

Booking form

Optical Design and Fabrication

11 - 15 January 2010

Course fee: £1380

Discounted rates are available for members of professional bodies/trade associations, and group bookings. Details available on request.

Surname _____

First name _____

Prof Dr Mr Mrs Miss

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Please find enclosed a cheque for
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Start date

Expiry date

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Please state any special dietary requirements

Course fee

The fee covers attendance, lunch, delegate coffee breaks and full meeting documentation. The fee does not cover travel or accommodation.

Cancellations and substitutions

It is regretted that cancellations and refunds cannot be made. However, the organisers will accept substitutions provided that written notification is received.

Data protection Please tick this box if you do not wish your details to be held by Cranfield University for the purpose of marketing courses, conferences, research programmes and other associated activities.

For further information contact the Academic Operations Unit:

T: +44 (0) 1234 754176

F: +44 (0) 1234 751206

E: shortcourse@cranfield.ac.uk

Please detach and return this form to:

Academic Operations Unit, Cranfield University,
FREEPOST BF463, Bedfordshire, MK43 0AL
UK.

Day five

09.00 **Special cases: visual optics and free-form surfaces** – Phil Rogers

- Vision/optics interface
- Free-form surface types and off-axis mirrors
- Conformal and foveal optics

10.00 **Manufacture of free-form surfaces** - David Walker

- Optical and non-optical applications
- Free-form as the extreme case of tool mis-fit
- Surfaces that are concave and convex at the same point

10.55 Break

11.10 **Extreme cases: X-ray and photolithography optics** – Phil Rogers / David Walker

- X-ray wavebands, soft and hard X-rays
- Violet, UV and lithography
- Mo/Si mirrors

13.05 Lunch

14.15 **Criteria for assessing optical surfaces and systems** – Phil Rogers

- Rayleigh limit – reprise
- Issues of high-slope and steep surfaces
- Overall system analysis

15.15 **Implementation in real life** - David Walker

- Up-and-coming advances
- Closing the loop between measurement and process
- What causes a process to fail?

Speakers

Paul Shore

McKeown Professor of Ultra Precision Technologies at Cranfield University, Head of the Cranfield University Precision Engineering Centre and Director of the UK's Integrated Knowledge Centre for Ultra Precision and Structured Surfaces (UPS2). Paul has extensive experience and expertise in large scale ultra precision surfaces technologies, ultra precision machine design, diamond turning, re-active atom plasma figuring and advanced optical fabrication.

David Walker

Director of the Optical Sciences Laboratory at University College London and the Technical Director of Zeeko Ltd. Founding Director of Optical Investments Ltd. David has considerable experience in optical design and precision surfaces, and is currently involved in

numerous industry projects relating to ultra precision and structured surfaces for a range of sectors, including optics, semiconductor, mould and die.

Phil Rogers

Fellow of the Royal Academy of Engineering, the Institute of Physics, the Optical Society of America, and a Fellow & past-Director of SPIE (International Society for Optical Engineering). Phil was made an MBE for services to the optical industry, has 45 publications in his name and has been granted 27 patents. Currently he is a Visiting Professor in Ultra Precision Engineering at Cranfield University.

Renaud Jourdain

Senior Research Officer at Cranfield having in-depth expertise of Plasma Physics.

Note: Cranfield University reserves the right to alter the programme without prior notification. Information correct at time of going to print.

www.cranfield.ac.uk/sas/short



Optical Design and Fabrication

Industrial short course at Technium OpTIC

11 - 15 January 2010

www.cranfield.ac.uk/sas/short

Introduction

Cranfield University and Technium OpTIC (Opto-electronics Technology and Incubation Centre) offer this five day short course which aims to provide students with an overview of modern technologies for designing and optimising optical systems, and fabricating precision lenses and mirrors. Practical issues will be emphasised, along with the interactions between the design and fabrication stages of a project.

Course content

- Ray-tracing and numerical optimisation as design and tolerancing tools for optical systems, and importance of some theoretical insight to ensure sensible solutions
- The classical curve-generating process, CNC grinding and diamond-turning, stressed mirror and stressed-lap techniques, CNC polishing including MRF and Precessions, ion-figuring and RAPT
- Issues with different materials, and with support-systems and handling in larger sizes
- Importance of metrology in the manufacturing cycle, including consistency of coordinate frames.

