandez, Wilmar, Universidad Politecnica de Madrid, Spain
Homontovschi, 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
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
Khelfaoui, Rachid, Université de Bechar, Algeria
Khan, Asif, Aligarh Muslim University, Aligarh, India
Kim, Min Young, Kyungpook National University, Korea South
Ko, Sang Choon, Electronics. and Telecom. Research Inst., Korea South
Kotulski, Malgorzata, Wroclaw University of Technology, Poland
Kockar, Hakan, Balikesir University, Turkey
Kong, Ing, RMIT University, Australia
Kratz, Henrik, Uppsala University, Sweden

Krishnamoorthy, Ganesh, University of Texas at Austin, USA
Kumar, Arun, University of Delaware, Newark, 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, Fengyuan (Thomas), Purdue University, USA
Li, Genxi, Nanjing University, China
Li, Hui, Shanghai Jiaotong University, China
Li, Sihua, Agiltron, Inc., USA
Li, Xian-Fang, Central South University, China
Li, Yuefa, Wayne State University, USA
Liang, Yuanchang, University of Washington, USA
Liawruangrath, Saisunee, 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
Malyshev, V.V., National Research Centre 'Kurchatov Institute', Russia
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
Mishra, Vivekanand, National Institute of Technology, India
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
Mrad, Nezhil, Defence R&D, Canada
Mulla, Imtiaz Sirajuddin, National Chemical Laboratory, Pune, India
Nabok, Aleksey, Sheffield Hallam University, UK
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
Passaro, Vittorio M. N., Politecnico di Bari, Italy
Penza, Michele, ENEA C.R., Italy
Pereira, Jose Miguel, Instituto Politecnico de Seteбал, 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
Pugno, Nicola M., Politecnico di Torino, Italy
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
Raoof, Kosai, Joseph Fourier University of Grenoble, France
Rastogi Shiva, K., University of Idaho, USA
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 Cataluña, Spain
Rothberg, Steve, Loughborough University, UK
Sadana, Ajit, University of Mississippi, USA
Sadeghian Marnani, Hamed, TU Delft, The Netherlands
Sapozhnikova, Ksenia, D.I.Mendeleyev Institute for Metrology, Russia
Sandacci, Serghei, Sensor Technology Ltd., UK
Saxena, Vibha, Bhabha Atomic Research Centre, Mumbai, India
Schneider, John K., Ultra-Scan Corporation, USA
Sengupta, Deepak, Advance Bio-Photonics, India
Seif, Selemeni, Alabama A & M University, USA
Seifter, Achim, Los Alamos National Laboratory, USA
Shah, Kriyang, La Trobe University, Australia
Sankarraj, Anand, Detector Electronics Corp., USA
Silva Girao, Pedro, Technical University of Lisbon, Portugal
Singh, V. R., National Physical Laboratory, India
Slomovitz, Daniel, UTE, Uruguay
Smith, Martin, Open University, UK
Soleimanpour, Amir Masoud, University of Toledo, USA
Soleymannpour, Ahmad, University of Toledo, USA
Somani, Prakash R., Centre for Materials for Electronics Technol., India
Sridharan, M., Sastra University, India
Srinivas, Talabattula, Indian Institute of Science, Bangalore, India
Srivastava, Arvind K., NanoSonix Inc., USA
Stefan-van Staden, Raluca-Ioana, University of Pretoria, South Africa
Stefanescu, Dan Mihai, Romanian Measurement Society, Romania
Sumriddetchka, Sarun, National Electronics and Comp. Technol. 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, Industr. 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
Thirunavukkarasu, I., Manipal University Karnataka, India
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
Vanga, Raghav Rao, Summit Technology Services, Inc., USA
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 Shiyong University, China
Wang, Kedong, Beihang University, China
Wang, Liang, Pacific Northwest National Laboratory, 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, Sen, Drexel University, USA
Xu, Tao, University of California, Irvine, USA
Yang, Dongfang, National Research Council, Canada
Yang, Shuang-Hua, Loughborough University, UK
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 16
Special Issue
November 2012

www.sensorsportal.com

ISSN 1726-5479

Research Articles

Foreword

Gongfa Li, Tinggui Chen, Hegen Xiong..... 1

Research of a Novel Attitude Regulating System of Autonomous Underwater Glider

Rong Liu, Jie Yu 1

Study on the Vibration of the 1700 Four Rollers Rolling Mill

Zehao Wu, Gongfa Li, Po Gao, Yuan He, Dawei Tan..... 11

The Design of Wireless Sensor Application System Based on Internet of Things

Zhang Ye, Zhang Feng, You Fei 18

Design and Simulation of the Air Compressor Control System

Yuan He, Gongfa Li, Po Gao, Zehao WU and Cunyuan Li..... 27

Precise Time Synchronization Technology for Distributed Automated Test System

Yan Xu, Ming Li, and Jiangtao Dong..... 35

FEM-based Simulation of Stress Distribution in U71Mn Heavy Rail during Quenching

Siqiang Xu, Jianyi Kong, Gongfa Li, Jintang Yang, Hegen Xiong and Guozhang Jiang 43

LTS: An Improved Self-Adaptive Data Replication Strategy for File Sharing in Grid

Liang Hu, Jia Zhao, Xiaodong Fu, Lin Lin, XJianfeng Chu 52

Influence of Expansion Joint of Bottom Lining in Ladle Composite Construction Body on Thermal Stress

Guozhang Jiang, Gongfa Li, Jianyi Kong, Liangxi Xie and Siqiang Xu..... 61

Numerical Simulation of the Gap Flow Field for CEDMMG Compound Machining Engineering Ceramics

Renjie Ji, Yonghong Liu, Chao Zheng, Fei Wang, Yanzhen Zhang, Yang Shen, Baoping Cai..... 68

Coke Oven Heating Model of Fuzzy Intelligent Control System

Guozhang Jiang, Gongfa Li, Jianyi Kong and Liangxi Xie 75

Three-Dimensional Model and Test Analysis of the 60t Converter

Po Gao, Gongfa Li, Zehao Wu, Yuan He, Ke Zhang 84

A Multi-pipe and Multi-address Switching Wireless Network for Distributed Seismic Data Acquisition System

