52. IWK

Internationales Wissenschaftliches Kolloquium
International Scientific Colloquium

PROCCEDINGS | 10 - 13 September 2007

FACULTY OF
COMPUTER SCIENCE AND AUTOMATION

COMPUTER SCIENCE MEETS AUTOMATION

VOLUME II

Session 6 - Environmental Systems: Management and Optimisation
Session 7 - New Methods and Technologies for Medicine and Biology
Session 8 - Embedded System Design and Application
Session 9 - Image Processing, Image Analysis and Computer Vision
Session 10 - Mobile Communications
Session 11 - Education in Computer Science and Automation

TECHNISCHE UNIVERSITÄT
ILMENAU

Bibliografische Information der Deutschen Bibliothek
Die Deutsche Bibliothek verzeichnet diese Publikation in der deutschen Nationalbiografie; detaillierte bibliografische Daten sind im Internet über **http://dnb.ddb.de** abrufbar.

ISBN 978-3-939473-17-6

Impressum

Herausgeber:	Der Rektor der Technischen Universität Ilmenau Univ.-Prof. Dr. rer. nat. habil. Peter Scharff
Redaktion:	Referat Marketing und Studentische Angelegenheiten Kongressorganisation Andrea Schneider Tel.: +49 3677 69-2520 Fax: +49 3677 69-1743 e-mail: kongressorganisation@tu-ilmenau.de
Redaktionsschluss:	Juli 2007
Verlag:	Technische Universität Ilmenau/Universitätsbibliothek Universitätsverlag Ilmenau Postfach 10 05 65 98684 Ilmenau www.tu-ilmenau.de/universitaetsverlag
Herstellung und Auslieferung:	Verlagshaus Monsenstein und Vannerdat OHG Am Hawerkamp 31 48155 Münster www.mv-verlag.de
Layout Cover:	www.cey-x.de
Bezugsmöglichkeiten:	Universitätsbibliothek der TU Ilmenau Tel.: +49 3677 69-4615 Fax: +49 3677 69-4602

© Technische Universität Ilmenau (Thür.) 2007

Diese Publikationen und alle in ihr enthaltenen Beiträge und Abbildungen sind urheberrechtlich geschützt. Mit Ausnahme der gesetzlich zugelassenen Fälle ist eine Verwertung ohne Einwilligung der Redaktion strafbar.

Preface

Dear Participants,

Confronted with the ever-increasing complexity of technical processes and the growing demands on their efficiency, security and flexibility, the scientific world needs to establish new methods of engineering design and new methods of systems operation. The factors likely to affect the design of the smart systems of the future will doubtless include the following:

- As computational costs decrease, it will be possible to apply more complex algorithms, even in real time. These algorithms will take into account system nonlinearities or provide online optimisation of the system's performance.
- New fields of application will be addressed. Interest is now being expressed, beyond that in "classical" technical systems and processes, in environmental systems or medical and bioengineering applications.
- The boundaries between software and hardware design are being eroded. New design methods will include co-design of software and hardware and even of sensor and actuator components.
- Automation will not only replace human operators but will assist, support and supervise humans so that their work is safe and even more effective.
- Networked systems or swarms will be crucial, requiring improvement of the communication within them and study of how their behaviour can be made globally consistent.
- The issues of security and safety, not only during the operation of systems but also in the course of their design, will continue to increase in importance.

The title "Computer Science meets Automation", borne by the 52nd International Scientific Colloquium (IWK) at the Technische Universität Ilmenau, Germany, expresses the desire of scientists and engineers to rise to these challenges, cooperating closely on innovative methods in the two disciplines of computer science and automation.

The IWK has a long tradition going back as far as 1953. In the years before 1989, a major function of the colloquium was to bring together scientists from both sides of the Iron Curtain. Naturally, bonds were also deepened between the countries from the East. Today, the objective of the colloquium is still to bring researchers together. They come from the eastern and western member states of the European Union, and, indeed, from all over the world. All who wish to share their ideas on the points where "Computer Science meets Automation" are addressed by this colloquium at the Technische Universität Ilmenau.

All the University's Faculties have joined forces to ensure that nothing is left out. Control engineering, information science, cybernetics, communication technology and systems engineering – for all of these and their applications (ranging from biological systems to heavy engineering), the issues are being covered.

Together with all the organizers I should like to thank you for your contributions to the conference, ensuring, as they do, a most interesting colloquium programme of an interdisciplinary nature.
I am looking forward to an inspiring colloquium. It promises to be a fine platform for you to present your research, to address new concepts and to meet colleagues in Ilmenau.

