

# PROCEEDINGS OF SPIE

## *Eighth International Conference on* **Quality Control by** **Artificial Vision**

**David Fofi**  
**Fabrice Meriaudeau**  
*Editors*

**23–25 May 2007**  
**Le Creusot, France**

*Organized by*  
Le2i UMR CNRS 5158, Le Creusot (France)

*Sponsored by*  
Le Site Universitaire Creusotin: Centre Universitaire Condorcet et IUT Le Creusot (France)  
Université de Bourgogne (France)  
Le Ville du Creusot (France)  
La Communauté Urbaine Creusot-Montceau (France)  
Le Conseil Général de Saône-et-Loire (France)  
Le Conseil Régional de Bourgogne (France)

*In Cooperation with*  
IEEE France Section  
SPIE Europe  
Biomaterials Network

*Published by*  
SPIE

Volume 6356



The International Society  
for Optical Engineering

Proceedings of SPIE, 0277-786X, v. 6356

SPIE is an international society advancing an interdisciplinary approach  
to the science and application of light.

The papers included in this volume were part of the technical conference cited on the cover and title page. Papers were selected and subject to review by the editors and conference program committee. Some conference presentations may not be available for publication. The papers published in these proceedings reflect the work and thoughts of the authors and are published herein as submitted. The publisher is not responsible for the validity of the information or for any outcomes resulting from reliance thereon.

Please use the following format to cite material from this book:

Author(s), "Title of Paper," in *Eighth International Conference on Quality Control by Artificial Vision*, edited by David Fofi, Fabrice Meriaudeau, Proceedings of SPIE Vol. 6356 (SPIE, Bellingham, WA, 2007) Article CID Number.

ISSN 0277-786X  
ISBN 9780819464514

Published by

**SPIE**

P.O. Box 10, Bellingham, Washington 98227-0010 USA  
Telephone 1 360/676-3290 (Pacific Time) · Fax 1 360/647-1445  
SPIE.org

Copyright © 2007, Society of Photo-Optical Instrumentation Engineers

Copying of material in this book for internal or personal use, or for the internal or personal use of specific clients, beyond the fair use provisions granted by the U.S. Copyright Law is authorized by SPIE subject to payment of copying fees. The Transactional Reporting Service base fee for this volume is \$18.00 per article (or portion thereof), which should be paid directly to the Copyright Clearance Center (CCC), 222 Rosewood Drive, Danvers, MA 01923. Payment may also be made electronically through CCC Online at <http://www.copyright.com>. Other copying for republication, resale, advertising or promotion, or any form of systematic or multiple reproduction of any material in this book is prohibited except with permission in writing from the publisher. The CCC fee code is 0277-786X/07/\$18.00.

Printed in the United States of America.

# Contents

- ix *Conference Committees*
- xi *Introduction*

---

## 3D ACQUISITION, PLANNING, AND REGISTRATION

---

- 635602 **Dynamic replanning of 3D automated reconstruction using situation graph trees and illumination adjustment** [6356-01]  
S. Kohler, A. B. Far, E. Hirsch, Lab. des Sciences de l'Image, de l'Informatique et de la Télédétection, CNRS (France) and Univ. Louis Pasteur (France)
- 635603 **3D digitizing path planning for part inspection with laser scanning** [6356-02]  
M. Mahmud, D. Joannic, J.-F. Fontaine, Lab. de Recherche en Mécanique et Acoustique, Univ. de Bourgogne (France)
- 635604 **Simulation for an automation of 3D acquisition and post-processing** [6356-03]  
B. Lorient, Le2i-CNRS, Univ. de Bourgogne (France) and Dynamic3D (France); R. Seulin, P. Gorria, F. Meriaudeau, Le2i-CNRS, Univ. de Bourgogne (France)
- 635605 **Overview of 3D registration techniques including loop minimization for the complete acquisition of large manufactured parts and complex environments** [6356-04]  
E. Batlle, C. Matabosch, J. Salvi, Univ. of Girona (Spain)

