Proceedings of the 4th International Conference on

Optical Measurement Techniques for Structures & Systems

OPTIMESS2009

Antwerp, Belgium 25-26 May 2009

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Shaker Publishing BV
St. Maartenslaan 26
6221 AX Maastricht
Tel.: 043-3500424
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http:// www.shaker.nl

Optical Measurement Techniques for Structures & Systems

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Printed in The Netherlands.

ISBN 978-90-423-0366-9

Cover design by *Jan Buytaert*.

PREFACE

Prof. **Joris Dirckx**

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Many techniques used nowadays in optical metrology, such as interferometers, speckle patterns and even holography, were invented long before the laser became available. The lack of powerful monochromatic light sources and especially the lack of strongly coherent light formed a major limitation for practical applications. Optical metrology is however not limited to light interferometry: the first use of optical triangulation techniques dates back to the 19th century, and stereoscopy was introduced very soon after the invention of photography. Quantitative use of these techniques was limited due to the lack of another basic component which we find in many current optical measurement techniques: affordable and large computing power. In the last fifty years, we had the privilege to witness a number of technological developments which brought optical measurement techniques into an unprecedented acceleration. Soon after Theodore Maiman created the first operating optical laser in 1960, many of the previous existing ideas for the use of coherent light were put into practice. The most famous example probably is holography, invented by Denis Gabor 13 years earlier in an attempt to improve resolution in electron microscopy but never really used in practice due to the lack of a source of coherent radiation.

In recent years, we have seen more examples of how technological development needs to precede the practical and widespread use of optical methods which were introduced much earlier. Electronic holography or Fourier profilometry for instance were proposed as early as the 1970's, but with only analog television cameras and tape recorders being available to catch and hold images, there was little use for the methods except as proof of principle in the laboratory. Over the last decades, the power-to-price ratio of lasers has made a huge jump and affordable solid state lasers have replaced the bulky and power-devouring ion lasers which used to cost a small fortune. Analog cameras were replaced by the CCD, and whereas a 1k by 1k

camera was a treasure only available for astronomers or other astronomy-budget research just 20 years ago, high resolution cameras have now even flooded the consumer market. As a result, digital holography and Fourier profilometry have found their way from the laboratory to in-line production testing, and commercial devices have become available which make the techniques accessible to non-specialist users. From the “fringes on a deformed beam” in the basic textbooks, interferometry has become a standard inspection tool in the production line, from car tires to entire airplane wings. Apart from the laser, many other developments played a crucial role in the widespread implementation of optical techniques as a practical measurement tool: the spectacular growth in computing power, the introduction of digital cameras, LCD’s, LED’s and OLED’s, aspheric lenses etc.

All of these developments have contributed to the top-rank role optical measurement techniques hold today in research, technology and production. But let us never forget: no matter how powerful the computer or the software package, the basic source of the information remains the optical wave front, so basic optical research needs to go hand in hand with practical implementation if real progress is to be made. For this reason, and with the support of the National Research Foundation of Flanders FWO, the research network Optical Measurement Techniques for Structures and Systems OPTIMESS was founded in 2004. The network brings together researchers in basic optics, developers and users of optical techniques. The aim of the network is to stimulate the interaction between basic research and practical implementation, between the optical scientist who develops the technique and the engineer who is using the technique to tackle a practical problem. Since its foundation, the network has grown strongly, now gathering Belgian key players and major research institutions from Argentina, Austria, Bulgaria, Brazil, France, Germany, Italy, United Kingdom and the US. The gatherings of the network partners soon turned into a full scale conference, organized every two years. OPTIMESS2009 was organized at Antwerp University and brought together over 115 researchers from 19 different countries. In this book, a reviewed selection of papers has been gathered which were presented at OPTIMESS2009. The papers bring a state of the art in optical measurement techniques and their practical use in different fields of application.

