Project Outline

Prenormative research in the area of strain measurement using optical techniques has been pursued. These techniques use a non-contacting approach to the assessment of engineering artefacts subject to in-service loading. The resultant comprehensive stress data allows lighter, stronger, more reliable and safer products to be designed with more certainty. Recent progress in computers and chip-mounted optical sensors has led to rapid advances in optical metrology. The project addressed the lack of standards that are necessary if the full benefit of the new technology is to be realised. The outputs from the project include a reference material, standardised test materials; and recommended routes for traceability. A unified approach to all optical techniques has been taken with partners both from across the innovation process and from a range of industries including aerospace, automotive and microelectronics. The project started at the beginning of 2003 and concluded at the end of 2005.

Project Co-ordinator

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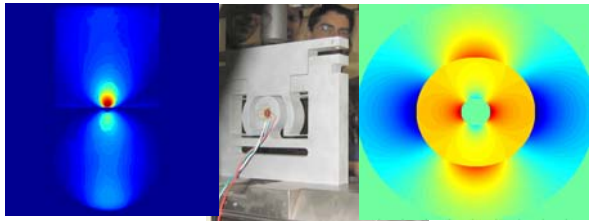


Project Partners

University of Sheffield www.shef.ac.uk/mecheng & www.experimentalstress.com	UK
Optical Metrology Innovations www.optical-metrology.com	IRL
Dantec Dynamics AG www.dantecdynamic.com	D
European Commission, Joint Research Centre www.jrc.org & www.bms.jrc.it	EU
NPL Management Ltd www.npl.co.uk & http://nanomaterials.npl.co.uk	UK
SNECMA www.snecma.com	F
Honlet Optical Systems GMBH www.honlet.com	D
Warszaw University of Technology www.pw.edu.pl & http://zto.mchtr.pw.edu.pl	PL
CRF Societa Consortile per Azionil www.crf.it	I
EMPA Swiss Federal Laboratories for Materials Testing and Research www.empa.ch	CH
Airbus www.airbus.com	UK

Project Website

www.opticalstrain.org

Standardisation Project for Optical Techniques of Strain Measurement

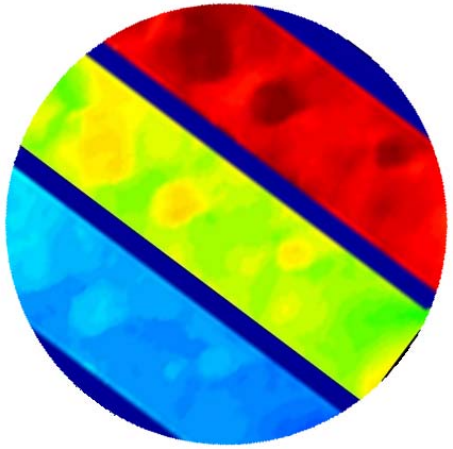
SPOTS

Shared cost RTD project with European Commission's

Competitive and Sustainable Growth Programme

(Contract No. G6RD-CT-2002-00856 'SPOTS')

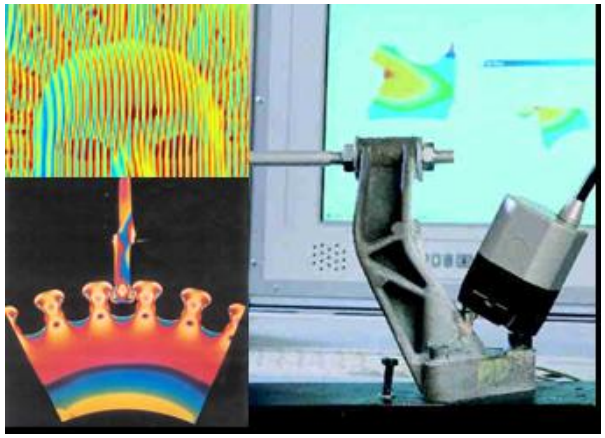
www.opticalstrain.org



"optical measurements of engineering components for accurate design data"