---

## INSPECTION OF SPECULAR/TRANSPARENT SURFACES

---

- 635606 **Quality control of transparent objects with polarization imaging** [6356-05]  
M. Ferraton, C. Stolz, O. Morel, F. Meriaudeau, Le2i-CNRS, Univ. de Bourgogne (France)
- 635607 **Automatic generation of image acquisition conditions for the quality control of specular surfaces** [6356-06]  
J. M. García-Chamizo, A. Fuster-Guilló, J. Azorín-López, Univ. of Alicante (Spain)

---

**Pagination:** Proceedings of SPIE follow an e-First publication model, with papers published first online and then in print and on CD-ROM. Papers are published as they are submitted and meet publication criteria. A unique, consistent, permanent citation identifier (CID) number is assigned to each article at the time of the first publication. Utilization of CIDs allows articles to be fully citable as soon they are published online, and connects the same identifier to all online, print, and electronic versions of the publication.

SPIE uses a six-digit CID article numbering system in which:

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

The CID number appears on each page of the manuscript. The complete citation is used on the first page, and an abbreviated version on subsequent pages.

635608 **Measurement of the three-dimensional mirror parameters by polarization imaging applied to catadioptric camera calibration** [6356-07]  
O. Morel, R. Seulin, D. Fofi, Univ. de Bourgogne (France)

635609 **Relief extraction of rough textured reflecting surface by image processing** [6356-08]  
X. Huang, J. Brochard, D. Helbert, M. Khoudeir, Univ. of Poitiers (France)

---

#### MACHINE VISION AND INDUSTRIAL INSPECTION I

---

63560B **A vision-based material tracking system for heavy plate rolling mills** [6356-10]  
M. Tratnig, J. Reisinger, H. Hlobil, voestalpine mechatronics GmbH (Austria)

63560C **Automated multiple view inspection of metal castings** [6356-11]  
D. Mery, M. Carrasco, Pontificia Univ. Católica de Chile (Chile)

63560D **Accurate length measurement of multiple cotton fibers** [6356-12]  
H. Wang, C. Mao, H. Sari-Sarraf, E. Hequet, Texas Tech Univ. (USA)

---

#### MACHINE VISION AND INDUSTRIAL INSPECTION II

---

63560E **A method of mura intensity quantification using multi-level sliced images** [6356-13]  
K. Taniguchi, K. Ueta, H. Onishi, Dainippon Screen Manufacturing Co., Ltd. (Japan);  
S. Tatsumi, Osaka City Univ. (Japan)

63560F **Flaw detection on decorated glasses by color image processing** [6356-14]  
L. Busin, N. Vandenbroucke, LAGIS, CNRS, Univ. des Sciences et Technologies de Lille (France) and EIPC (France); L. Maccaire, J.-G. Postaire, LAGIS, CNRS, Univ. des Sciences et Technologies de Lille (France); P. Tahon, ARC International (France)

63560G **Optical spatial heterodyned interferometry for inspection of micro-electro-mechanical systems** [6356-15]  
K. W. Tobin, Jr., P. R. Bingham, J. R. Price, Oak Ridge National Lab. (USA)

---

#### KEYNOTE SPEAKER

---

63560H **Industrial applications of the wavelet and multiresolution-based signal-image processing: a review** [6356-16]  
F. Truchetet, O. Laligant, Le2i-CNRS, Univ. de Bourgogne (France)

---

#### AGRICULTURAL APPLICATIONS

---

63560I **Velocity measurement using motion blurred images to improve the quality of fertiliser spreading in agriculture** [6356-17]  
S. Villette, F. Cointault, ENESAD, DSI-LGAP (France); P. Zwaenepoel, Cemagref (France);  
B. Chopinet, ENESAD, DSI-LGAP (France); M. Paindavoine, Le2i, CNRS, Univ. de Bourgogne (France)