Li Huailiang, Tuo Xianguo, Zhu Lili..... 92

Remote Monitoring and Diagnosis System of Rolling Mill Transmission System

Gongfa Li, Yuesheng Gu, Zehao Wu, Han Xiao, Guozhang Jiang, Jianyi Kong, Liangxi Xie and Siqiang Xu 101

Study on Frequency Division Technique of Photoelectric Encoder <i>Shi-xiong Zhang</i>	108
Job-shop Scheduling Problem Based on Particle Swarm Optimization Algorithm <i>Ying Sun and Hegen Xiong</i>	116
Wireless Sensor Network Data Fusion Algorithm Based on Neural Network in the Area of Agriculture <i>Yi Zhou, Gelian Song, Maohua Wang.....</i>	128
Optimal Design of Gear Based on Quantum Genetic Algorithm <i>Ying Sun and He-gen Xiong</i>	137
Independent Axiom-based Robust Design for Nonlinear System <i>Xianfu Cheng.....</i>	144
Development of a New Kind of Multihole Cylindrical Electrode Used for Electrical Discharge Milling <i>Fei Wang, Yonghong liu, Renjie Ji, Yanzhen Zhang, Zemin Tang, Xiangzhen Han.....</i>	152
Energy Efficiency Evaluation of Iron and Steel Enterprise <i>Guozhang Jiang, Gongfa Li, Jianyi Kong and Liangxi Xie</i>	161
Classification Model of Traffic Emergency Response to Urban Emergency <i>Yaqin He, Jie Li</i>	169
Modeling the Machining Parameters in End Electric Discharge Milling of Silicon Carbide Ceramic <i>Renjie Ji, Yonghong Liu, Yanzhen Zhang, Fei Wang, Chao Zheng, Yang Shen.....</i>	179
Testability Analysis of Inertial Measure Unit Based on Multi-signal Model <i>Xing He, Hongli Wang, Jinghui Lu.....</i>	188
Vibration Model of Pipe Conveying Fluid Considered Fluid Structure Interaction <i>Gongfa Li, Yuesheng Gu, Zehao Wu, Han Xiao, Jianyi Kong, Guozhang Jiang, Liangxi Xie, Li Hu and Siqiang Xu</i>	197
Optimization SVM Algorithm and it's Application in Agricultural Science and Technology Project Classification <i>Hui Feng Yan, Wei Feng Wang, Qin Mao, Ming Liang Zhou</i>	203
Accuracy of Experimental Platform of Controlled Five-bar Linkages <i>Li Pan.....</i>	210
Analysis on Sliding Velocity of Cycloid Gear Pair during Meshing <i>Shuyan. Wang, Guizhong Tian, Xujun Jiang.....</i>	218
Intelligent Diagnosis of Coke Oven Heating Production <i>Gongfa Li, Yuesheng Gu, Jianyi Kong, Guozhang Jiang and Liangxi Xie</i>	226
Adaptive Fuzzy Control of Aircraft ABS Based on Runway Identification <i>Hua-wei Wu, Te-fang Chen, Wei-ming Huang.....</i>	233
The Total Factor Productivity Growth of the Municipal Water Industry in China <i>Wang Fen</i>	243
Research on Attainable Moment Subset of Singular Over-actuated System <i>Shi Jingping, Qu Xiaobo.....</i>	252
Finite Element Analysis of Vane Seals <i>Guozhang Jiang, Li Zhao, Jianyi Kong, Gongfa Li, Liangxi Xie</i>	261
	269

Application of Multi-factor Fuzzy Comprehensive Evaluation in Stability of Surrounding Rock of Underground Engineering

Jinglong Li, Jiachun Li, Shuchen Li.....

Jackknife Control on Tractor Semi-trailer during High Speed Curve Driving

Shuwen Zhou and Siqi Zhang 277

Simulation and Experiment Research on Deforming Force of Slab Cold Roll-beating

Mingshun Yang, Yan Li, Jianming Zheng, Qilong Yuan..... 285

Research on Organizational Culture and Resources Integration Model Based on MICK-4FI

Yan Zhan, Jiansha Lu and Shiyun Li..... 295

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>

International Frequency Sensor Association (IFSA).



International Frequency Sensor Association Publishing Call for Books Proposals

Sensors, MEMS, Measuring instrumentation, etc.



Benefits and rewards of being an IFSA author:

1

Royalties

Today IFSA offers most high royalty in the world: you will receive 50 % of each book sold in comparison with 8-11 % from other publishers, and get payment on monthly basis compared with other publishers' yearly basis.

2

Quick Publication

IFSA recognizes the value to our customers of timely information, so we produce your book quickly: 2 months publishing schedule compared with other publishers' 5-18-month schedule.

3

The Best Targeted Marketing and Promotion

As a leading online publisher in sensors related fields, IFSA and its Sensors Web Portal has a great expertise and experience to market and promote your book worldwide. An extensive marketing plan will be developed for each new book, including intensive promotions in IFSA's media: journal, magazine, newsletter and online bookstore at Sensors Web Portal.

4

Published Format: printable pdf (Acrobat).

When you publish with IFSA your book will never go out of print and can be delivered to customers in a few minutes.