Joris J.J. Dirckx
conference chairman
OPTIMESS2009

TABLE of CONTENTS

KEYNOTES

1. In-field loading analysis of pipelines using a radial digital speckle pattern interferometer combined with the hole drilling method – *Armando Albertazzi* – p.1
2. Some answers to new challenges in optical metrology – *Wolfgang Osten* – p.11
3. Speckle Metrology: Theory and Practice – *Rajpal Sirohi* – p.31

REGULAR CONTRIBUTIONS

4. Elastic characterization of latex rubbers with Moiré profilometry and inverse modeling – *Jef Aernouts* – p.41
5. Detection of nonlinear distortions in the vibration of the middle ear system using heterodyne vibrometry – *Johan Aerts* – p.53
6. Micro- and macro deformation measurement by extension of correlation technique – *Marcelino Anguiano-Morales* – p.63
7. Deformation measurement of an electronic device using speckle interferometry based on a dual-camera technique – *Yasuhiko Arai* – p.73
8. An alternative method for obtaining distributions of submicrometric particles: Analysis using Virtual samples – *Angel Augier* – p.85
9. Optical demodulation and phase-shifting on liquid crystals in moiré profilometry – *Jan Buytaert* – p.95

10. Fiber Bragg gratings quasi-distributed sensor interrogated by a narrow-band reflectometric technique – *Christophe Caucheteur* – p.103
11. Generation of realistic ground truth images using Radial Basis Functions for the evaluation of DIC algorithms – *Corneliu Cofaru* – p.111
12. Identification of the plastic hardening behaviour beyond necking through inverse modelling and DICT – *Steven Cooreman* – p.121
13. Online monitoring and quality control of Selective Laser Melting using optical sensors – *Tom Craeghs* – p.131
14. Applications of laser-Doppler vibrometry during MEMS device qualification – *Jeroen De Coster* – p.141
15. Fluorescence technique for monitoring swelling of PAAm-κ-carrageenan gel composites – *Gülşen Evingür* – p.151
16. Region of interest micro-CT of the middle ear: a practical approach – *Stefan Gea* – p.161
17. Measurement of magnetostriction using dual laser heterodyne interferometers: experimental challenges and preliminary results – *Setareh Gorji Ghalamestani* – p.171
18. Objective evaluation for corrugation of flat glass surfaces – *Vlastimil Hotař* – p.181
19. Image correlation and homography mapping in optical deflection measurement – *Piotr Kohut* – p.191
20. Study of systematic errors in DIC using deformation fields imposed by finite element simulations – *Pascal Lava* – p.201
21. Underwater visualization of multi-input interleaved multisine for ultrasonic testing using Laser Doppler Vibrometry – *Roberto Longo* – p.211
22. Measurement of in plane strain with shearography and electronic speckle pattern interferometry – *Amalia Martínez* – p.217
23. Non-Destructive Detection of Defects in Artificial Skin Tissue by Optical Coherence Tomography – *Ulrich Marx* – p.227
24. Thermal phase angle interferometry for remote imaging in NDE – *Philipp Menner* – p.235
25. Application of an Optomechanical Image Derotator for Measuring Vibration and Deformation of Rotating Objects – *Sahar Mirzaei* – p.245

26. Experimental study of thick composites stability under thermal loading using 3D ESPI set-up – *Jérôme Molimard* – p.255
27. Combining digital image correlation and projected fringe techniques on a multi-camera multi-projector platform – *Nam Nguyen* – p.265
28. Application of various strain measuring techniques on a biaxially loaded cruciform composite specimen – *Carla Ramault* – p.275
29. The use of a high speed camera system for static and dynamic testing of civil engineering structures – *Edwin Reynders* – p.287
30. Development and validation of an accurate one pixel resolution temporal profilometry technique – *Bart Ribbens* – p.297
31. Real-time digital holographic microscopy – *Ventseslav Sainov* – p.307
32. Optical Metrology as an Enabler for Economical FRP-Processes – *Alexander Schoenberg* – p.317
33. Full field stress analysis of window security films by phase-stepping photoelasticity – *Elena Stoykova* – p.327
34. Detection of induced micro-cracks in quartz grains – *Abbass Tavallali* – p.338
35. Dynamic holographic interferometry development for dilatometry measurement of composites under vacuum-thermal conditions – *Cédric Thizy* – p.349
36. Evaluation of Measurement Uncertainty Contributors for Vision CMMs – *Nick Van Gestel* – p.359
37. Projection moiré measurement of glass specimens retrofitted with safety film – *Assen Shulev* – p.369
38. Study of deformation phenomena in Single Point Incremental Forming by means of Digital Image Correlation technique – *Ioannis Vasilakos* – p.379
39. Evaluation of structural power flow using an optimized regressive discrete Fourier series – *Cedric Vuye* – p.389
40. Industrial Computer Tomography for Dimensional Metrology: Overview of Influence Factors and Improvement Strategies – *Frank Welkenhuyzen* – p.401
41. Spatial resolution enhancement in coherent optical frequency domain reflectometer by nonlinear frequency sweep suppression – *Kivilcim Yuksel* – p.411