- 63560J **Simulation of agronomic images for an automatic evaluation of crop/weed discrimination algorithm accuracy** [6356-18]  
G. Jones, Ch. Gée, ENESAD/DSI, Unité Propre GAP (France); F. Truchetet, UMR 5158, Univ. de Bourgogne-CNRS (France)
- 63560K **Development of a machine vision system for a real-time precision sprayer** [6356-20]  
J. Bossu, C. Gée, ENESAD/DSI, Unité Propre GAP (France); F. Truchetet, UMR 5158, Univ. de Bourgogne-CNRS (France)
- 63560L **Texture analysis with statistical methods for wheat ear extraction** [6356-21]  
M. Bakhouché, F. Cointault, ENESAD, Unité Propre GAP (France); P. Gouton, Le2i-CNRS, Univ. of Burgundy (France)

---

#### TOOLS AND METHODS I

---

- 63560M **Rational supershapes for surface reconstruction** [6356-22]  
Y. D. Fougerolle, Le2i Lab., CNRS, Univ. of Burgundy (France); A. Gribok, Univ. of Tennessee (USA); S. Fofou, F. Truchetet, Le2i Lab., CNRS, Univ. of Burgundy (France); M. A. Abidi, Univ. of Tennessee (USA)
- 63560N **Feature extraction and classification in surface grading application using multivariate statistical projection models** [6356-23]  
J. M. Prats-Montalbán, F. López, J. M. Valiente, A. Ferrer, Technical Univ. of Valencia (Spain)
- 63560O **Optimizing signal and image processing applications using Intel libraries** [6356-24]  
J. Landré, Lab. CReSTIC, Univ. de Reims-Champagne-Ardenne (France); F. Truchetet, Le2i, Univ. de Bourgogne (France)

---

#### X-RAY, RADIOGRAPHIC, ULTRASOUND IMAGING

---

- 63560P **Robust speckle detection in ultrasound images: evaluation aspects** [6356-26]  
R. Martí, J. Martí, J. Freixenet, Univ. of Girona (Spain); J. C. Vilanova, J. Barceló, Girona Magnetic Resonance Imaging Ctr. (Spain)
- 63560Q **From medical data to simple virtual mock-up of scapulo-humeral joint** [6356-27]  
H. Atmani, F. Merienne, Lab. Le2i/Institut Image, ENSAM (France); D. Fofi, Lab. Le2i/IUT Le Creusot (France); P. Trouilloud, Lab. d'Anatomie de Dijon (France)
- 63560R **Parametric active contour for weld defects boundary extraction in radiographic testing** [6356-28]  
A. B. Goumeidane, Ctr. de Recherche en Soudage et Contrôle (Algeria); M. Khamadja, Mentouri Univ. (Algeria); N. Nacereddine, F. Mekhalfa, Ctr. de Recherche en Soudage et Contrôle (Algeria)
- 63560S **A coarse-grained spectral signature generator** [6356-29]  
K. P. Lam, J. C. Austin, C. R. Day, Univ. of Keele (United Kingdom)
- 63560T **Optimization of illuminating system to detect optical properties inside a finger** [6356-30]  
E. Sano, M. Shikai, A. Shiratsuki, T. Maeda, M. Matsushita, K. Sasakawa, Mitsubishi Electric Corp. (Japan)

---

## TOOLS AND METHODS II

---

- 63560U **Axis detection method for cylindrical objects** [6356-31]  
C. Mulat, IMS, CNRS, ENSEIRB (France) and LCTS, CNRS-Univ. Bordeaux I (France);  
M. Donias, P. Baylou, IMS, CNRS, ENSEIRB (France); G. Vignoles, LCTS, CNRS-Univ. Bordeaux I  
(France); C. Germain, IMS, CNRS, ENITAB (France)
- 63560V **Reaction-diffusion applied to discrete distorted circles for industrial control** [6356-32]  
F. Mairesse, T. M. Sliwa, Y. Voisin, S. Binczak, Le2i, CNRS, Univ. de Bourgogne (France)
- 63560W **Analysis and evaluation of facial expression and perceived age for designing automotive frontal views** [6356-33]  
T. Fujiwara, Chukyo Univ. (Japan); M. Kawasumi, Aichi Shukutoku Univ. (Japan);  
H. Koshimizu, Chukyo Univ. (Japan)