You are invited kindly to share in the benefits of being an IFSA author and to submit your book proposal or/and a sample chapter for review by e-mail to editor@sensorsportal.com. These proposals may include technical references, application engineering handbooks, monographs, guides and textbooks. Also edited survey books, state-of-the art or state-of-the-technology, are of interest to us. For more detail please visit: http://www.sensorsportal.com/HTML/IFSA_Publishing.htm



The Fourth International Conference on Sensor Device Technologies and Applications

SENSORDEVICES 2013

25 - 31 August 2013 - Barcelona, Spain

Tracks: Sensor devices - Ultrasonic and Piezosensors - Photonics - Infrared - Gas Sensors - Geosensors - 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 - Sensors and Transducers for Non-Destructive Testing

Deadline for papers: 30 March 2013

<http://www.iaria.org/conferences2013/SENSORDEVICES13.html>



The Seventh International Conference on Sensor Technologies and Applications

Deadline for papers:
30 March 2013

SENSORCOMM 2013

25 - 31 August 2013 - Barcelona, Spain

Tracks: Architectures, protocols and algorithms of sensor networks - Energy, management and control of sensor networks - Resource allocation, services, QoS and fault tolerance in sensor networks - Performance, simulation and modelling of sensor networks - Security and monitoring of sensor networks - Sensor circuits and sensor devices - Radio issues in wireless sensor networks - Software, applications and programming of sensor networks - Data allocation and information in sensor networks - Deployments and implementations of sensor networks - Under water sensors and systems - Energy optimization in wireless sensor networks

<http://www.iaria.org/conferences2013/SENSORCOMM13.html>



The Sixth International Conference on Advances in Circuits, Electronics and Micro-electronics

CENICS 2013

25 - 31 August 2013 - Barcelona, Spain

Deadline for papers: 30 March 2013

Tracks: Semiconductors and applications - Design, models and languages - Signal processing circuits - Arithmetic computational circuits - Microelectronics - Electronics technologies - Special circuits - Consumer electronics - Application-oriented electronics

<http://www.iaria.org/conferences2013/CENICS13.html>

Simulation and Experiment Research on Deforming Force of Slab Cold Roll-beating

Mingshun YANG, Yan LI, Jianming ZHENG, Qilong YUAN

School of Mechanical and Precision Instrument Engineering

Xi'an University of Technology, Xi'an, 710048, China

Tel.: +86-029-82312776

E-mail: Yangmingshun@xaut.edu.cn

Received: 11 September 2012 /Accepted: 11 October 2012 /Published: 20 November 2012

Abstract: Firstly, the principle of slab cold roll-beating is simply described. Then finite element model of slab cold roll-beating is established with ABAQUS and the simulation is completed. According to the simulation results, the changes of deforming force and the influence of technological parameters on the deforming force are analyzed. Finally, in combination with cold roll-beating experiments, the comparative analysis between the simulation and the experiment results is completed to test the validity of the finite element model. *Copyright* © 2012 IFSA.

Keywords: Cold roll-beating; Deforming force, Finite element simulation, Technological parameter, Experimental study.

1. Introduction

With the increasingly drastic marketing competition and fast updating of products, many drawbacks such as long time production preparation, equipment of large tonnage, poor processing flexibility and high manufacturing costs by the traditional die forming process are reflected day by day [1]. In order to adapt to the market demand of the rapid product updating in modern manufacturing field, many scholars committed to the new dieless (or flexible die) precise plastic forming process combining with high speed and efficient. Because of the features of its dieless unconstrained, partial load and low energy consumption, single point cumulative incremental forming has become increasingly attractive as new precise plastic forming technology [2-5].

High speed cold roll-beating is of great concern as dieless unconstrained incremental forming technology. During the initial research period, the exploration for the forming principle, finite element analysis, dynamic simulation and prototype equipment are conducted [6-8], which verified the feasibility of the cold roll-beating forming process, but further detailed study is still needed to get the variation of the deforming force which affects the metal flow mechanism and geometry of the forming surface.

Deforming force of cold roll-beating directly affects metal flow of forming process, thereby affecting geometry of the forming surface, and will influence part quality finally. Thus, deforming force plays an important role in the research of cold roll-beating forming as a key factor affecting forming mechanism and precision [4, 5].

In this paper, ABAQUS is applied to simulate the forming process of cold roll-beating. Combined with experimental study, changes of deforming force in forming process and the effects of process parameters on the deforming force are revealed which not only provide the basis for the select of process parameters and the control of forming process, but also lay theoretical and applied foundation for further study on high-speed cold roll-beating of function surface and the technique of single point dieless unconstrained accumulation forming.

2. Principle of Cold Roll-beating

High speed precision cold roll-beating is typical of precise plastic forming technology. In the forming process, by taking advantage of the inherent plasticity of rough material at ordinary temperatures, the roller with certain shape and high speed rotation, roll-presses and beats the rough blank intermittently, forcing the local metal of the rough surface flow, plastic deformations of continuous accumulate to form the profile of the required part [8].

The working principle of slab cold roll-beating is shown in the Fig. 1. The rollers of certain shape are mounted on a rotating shaft with high speed evenly. In the cold roll-beating forming, slab blank feeds horizontally; the rollers with high speed rotation beat the slab blank intermittently; metal materials of slab blank surface move a certain displacement due to high speed impact of the rollers. The roller rotates around its own axis the moment the roller contacts with the slab because of the action of the friction between them, thereby the rolling between the roller and the slab is ensured. The action is repeated until the specific shape is formed eventually in the slab blank to satisfy the predetermined depth of cut (rolling reduction).

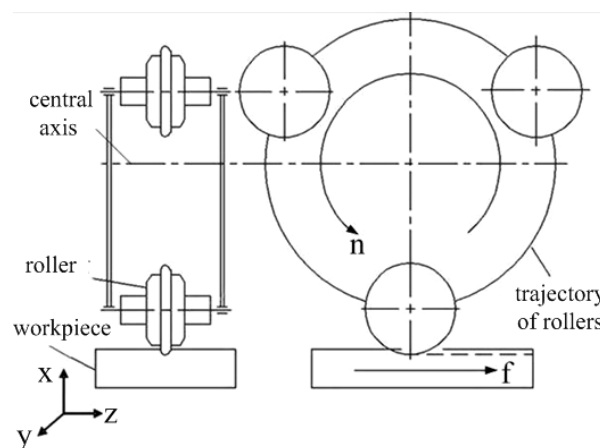


Fig. 1. Principle of slab cold roll-beating forming.

According to the direction of metal flow, the deforming force of cold roll-beating is divided into CFN_x , CFN_y and CFN_z . The paper focuses on the changes of radial deforming force (CFN_x), and the effects of process parameters (rolling reduction, feed rate and different speed) on the deforming force.

3. Slab Cold Roll-beating FEA Model

To ensure that the numerical simulation goes smoothly and computational efficiency, it is necessary to simply FEA model and initial conditions. The influence of the roller rotation is ignored, and only the roller model used to cold roll beating forming the roll tooth is established [9]. The deformation body blank adopts the square slab. The material is 45# steel.