Professor Peter Scharff
Rector, TU Ilmenau

Professor Christoph Ament
Head of Organisation

Table of Contents

CONTENTS

Page

6 Environmental Systems: Management and Optimisation

7 New Methods and Technologies for Medicine and Biology

8 Embedded System Design and Application

10 Mobile Communications

11 Education in Computer Science and Automation

52nd Internationales Wissenschaftliches Kolloquium
Technische Universität Ilmenau
10 – 13 September 2007

I. Aksit, K. Bünger, A. Fassbender, D. Frekers, C. Götze, J. Kemenas,

An ultra-fast on-line microscopic optical quality assurance concept for small structures in an environment of mass production

Today's Printed Circuit Boards (PCB) for sensors meet structure sizes in the µm or even nm range at high circuit complexity. These structures are usually printed in thin layer technology and coated in thin film technology. Those PCBs are being used in a large variety of applications ranging from cars to space stations, from private security devices to power plant control facilities, from toys and domestic appliances to consumer electronics, from robots to information devices. With increasing complexity, the demands on quality assurance and quality evaluation are quickly increasing. PCBs usually have to be investigated for surface and coating defects by optical techniques. So far, it has been impossible or prohibitively expensive to implement automated quality assurance procedures for each individual PCB by optical measures and at high throughput. Quality assessment is therefore mostly limited to statistical sampling techniques employing specially trained personnel performing the evaluations. This means that performance is frequently subjective and non-reproducible, let aside the often stress-prone conditions facing the personnel. Past attempts to automate optical inspections for each individual PCB and allowing on-line keep-or-reject decisions have largely been unsuccessful because the structures to be inspected are microscopically small, therefore requiring high magnifications and advanced image resolutions, which usually prevents large area inspections in one working step. Clearly, a novel approach is needed in the area of hardware and software, both of them being capable of acquiring and accurately analysing these structures at high resolution and within a time slot that allows on-line implementation in a mass production.

In the present pilot project, the authors have demonstrated a successful implemention of a system providing these features. Each partner company contributed special core competencies and integrated those into a single product. In a first step, the Eclipse optical microscope of the **MedXP GmbH** equipped with the patented AMBIS™

technique acquires a series of images from the entire area of test samples, each of them being about 10mm in diameter. Typical sustained acquisition speeds are about 25 – 30 frames/s at full image resolution in continuous scanning mode. The resulting image sizes depend on the optical system used, and in the present application perfect results were achieved with images of about 18.000x14.000 pixels per sample. In this case, the overall image of a single sample is separated into 14x14 partial images, each of 1280x1024 pixels in size and joined together without the need of a seaming algorithm for any of the edges. The samples can optionally be supplied to the microscope in a magazine of about 100 pieces by an automatic robot system. For acquiring the image of a single sample of the typical size of 10mm in diameter, the microscope needs about 10s, which includes the overhead for the focusing to the object surface. As there are no start-stop sequences involved during image acquisition, the microscope system operates without generating any extra noise and without creating any inertial forces due to acceleration or decelaration or any other frictional forces.

Together with position information for each single image the acquired images are then handed over to the *arivis ImageCore* software developed and distributed by **arivis – Multiple Image Tools GmbH**. This software package is capable of handling extremely large, multi-dimensional image data even on common, budget-priced hardware and manages these image areas for visual inspection at any zoom level or for an automated analysis. The software combines all individual image parts to a single large image for each sample and stores the image for subsequent ultra-fast access into a single file using proprietary formatting software.

Next, the image data are transferred to the *alfaVis* analysis software developed and distributed by **alfa vision systems GmbH**. This software package is developed for the detection of various types of structural defects on the original sample, like missing circuit structures, short circuits or any other surface defects or surface pollution. The analysis provides a quality certificate for every single sample in the line of the production.

The integrated pilot system needs about 20 minutes for the inspection of a magazine containing about 100 samples. Every sample is treated in an identical way making the evaluation independent of time, human subjectivity or human error. The system is flexible and can be adopted quickly and easily to a change of sample layout requiring only minutes for the adjustment to the new layout and to the optimization process.

Authors:
Dipl. Phys. Ishak Aksit,
MedXP GmbH, Munscheidstraße 14,
45886 Gelsenkirchen
Phone: 0251 83 36216
Fax: 0251 83 34962
E-mail: aksit@medxp.de