---

## MATCHING/IMAGE PROCESSING

---

- 63560X **A hardware architecture for fast video object recognition using SVM and Zernike moments** [6356-34]  
C. Lemaitre, J. Miteran, Lab. Le2i, CNRS, Univ. de Bourgogne (France); O. Aubreton, Lab.  
Le2i, CNRS, IUT Le Creusot (France); R. Mosqueron, Lab. Le2i, CNRS, Univ. de Bourgogne  
(France)
- 63560Y **Moving object detection based on correlation rate subtraction using local region template matching** [6356-35]  
K. Goto, F. Saitoh, K. Yamamoto, K. Kato, Gifu Univ. (Japan)
- 63560Z **A new simple algorithm for image processing in Shack-Hartmann wavefront sensing** [6356-36]  
F. D. Kashani, B. Ghafary, S. B. Shokouhi, Iran Univ. of Science and Technology (Iran)
- 635610 **Robust focusing by orientation code matching and its application to depth reconstruction** [6356-37]  
Y. Li, Hokkaido Univ. (Japan); I. Ohmura, Hokkaido Industrial Research Institute (Japan);  
H. Takauji, S. Kaneko, T. Tanaka, Hokkaido Univ. (Japan)

---

## TOOLS AND METHODS III

---

- 635611 **Quality assessment for color reproduction using a blind metric** [6356-38]  
B. Bringier, Univ. de Poitiers (France); L. Quintard, Univ. de Poitiers (France) and Lab.  
National de Métrologie et d'Essais (France); M.-C. Larabi, Univ. de Poitiers (France)
- 635612 **Bubble structure evaluation method of sponge cake by using image morphology** [6356-39]  
K. Kato, K. Yamamoto, Gifu Univ. (Japan); M. Nonaka, Y. Katsuta, C. Kasamatsu, Ajinomoto  
Co., Inc. (Japan)
- 635613 **Visual inspection systems and human sensitivity** [6356-40]  
S. Hata, Y. Matsuda, Kagawa Univ. (Japan); N. Kamido, Futec Co. (Japan)

## POSTER SESSION

---

- 635614 **Non-negative matrix factorization: a study on influence of matrix sparseness and subspace distance metrics on image object recognition** [6356-41]  
I. Bajla, D. Soukup, ARC Seibersdorf research GmbH (Austria)
- 635615 **A multistable cellular nonlinear network for quality control by visual inspection** [6356-42]  
B. Nofiele, S. Morfu, P. Marquié, Le2i, CNRS, Univ. de Bourgogne (France)
- 635616 **A practical use of ROC analysis to assess the performances of defects detection algorithms** [6356-43]  
Y. Le Meur, INP Grenoble (France) and Trixell (France); J.-M. Vignolle, Trixell (France); J. Chanussot, INP Grenoble (France)
- 635617 **Enhancing accuracy of camera rotation angles detected by inaccurate sensors and expressing them in different systems for wide baseline stereo** [6356-44]  
R. Elias, German Univ. in Cairo (Egypt)
- 635618 **Optical measurement system for the quality control of aeronautic parts: 3D measurement of circular holes and curved edges** [6356-45]  
S. Naudet-Collette, F. Dekeyser, F. Gaspard, Y. Dhome, CEA, LIST (France)
- 635619 **Control of the visual and tactile aspects of poultry food according to the poultry food behavior by image analysis** [6356-46]  
R. Hachemi, N. Vincent, N. Lomenie, Univ. of René Descartes (France)
- 63561A **Uranus: a rapid prototyping tool for FPGA embedded computer vision** [6356-47]  
V. Rosales-Hernandez, L. Castillo-Jimenez, G. Viveros-Velez, V. Zuñiga-Grajeda, A. Treviño Torres, M. Arias-Estrada, Instituto Nacional de Astrofísica, Óptica y Electrónica (Mexico)
- 63561B **Detection of surfaces for projection of texture** [6356-48]  
T. Molinier, D. Fofi, P. Gorria, Le2i, CNRS, Univ. of Burgundy (France); J. Salvi, Univ. of Girona (Spain)
- 63561C **Local isoplanatism effects removal on infrared sequences** [6356-49]  
M. Lemaitre, O. Laligant, Le2i Lab. (France); J. Blanc-Talon, DGA/D4S/MRIS (France); F. Mériaudeau, Le2i Lab. (France)
- 63561D **A method of local exposure compensation in color image using color histogram** [6356-50]  
M. Shimanouchi, S. Oe, The Univ. of Tokushima (Japan); T. Kashiwagi, Tokushima Prefectural Industrial Technology Ctr. (Japan)
- 63561E **Complex networks: application for texture classification** [6356-51]  
T. Chalumeau, Le2i, Univ. de Bourgogne (France) and Univ. de Sao Paulo (Brazil); L. da Fontoura Costa, Univ. de São Paulo (Brazil); O. Laligant, F. Meriaudeau, Le2i, Univ. de Bourgogne (France)