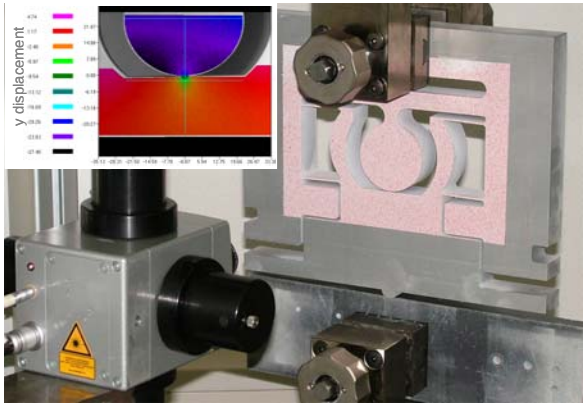
Outputs

1. A recommended format for full-field optical strain data.
2. Draft standard guides on ESPI, geometric moiré, grating interferometry, image correlation, photoelasticity, and thermoelasticity.
3. Completion of two round robins and a set of industrial case studies as part of the verification process.
4. Reports on routes for traceability and on feasibility of full-field data comparisons.
5. A SPOTS standard for the calibration and assessment of optical strain measurements including the design and methodology for use of a reference material and a set of standardised test materials.
6. Draft proposed ISO TTA submitted to VAMAS TWA26 (www.vamas.org and www.twa26.org).
7. Project final report (January 2006) available on project website: www.opticalstrain.org.

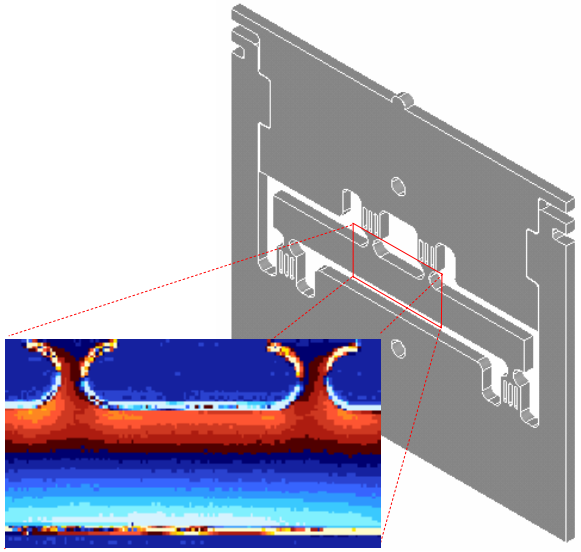


Project Description

The project objectives formed a programme of pre-normative research for a range of optical techniques for strain measurement in which there have been significant innovative advances in recent years. Partners have been drawn from throughout the innovation process, i.e. research labs, instrument designers, manufacturers, suppliers, and end-users from a range of industries including aerospace, automotive and microelectronics. The type of partners is also wide including three SMEs, three multi-national companies, two Universities, and three government laboratories including a standards laboratory. Care has been taken to consult with scientific community throughout the project and special sessions have been held at international conferences in 2004 and 2005.



A unified approach was required for all optical techniques. It was quickly appreciated that there are two needs, namely for calibration of optical instruments and independently for evaluation of instruments and their sub-systems. Calibration requires traceability to an international standard which implies a simple reproducible strain field. A beam subject to four-point bending was selected to generate the strain field in the reference material (right photo). The beam was enclosed in a monolithic frame to eliminate the influence of boundary conditions and to provide a route for traceability to the standard for length.



A set of standardised test materials (STMs) have been designed to allow evaluation of both complete systems and sub-systems or algorithms. STMs are intended to allow the 'fitness for purpose' of a system to be assessed and to enable diagnostic investigations in the most sophisticated instrument. This implies that STMs must contain complicated strain fields that offer challenging problems for analysis. Two geometries have been proposed: an disc in contact with an elastic half-space (middle photo) and the interference fit of a pair of rings. In addition, standard data sets are needed for the input and output from each step in an analysis process. The concept of functional pathways has been developed to allow the generation of standard data sets (SDS) from an analytical description of the strain field in the STM. Pathways have been created for ESPI, grating interferometry, image correlation, moiré, photoelasticity and thermoelasticity. The final report of the project and the draft proposed standard are available at www.opticalstrain.org.