When meshing, the roller is bound into a rigid body, and its own deformation is ignored. As the plastic deformation body the slab blank adopts the element type of C3D8R. The high density meshing method is selected in the contact area between the roller and the blank. The surface to surface contact between the rigid body and the deformation body is applied to define the contact of the roller and the blank [10, 11]. For the boundary conditions, the blank bottom is restricted and only the constant feeding velocity in the forward direction is maintained. While dealing with the roller constraints only the quality characteristic and the moment of inertia in the coordinate are given to its reference point, three translational degrees of freedom and the x- and z- rotational degrees of freedom are restricted, and its y- constant revolution speed is defined. The final finite element simulation model is shown in the Fig. 2.

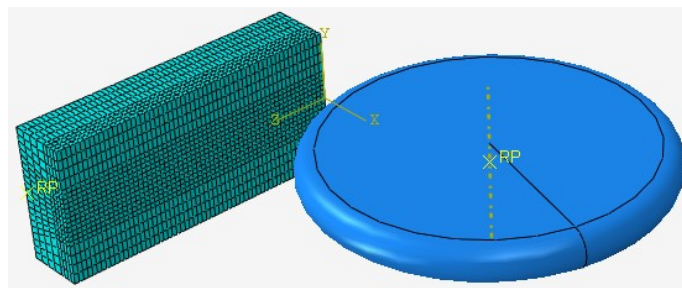


Fig. 2. Finite element model of cold roll-beating shaping.

4. Analysis of Deforming Force Simulation

According to the simulation results, the change of deforming force is analyzed, the single factor testing program is applied to study the influence of the process parameters such as rolling reduction, feed rate and rolling speed to the deforming force.

4.1. Changing Law of Deforming Force in Cold-rolling Process

The rolling reduction is set as 0.5 mm, the feeding rate is 490 mm/min, and the rolling speed is 2000 rpm. The radial deforming force change curve in the slab cold roll beating process, obtained in the simulation, is illustrated in the Fig. 3.

As shown in the Fig. 3, the whole process of the blank forming period is divided into the beginning stage, the steady stage and the ending stage. During the process the deforming force increases initially, then becomes steady and decreases at last. As a single beating process, the deforming force illustrates the same change tend as increasing initially and decreasing finally. Meanwhile the simulation results show

that the cold roll beating forming is a periodically loading and unloading process and the peaks and the troughs appear in a certain law.

As can be seen from the deforming force in the steady stage, the slab cold roll beating process is a periodically beating process (the beating period is 0.01 s), which indicates that cold roll beating is a process during which the blank is loaded locally, beat repeatedly and then the deformation of the blank cumulates step by step. The single beating force from the simulation is shown in the Fig. 4.

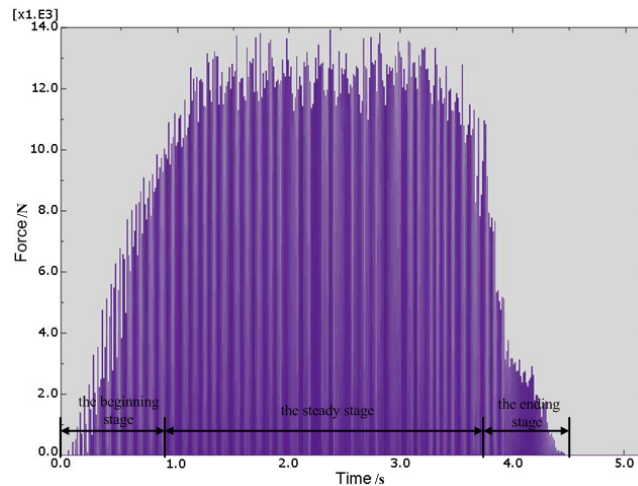


Fig. 3. Deforming force of cold roll-beating forming process.

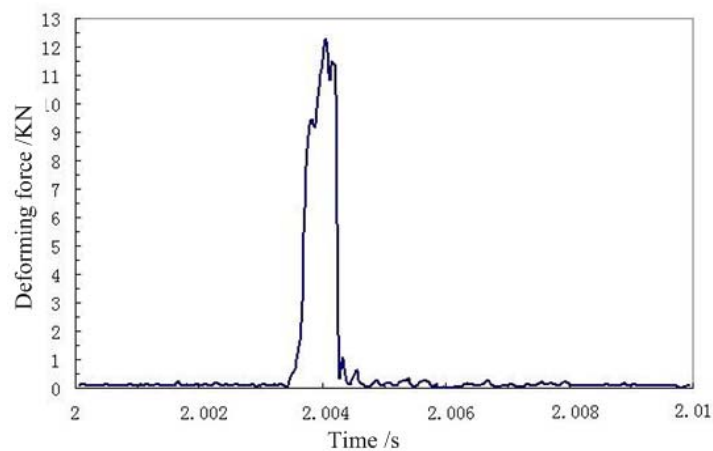


Fig. 4. Curve of forces in a cold roll-beating process.

As shown in the Fig. 4, the radial roll beating deforming force in the high-speed cold roll beating process can be generally divided into the ascent (loading) stage and the descent (unloading) stage. In the ascent initial stage the average gradient and the deforming force appear smaller. Because this is the first time that the roller and the blank contact, and the larger contact width makes the plastic deformation resistance larger, thus making the relative deformation velocity lower. In the descent stage the curve is steeper and the deformation velocity is higher. This is because the contact area is the loaded area in which area the needed deforming force is smaller than the initial force, making the deformation easier. The maximum deforming force in a single cold roll beating force process is 12.45 kN.

4.2. Influence of Rolling Reduction on Deforming Force

When the rolling reduction and the blank feeding rate are given, the single factor of the feeding depth of the roller, named as the rolling reduction, will influence the cold roll beating forming process. The rolling speed is $v=1500$ r/min $=157.079$ rad/s, and the blank feeding rate is $f=490$ mm/min. When the rolling reduction varies, the mean value of the maximum radial deforming force of different materials in the steady beating stage, obtained from the simulation, is shown in Table 1. And then the least square method is applied to fit the simulation value. The results are illustrated in the Fig. 5.