63561F **3D vision sensor and its algorithm on clone seedlings plant system** [6356-52]  
J. Hayashi, T. Hiroyasu, H. Hojo, S. Hata, Kagawa Univ. (Japan); H. Okada, Takarada Densan  
Co. (Japan)

*Author Index*



## Conference Committees

### *Conference Chair*

**David Fofi**, Le2i CNRS, IUT Le Creusot (France)

### *Conference Cochair*

**Fabrice Meriaudeau**, Le2i CNRS, Université de Bourgogne (France)

### *International Scientific Committee*

**Philippe Bolon**, *General Chair*, Université de Savoie (France)

**Kenneth W. Tobin, Jr.**, *General Cochair*, Oak Ridge National Laboratory (USA)

**Mongi Abidi**, University of Tennessee (USA)

**Pierre Boulanger**, University of Alberta (Canada)

**Jean-Marc Chassery**, Institut National Polytechnique de Grenoble (France)

**Luciano Da Fontoura Costa**, Universidade de São Paulo (Brazil)

**Carlos Fernandez**, Polytechnic University of Cartagena (Spain)

**Christian Germain**, ENITA Bordeaux (France)

**Shaun Gleason**, Oak Ridge National Laboratory (USA)

**Patrick Gorria**, Le2i CNRS, Université de Bourgogne (France)

**Seija Hata**, Kagawa University (Japan)

**Martin Hunt**, nLine Corporation (USA)

**Akira Ishii**, Kagawa University (Japan)

**Valérie Kaftandjian**, INSA-Lyon (France)

**Majdi Khoudeir**, Université de Poitiers (France)

**Hiroyasu Koshimizu**, Chukyo University (Japan)

**Lew F. C. Lew Yan Voon**, Le2i CNRS, Université de Bourgogne (France)

**Xavier Maldague**, Université Laval (Canada)

**Timothy McIntyre**, Oak Ridge National Laboratory (USA)

**Fabrice Meriaudeau**, Le2i CNRS, Université de Bourgogne (France)

**Vittorio Murino**, Università degli Studi di Verona (Italy)

**Tim Newman**, University of Alabama (USA)

**Kurt Niel**, University of Applied Sciences (Austria)

**Heinrich Niemann**, University of Erlangen (Germany)

**Fathallah Nouboud**, Université du Québec à Trois-Rivières (Canada)

**Christophe Odet**, INSA-Lyon (France)

**Paul O'Leary**, Institute for Automation (Austria)

**Jean-Charles Pinoli**, École Nationale Supérieure des Mines de Saint-Étienne (France)

**Françoise Prêteux**, Institut National des Télécommunications (France)

**Jeffery R. Price**, Oak Ridge National Laboratory (USA)

**Philippe Salembier**, Polytechnic University of Catalonia (Spain)

**Hamed Sari-Sarraf**, Texas Tech University (USA)

**Olli Silvén**, University of Oulu (Finland)

**Vladimir Smutny**, Czech Technical University (Czech Republic)  
**James Solinsky**, Pacific Northwest National Laboratory (USA)  
**Rin-Ichiro Taniguchi**, Kyushu University (Japan)  
**Frédéric Truchetet**, Le2i CNRS, Université de Bourgogne (France)  
**Okitoshi Tsunoda**, IBM Japan (Japan)  
**Pascal Vasseur**, Centre de Robotique, d'Electrotechnique et  
d'Automatique (France)  
**Kazuhiko Yamamoto**, Gifu University (Japan)  
**Hongbin Zha**, Beijing University (China)