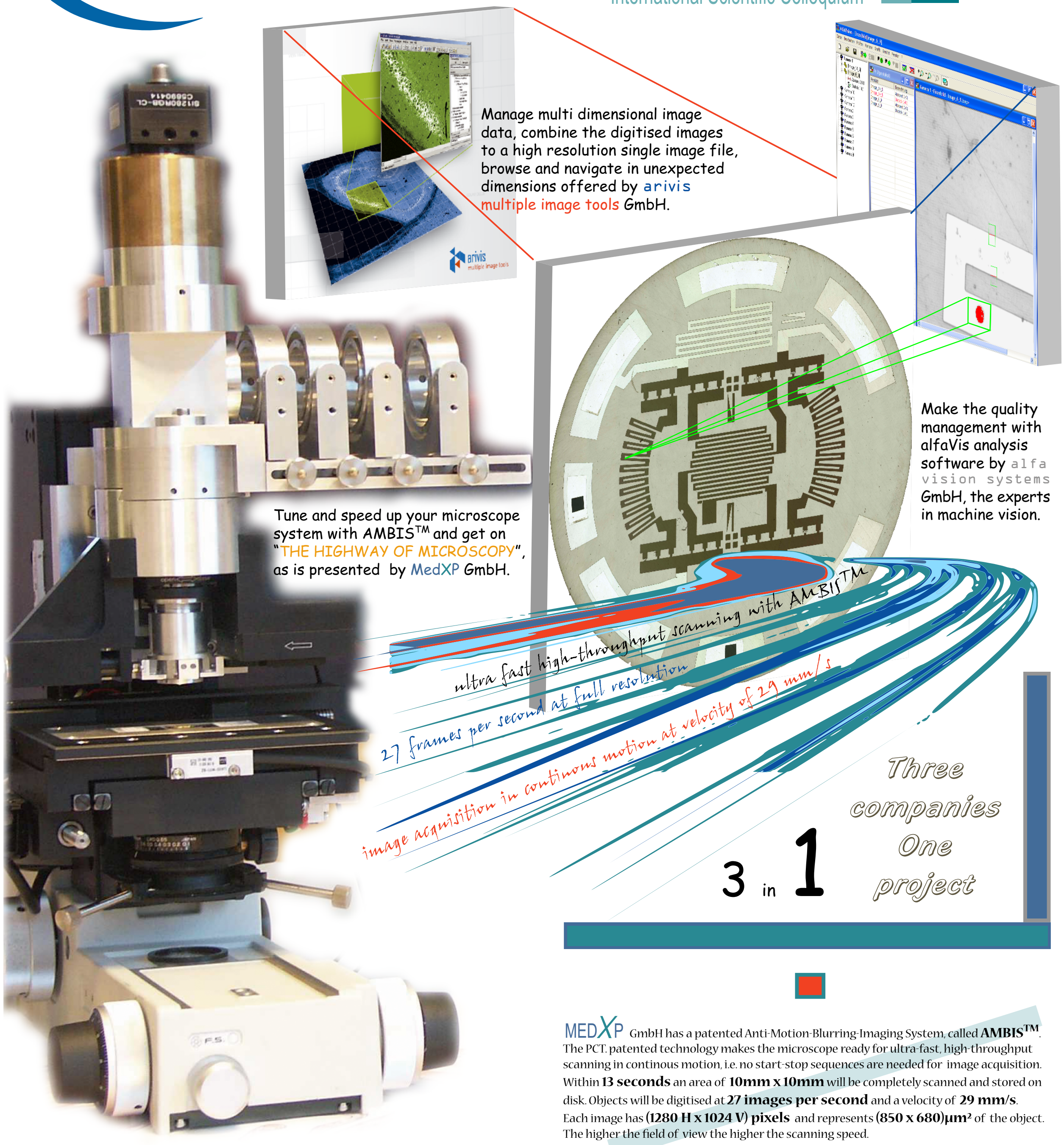
Dr. Kirsten Bünger,
MedXP GmbH, Munscheidstraße 14,
45886 Gelsenkirchen
Phone: 0209 167 1050
Fax: 0209 167 1051
E-mail: buenger@medxp.de

Alfred Fassbender,
alfa vision systems GmbH,
Altenlinde 51a,
51789 Lindlar
Phone: 02266 901206
Fax: 02266 901331
E-mail: fassbender@alfavisionsystems.com

Prof. Dr. Dieter Frekers,
MedXP GmbH, Munscheidstraße 14,
45886 Gelsenkirchen
Phone: 0251 83 34996
Fax: 0251 83 34962
E-mail: frekers@medxp.de, frekers@uni-muenster.de

Dr. Christian Götze,
arivis – Multiple Image Tools GmbH,
Schwaansche Straße 1
18055 Rostock
Phone: 0381 461393-0
Fax: 0381 461393-99
E-mail: christian.goetze@arivis.com

Jürgen Kemenas,
SMD-Production-Technology,
Inrather Straße 11-15
47798 Krefeld
Phone: 02151 5696573
Fax: 02151 5696575
E-mail: jk@smd-pt.de



MEDXP GmbH has a patented Anti-Motion-Blurring-Imaging System, called **AMBIS™**. The PCT. patented technology makes the microscope ready for ultra-fast, high-throughput scanning in continous motion, i.e. no start-stop sequences are needed for image acquisition. Within **13 seconds** an area of **10mm x 10mm** will be completely scanned and stored on disk. Objects will be digitised at **27 images per second** and a velocity of **29 mm/s**. Each image has **(1280 H x 1024 V) pixels** and represents **(850 x 680)µm²** of the object. The higher the field of view the higher the scanning speed.

alfa vision systems

arivis multiple image tools

MEDXP