Table 1. Deforming force (/KN) under different rolling reduction.

Rolling reduction	0.1	0.3	0.5	0.6	0.8	1	1.2	1.5
Cu	1.075	2.26	3.502	3.59	4.33	4.87	5.41	5.55
45# steel	4.1	8.615	12.45	13.6	15.25	16.5	17.355	20

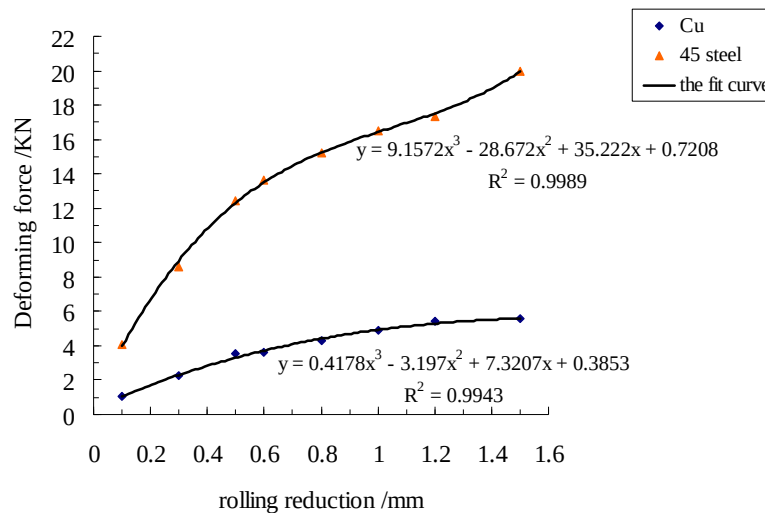


Fig. 5. Deforming force under different rolling reduction.

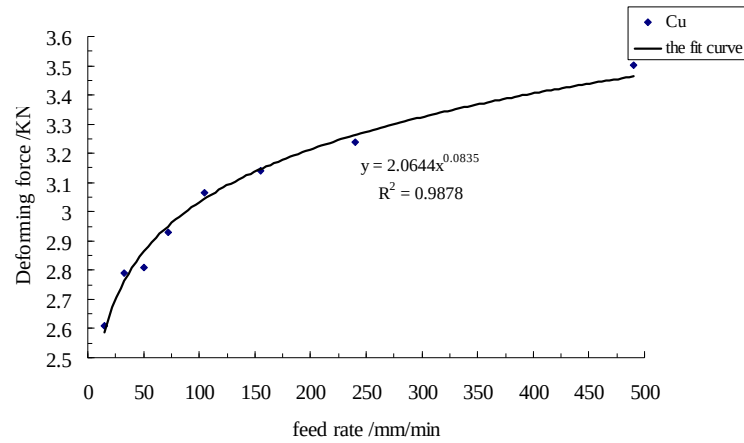
As can be seen from the Fig. 5, different reductions will have a great impact on the deforming force in the forming process. As the reduction increases, the deforming force increases gradually. While the contact area between the roller and the blank is larger, the more metal material produces great deformation in a short time. And the material relatively flows more difficult, thus leading to the deforming force increase. The smaller reduction makes the smaller deformation of the material. The time of the material flow is relatively more abundant and the deformation is well-distributed. Thus the material deformation has a smaller impact on the product performance. The forming quality of the blank, especially the appearance quality, is better.

4.3. Influence of Feed Rate on Deforming Force

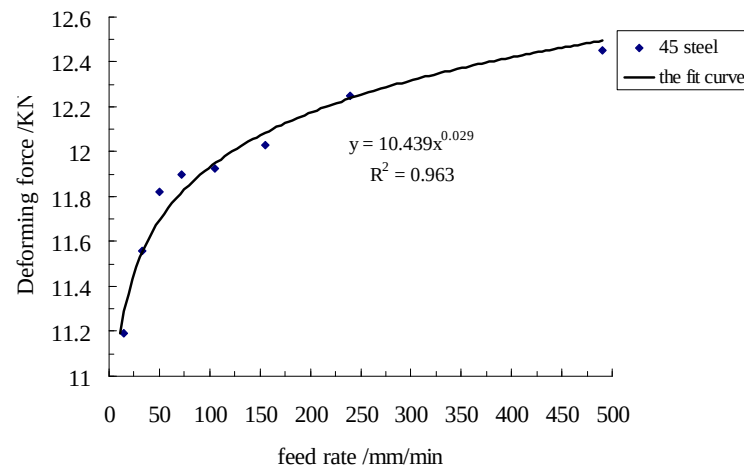
When the rolling speed and the rolling reduction are given, the single factor of the blank feeding rate will influence the cold roll beating forming process. The rolling reduction is $h=0.5$ mm, and the rolling speed is $v=1500$ rpm. The deforming force change with the blank feeding rate of Cu, hard aluminum alloy LY12 and 45# steel are shown in Table 2. And the deforming force change curves of Cu and 45# steel are illustrated in the Fig. 6.

Table 2. Deforming force under different feed rate.

Feed rate	15	33	50	72	105	155	240	490
Cu	2.61	2.79	2.81	2.93	3.064	3.139	3.24	3.502
45#	11.19	11.56	11.79	11.86	11.925	12.03	12.25	12.45



(a)



(b)

Fig. 6. Deforming force under different feed rate.

As the feeding rate increases, the deformation increases, the resistance arising while the blank produce plastic deformation increases, and the metal flow becomes difficult, which leads to the roll beating force in the roll beating process increase. When the feeding rate is smaller, the deformation is smaller and the deformation cannot penetrate into the internal of the blank, making the metal deformation heterogeneity intensified and thus influencing the forming quality. But from the simulation result, the effect of feed rate on deforming force is relatively small, compared to the influence of rolling reduction. Therefore, in the equipment permit, large feeding can be put to use from the view of improving productivity.