*Organizing Committee*

**Hakim Atmani**, Le2i/Institut Image, ENSAM (France)  
**Olivier Aubreton**, Le2i CNRS, IUT Le Creusot (France)  
**Thomas Chalumeau**, Le2i CNRS, Université de Bourgogne (France) and  
Universidade de São Paulo (Brazil)  
**Alain Diou**, Le2i CNRS, Université de Bourgogne (France)  
**Eric Fauvet**, Le2i CNRS, Université de Bourgogne (France)  
**Mathias Ferraton**, Le2i CNRS, Université de Bourgogne (France)  
**Patrick Gorria**, Le2i CNRS, Université de Bourgogne (France)  
**Olivier Lalignant**, Le2i CNRS, Université de Bourgogne (France)  
**Bernard Lamalle**, Le2i CNRS, Université de Bourgogne (France)  
**Jérôme Landré**, CReSTIC, Université de Reims-Champagne-Ardenne (France)  
**Alexandra Lathuilière**, Université de Bourgogne (France)  
**Dominique Laurent**, Le2i CNRS, Université de Bourgogne (France)  
**Magali Lemaître**, Le2i CNRS, Université de Bourgogne (France)  
**Lew F. C. Lew Yan Voon**, Le2i CNRS, Université de Bourgogne (France)  
**Benjamin Lorient**, Le2i CNRS, Université de Bourgogne (France)  
**Thierry Molinier**, Le2i CNRS, Université de Bourgogne (France)  
**Olivier Morel**, Le2i CNRS, Université de Bourgogne (France)  
**Nathalie Ravey**, Le2i CNRS, Université de Bourgogne (France)  
**Ralph Seulin**, Le2i CNRS, Université de Bourgogne (France)  
**Christophe Stolz**, Le2i CNRS, Université de Bourgogne (France)  
**Pierre Suzeau**, Le2i CNRS, Université de Bourgogne (France)  
**Frédéric Truchetet**, Le2i CNRS, Université de Bourgogne (France)  
**Nicolas Walter**, Le2i CNRS, Université de Bourgogne (France)

## Introduction

The 3D Vision research team of the Le2i (Laboratory of Electronics, Computer Science, and Image Processing) is proud to welcome the Eighth International Conference on Quality Control by Artificial Vision to Le Creusot. After having traveled worldwide — the previous editions have been held in Le Creusot in 1993, 1995, 1997 and 2001, in Japan in 1998 and 2005, in Canada in 1999, and in the USA in 2003) — QCAV is back in the city which saw it being born.

Forty-eight papers have been selected by the international scientific committee (among which 12 are for the poster session) from Algeria, Austria, Brazil, Chile, Egypt, France, Iran, Japan, Mexico, Spain, United Kingdom, and United States of America. Moreover, four invited speakers, renowned in the field of image processing and quality control, are honouring us with their presence: Jeffery Price and Kenneth Tobin from the Oak Ridge National Laboratory (USA), Paul O'Leary from the Institute of Automation (Austria); and Frédéric Truchetet from the Le2i, University of Burgundy (France).

It is our pleasure to say that a special section of the *Journal of Electronic Imaging* (co-published by SPIE and IS&T) and a special issue of the *Electronic Letters on Computer Vision and Image Analysis* (edited by CVC Press) will be dedicated to QCAV and will feature selections based on the best papers presented at the conference.

This year's conference is supported by IEEE France Section, SPIE Europe as a cooperating organization, and endorsed by Biomaterials Network. The organizing committee is very grateful to them for trusting us, and would also like to acknowledge our partners and sponsors for their precious help in organizing the conference:

- Le2i UMR CNRS 5158
- Le Site Universitaire Creusotin: Centre Universitaire Condorcet et IUT Le Creusot
- Université de Bourgogne
- La Ville du Creusot
- La Communauté Urbaine Creusot-Montceau
- Le Conseil Général de Saône-et-Loire
- Le Conseil Régional de Bourgogne

**The Organizing Committee**