Venue

Technium OpTIC, St Asaph Business Park, St Asaph, Denbighshire, LL17 0JD

Who should attend?

Scientists and engineers working in the space, aerospace, medical devices, semiconductor, optics, optoelectronics, and displays industries.

Benefits of attending

- Critical awareness, and practical and theoretical understanding of modern optical design and manufacturing techniques in an industrial context
- Ability to critically evaluate and optimise manufacturing and product performance, and effectively apply precision processes in new applications for optical systems
- Critical awareness of craft manufacturing techniques, and how these are relevant to precision process development with modern automated techniques.

Contact

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Day one

- 09.00 **Introduction to optical design** – David Walker
- Surface form and texture
 - Mid-spatial frequencies
 - Sub-surface damage
- 10.00 **Atmospheric pass-bands and optical materials** – Phil Rogers
- Pass-bands and transmission limits
 - Types of optical material and metallic reflection
- 10.55 Break
- 11.10 **Optical design basics** – Phil Rogers
- Simple and compound optics
 - Aberrations
 - Basic lens and mirror forms
- 13.05 Lunch
- 14.15 **Classical optical fabrication techniques** – David Walker
- Generating the base curve
 - Mating surfaces
 - Loose abrasive grinding, polishing and figuring
- 15.15 **Manufacturing challenges for aspherics** – David Walker
- Issue of tool-misfit over an asphere
 - Challenge of measuring aspheres for manufacture
 - Difficulty of alignment on manufacturing machines

Day two

- 09.00 **The optical design process including Zemax optimisation** – Phil Rogers
- Design starting points, optimisation and pitfalls
- 10.00 **Modern optical design including aspherics** – Phil Rogers
- Forms of aspheric surface and aspheric mirror systems
 - Diffractive structures and applications
- 10.55 Break
- 11.10 **Ultra-high precision grinding processes** – Paul Shore
- Deterministic grinding
 - Grinding of metal, glass, ceramics and super-smooth surfaces
- 13.05 Lunch
- 14.15 **Diamond ruling and diamond turning** – Paul Shore
- Unique process features, capabilities, roughness and form
 - State-of-the-art applications
- 15.15 **Ion milling and reactive atom plasmas** – Renaud Jourdain
- Theory and practice of ion beam and plasma processes
 - RAPT and Ion Beam Milling applications

Day three

- 09.00 **Optical performance effects** – Phil Rogers
- Diffraction and the Rayleigh limit
 - MTF
 - Theoretical versus actual performance
- 10.00 **Design for successful manufacture** – Phil Rogers
- Choice of optical material
 - Importance of design starting point
 - Desensitisation
- 10.55 Break
- 11.10 **Advanced mirror substrates** – David Walker
- Light-weighting (honeycombing) strategies
 - Thin-meniscus light-weight mirrors
 - Advanced materials eg silicon carbide
- 13.05 Lunch
- 14.15 **Large optics fabrication** - David Walker
- Current and future applications of large optics
 - Stressed-lap and stressed mirror techniques
 - Sub-diameter tooling methods
- 15.15 **Tolerances and procedures for centring, leveling, fiducialisation** - David Walker
- Importance of tolerance in setting up on a machine
 - Methods of adjustment on a machine
 - Machine and metrology coordinates and fiducialisation

Day four

- 09.00 **CNC polishing and finishing** – David Walker
- Magnetorheological finishing (MRF)
 - The 'Precessions' process
- 10.00 **Component fixturing and handling** – David Walker
- Small size parts – chucks and fixtures
 - Large parts – hydrostatic support
 - Handling procedures
- 10.55 Break
- 11.10 **Formal tolerancing and specifying for manufacture** – Phil Rogers
- Tolerance distribution and tolerance in asymmetry
 - Surface figure, form and finish
- 13.05 Lunch
- 14.15 **Characteristics and choice of special optical materials** – Phil Rogers
- Infrared and multispectral
 - Window materials, low expansion and ultra-hard materials
- 15.15 **Issues of special substrate materials** – David Walker
- Challenges in polishing and issues in handling