4.4. Influence of Speed on Deforming Force

Rolling reduction is set as 0.5 mm and the feed rate is 490 mm/min. The values of deforming force and deforming curve of Cu duralumin alloy and 45# steel are shown in Table 3 and the Fig. 7.

Table 3. Deforming force (KN) under different speed (rpm) of Cu and 45# steel.

Speed	500	1000	2000	3000	4000	5000	6000
Cu	3.56	3.531	3.62	3.87	3.774	3.57	3.52
Speed	1000	1500	2000	2400	2500	3000	4000
45#	11.93	12.45	12.48	11.73	11.59	11.455	11.38

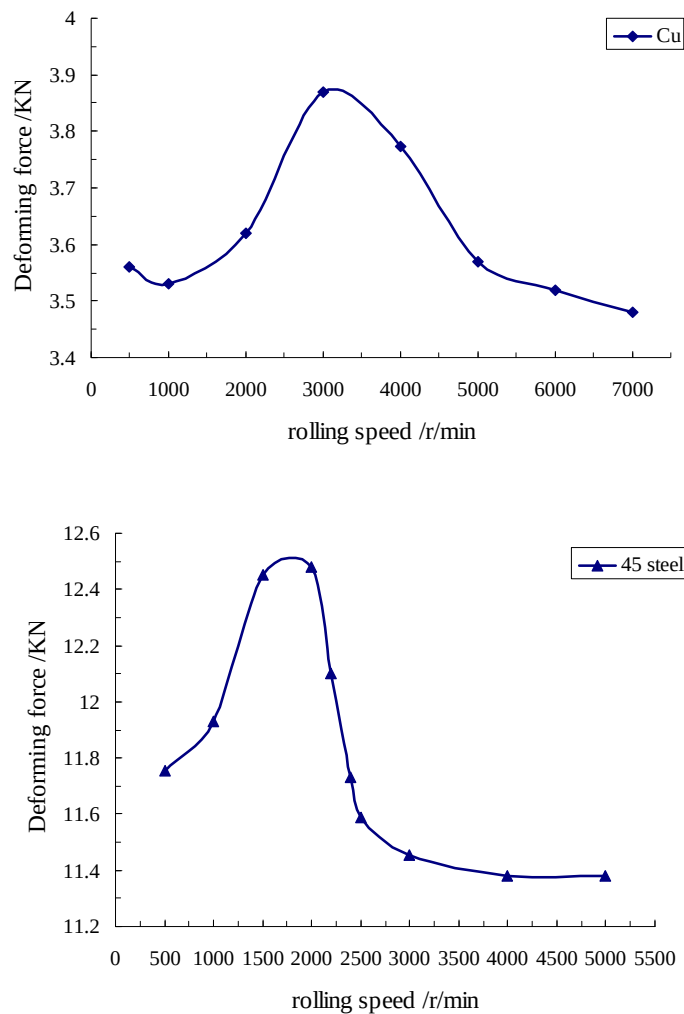


Fig. 7. Deforming force under different speed.

As is shown in the Fig. 7, deforming force increases at the beginning, then decreases with the rise of the rolling speed. At the stage of increasing, deforming force gets bigger and bigger due to significant impact of rollers. With the increasing of the rolling speed, deformation velocity increases, which results in the increase of the deformation resistance and the deforming force. Meanwhile, feed per tooth of the roller and the flow of metal decrease, which results in the decrease of the deforming force.

As the rolling speed varies, the roll beating deforming force curves of the two materials have a cusp at the relevant rolling speed. The loading process of the slab cold roll beating forming movement is transient and dynamic process. As the rolling speed increase, the dynamic impact effect plays a dominant role. At the cusp the loading frequency is close to its own frequency, which makes its amplitude reach the maximum, thus the roll beating deforming force appears the maximum.

5. Experimental Analysis

In order to verify the reliability and accuracy of the finite element simulation, the paper taking copper for test materials, cold roll-beating is carried out based on the two experiment parameters (rolling reduction, feed rate and rolling speed). The comparative analysis of the finite element simulation and the measured values is made.

The cold roll-beating forming experiments are carried out with self developed cold roll-beating equipment. As is shown in the Fig. 8, measuring system of deforming force consists of special strain dynamometer and NEC data logger RA1200.



Fig. 8. Test equipment of cold roll-beating.

Sampling frequency is set as 5000Hz in measurement process, Parameters such as rolling reduction, feed rate and rolling speed are corresponding to the values of finite element simulation. Taken the peak average of the radial deforming force at the stage of stable cold roll-beating forming as the measured values, comparison curves between the simulation and the measured values are shown in the Fig. 9.

As is shown in the Fig. 9, the simulation curves based on the two parameters agree well with the experiment. Maximum deviation is about 10 %, which shows the rationality and validity of the finite element simulation. rolling reduction, feed rate and rolling speed.

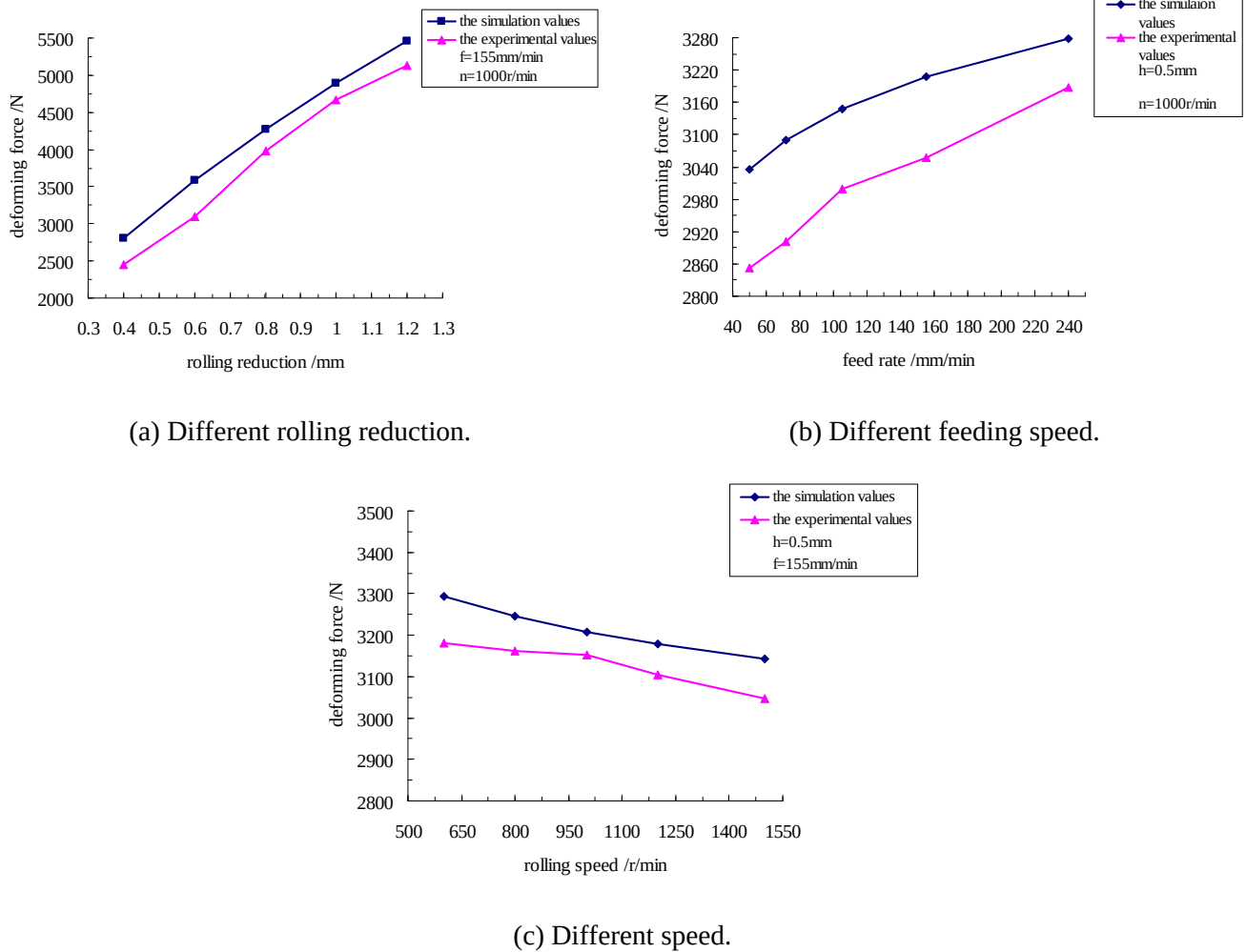


Fig. 9. Comparison between simulation and experiment.

6. Conclusion

FEM of cold roll-beating forming is established with ABAQUS, and the simulation is completed combined with the actual processing. The deforming force of the work-piece in forming process and the effects of process parameters (rolling reduction, feed rate and rolling speed) on the deforming force are analyzed. The forming experiments are carried out with self developed cold roll-beating equipment. The validity of the finite element simulation is verified through the comparisons with the experimental data, which show good agreements with numerical simulation results. The research results laid theoretical and applied foundation for further study on the technique of single point dieless accumulation forming and high-speed cold roll-beating of function surface such as screw, gear and spline.

Acknowledgements

This work was supported by the national nature science foundation of China (NSFC) project [50975229, 51075124], Specialized Research Fund for the Doctoral Program of Higher Education of China [20116118110005], Science& technology project of Shaanxi province, China [2009JQ7003].

References

- [1]. H. Yang, Z. C. Sun, M. Zhan, et al., Advances in control of unequal deformation by locally loading and theories related to precision plastic forming, *Journal of Plasticity Engineering*, Vol. 15, Issue 2, 2008, pp. 6-14.
- [2]. J. Jeswiet, M. Geiger, U. Engel, et al., Metal forming progress since 2000, *CIRP Journal of Manufacturing Science and Technology*, Vol. 1, Issue 1, 2008, pp. 2-17.
- [3]. M. X. Li, N. Y. Min, G. H. An et al, Frontier of Precise Shaping Technology Development, *Chinese Journal of Mechanical Engineering*, Vol. 11, Issue 1-2, 2000, pp. 183-186.
- [4]. K. Jackson, J. Allwood, The mechanics of incremental sheet forming, *Journal of Materials Processing Technology*, Vol. 209, Issue 3, 2009, pp. 1158-1174.
- [5]. A. Petek, B. Jurisevic, K. Kuzman, et al., Comparison of alternative approaches of single point incremental forming processes, *Journal of Materials Processing Technology*, Vol. 209, Issue 4, 2009, pp. 1810-1815.
- [6]. F. K. Cui, Y. Li, Y. W. Zhou, et al., CAD System of Roller for Involute Spline and Simulation of Grinding Process, *Chinese Journal of Mechanical Engineering*, Vol. 41, Issue 12, 2005, pp. 210-215.
- [7]. F. K. Cui, Y. Li, Y. W. Zhou, Technologic Research on Rolling Involute Spline Axis, *Transactions of the Chinese Society for Agricultural Machinery*, Vol. 37, Issue 12, 2006, pp. 189-192.
- [8]. Y. Li, M. S. Yang, B. Li, et al., Dynamics Simulation and Analysis of Lead Screw Cold Roll-Beating, *Journal of Xi'an University of Technology*, Vol. 25, Issue 4, 2009, pp. 383-386.
- [9]. J. I. V. Sena, R. J. Alves de Sousa, R. A. F. Valente, On the use of EAS solid-shell formulations in the numerical simulation of incremental forming processes, *Engineering Computations*, Vol. 28, Issue 3, 2011, pp. 287-313.
- [10]. A. Ghaei, M. R. Movahhedy, A. Karimi Taheri, Finite element modeling simulation of radial forging of tubes without mandrel, *Advances in Production and Processing of Aluminum*, Vol. 29, Issue 4, 2008, pp. 867-872.
- [11]. S. H. Hsiang, S. L. Lin, Modeling and Optimization of Caliber Rolling Process, *Journal of Manufacturing Science and Engineering*, Vol. 129, Issue 1, 2007, pp. 77-83.

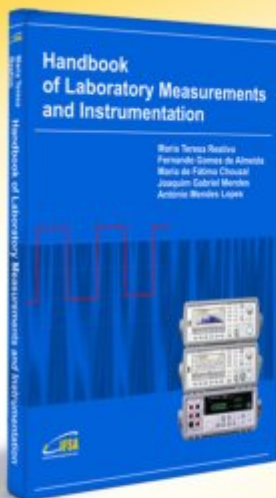
2012 Copyright ©, International Frequency Sensor Association (IFSA). All rights reserved.
(<http://www.sensorsportal.com>)

Promoted by IFSA

**Status of the CMOS Image Sensors Industry
Report up to 2017**

The report describes in detail each application in terms of market size, competitive analysis, technical requirements, technology trends and business drivers.

Order online:
http://www.sensorsportal.com/HTML/CMOS_Image_Sensors.htm



Handbook of Laboratory Measurements and Instrumentation

Maria Teresa Restivo
Fernando Gomes de Almeida
Maria de Fátima Chouzal
Joaquim Gabriel Mendes
António Mendes Lopes

The Handbook of Laboratory Measurements and Instrumentation presents experimental and laboratory activities with an approach as close as possible to reality, even offering remote access to experiments, providing to the reader an excellent tool for learning laboratory techniques and methodologies. Book includes dozens videos, animations and simulations following each of chapters. It makes the title very valued and different from existing books on measurements and instrumentation.



International Frequency Sensor Association Publishing

Order online:

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



International Frequency Sensor Association (IFSA) Publishing

Digital Sensors and Sensor Systems: Practical Design

Sergey Y. Yurish



The goal of this book is to help the practitioners achieve the best metrological and technical performances of digital sensors and sensor systems at low cost, and significantly to reduce time-to-market. It should be also useful for students, lectures and professors to provide a solid background of the novel concepts and design approach.

Book features include:

- Each of chapter can be used independently and contains its own detailed list of references
- Easy-to-repeat experiments
- Practical orientation
- Dozens examples of various complete sensors and sensor systems for physical and chemical, electrical and non-electrical values
- Detailed description of technology driven and coming alternative to the ADC a frequency (time)-to-digital conversion

Formats: printable pdf (Acrobat)
and print (hardcover), 419 pages

ISBN: 978-84-616-0652-8,
e-ISBN: 978-84-615-6957-1

Digital Sensors and Sensor Systems: Practical Design will greatly benefit undergraduate and at PhD students, engineers, scientists and researchers in both industry and academia. It is especially suited as a reference guide for practitioners, working for Original Equipment Manufacturers (OEM) electronics market (electronics/hardware), sensor industry, and using commercial-off-the-shelf components

http://sensorsportal.com/HTML/BOOKSTORE/Digital_Sensors.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 of it is a peer reviewed international journal, papers rapidly published in *Sensors & Transducers Journal* will receive a very high publicity. The journal is published monthly as twelve issues per year by International Frequency Sensor 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. Since 2011 the journal is covered and indexed (including a Scopus, Embase, Engineering Village and Reaxys) in Elsevier products.

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

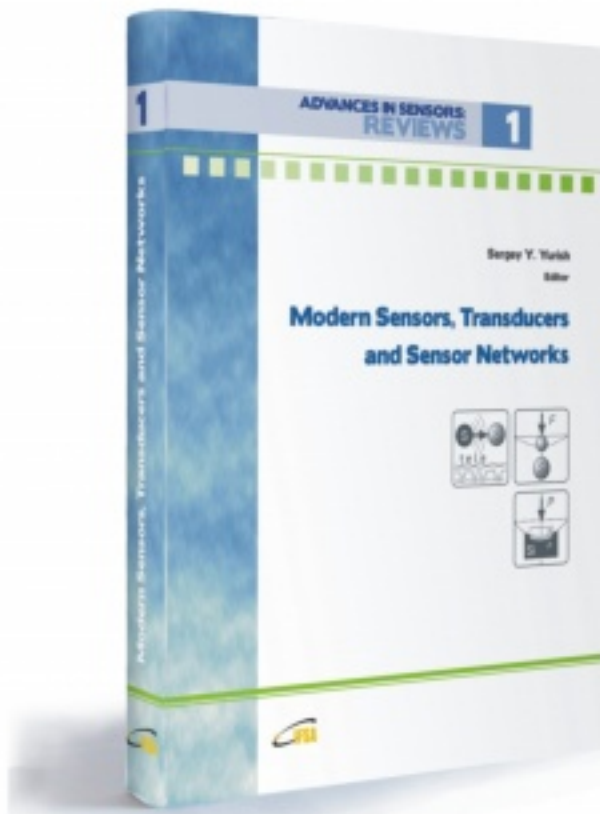
Articles should be written in English. Authors are invited to submit by e-mail editor@sensorsportal.com 8-14 pages article (including abstract, illustrations (color or grayscale), photos and references) in both: MS Word (doc) and Acrobat (pdf) formats. Detailed preparation instructions, paper example 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_2012.pdf

**ADVANCES IN SENSORS:
REVIEWS****1****Sergey Y. Yurish**
Editor

Modern Sensors, Transducers and Sensor Networks



Modern Sensors, Transducers and Sensor Networks is the first book from the Advances in Sensors: Reviews book Series contains dozen collected sensor related state-of-the-art reviews written by 31 internationally recognized experts from academia and industry.

Built upon the series Advances in Sensors: Reviews - a premier sensor review source, the *Modern Sensors, Transducers and Sensor Networks* presents an overview of highlights in the field. Coverage includes current developments in sensing nanomaterials, technologies, MEMS sensor design, synthesis, modeling and applications of sensors, transducers and wireless sensor networks, signal detection and advanced signal processing, as well as new sensing principles and methods of measurements.

Modern Sensors, Transducers and Sensor Networks is intended for anyone who wants to cover a comprehensive range of topics in the field of sensors paradigms and developments. It provides guidance for technology solution developers from academia, research institutions, and industry, providing them with a broader perspective of sensor science and industry.

Order online:

http://sensorsportal.com/HTML/BOOKSTORE/Advance_in_Sensors.htm



www.sensorsportal.com