



University College Dublin,
Ireland

SPIE Student Chapter



The International Society
for Optical Engineering

Annual report
January – December 2006

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Chapter Activities since last report:

In April of this year SPIE student members UCD SPIE Student Chapter members David Monaghan, Jennifer Ward, John Ging and Jonathan Maycock travelled to the beautiful city of Strasbourg for the SPIE Photonics Europe conference.



David Monaghan and Jonathan Maycock adorn the Photonics Europe sign outside the Palais de la Musique et des Congrès. Dave and Jonathan join Dr. Thomas Naughton of University College Ireland/ Maynooth for a tour of the beautiful city.

Each of the group gave an oral presentation presenting their research and some even had the time to also present a poster! The event was well organized and the general consensus was that it was a huge success. We all enjoyed having "lunch with the experts" and got an excellent opportunity to give our perspective on all aspects of SPIE.



(Left) Spring School on Optics in Maynooth college.

The UCD SPIE student chapter join with students from National University of Ireland Maynooth & Galway for the Spring School on Optical Information Processing 2006 hosted by the department of

computer science in Maynooth. This multidisciplinary school is aimed at PhD students in applied optics. The lecturers were Chris Dainty (Professor, Experimental Physics, NUIG) with title "Adaptive Optics," John Sheridan (Senior Lecturer, Electrical & Electronic Engineering, UCD) with title "Fourier Optics," and Thomas Naughton (Lecturer, Computer Science, NUIM) with title "Analogue Optical Computing."



(Right) University of Ireland, Maynooth

The second meeting of the Irish Optics and Photonics Network was held in March of this year in Trinity College Dublin. The morning session was entitled Outreach in Photonics to Schools and the afternoon session was about starting a company. The meeting had some excellent speakers including Prof. Rob Eason from the University of Southampton in the UK and Dr. John Dunne the CTO of Commercial Systems from Intune Technologies. Almost every member from the chapter attended the meeting, which was once again organised by Prof. Chris Dainty of NUIG.

Earlier this year, Prof. K. I. Hajim gave a short course in Quantum Optics in the Physics department at UCD. This was attended by many of the SPIE student chapter members.

In April, Prof. Rick Johnson of Cornell University gave an intensive course in Digital Signal Processing. Several SPIE student chapter members took the course, building their familiarity with Matlab and expanding their signal processing skillset in order to carry DSP concepts over into Optical Signal Processing and optical system simulation.

This year, thanks in part to funding received from the SPIE, we were able to send over four chapter members to the SPIE's Annual Photonics and Optics meeting at San Diego.



(left) Michael Gleeson received a scholarship for his contributions towards the field of optics. (right) David Monaghan accepts an educational grant on behalf of the Student Chapter.

James Ryle, Jennifer Ward, Michael Gleeson and David Monaghan went over to San Diego and all gave oral presentations on their research. Jennifer and James had delays at Heathrow airport due to increased security arrangements but David and Michael arrived on time and were delighted to attend the student leadership training day, which was expertly organized by SPIE's Dirk Fabian and Jason Hamman. The conference was a great success and there was a considerable emphasis on student events.



(left) David Monaghan, James Ryle and James Westphal network and socialise at one of the poster sessions.

In November, John Healy spent several weeks in Cork working with an Irish start-up company called Xerenet (www.xerenet.com) to develop an FPGA-based hardware accelerator for Linear Canonical Transform calculations.

Jennifer Ward recently participated in the ITU telecom World 2006 conference in Hong Kong, where she was the Irish female delegate in the Youth Forum. This Forum consisted of interactive discussions between young delegates, government regulators, and successful entrepreneurs in the ICT (Information and Communications Technology) sector from both developed and developing countries. The purpose of these forums was to explore the role and

implications of ICT as a tool for socioeconomic development. One male and one female delegate from 130 countries worldwide participated in this forum. Topics such as the digital divide between nations, urban and rural societies, and between genders were discussed, and action plans were initiated.

The following papers have been produced by Student Chapter members:

Journals Published:

U. Gopinathan, D. S. Monaghan, T. J. Naughton, J. T. Sheridan, "A known-plain text attack on Fourier plane encryption algorithm," *Opt. Exp.*, Vol. 14, pp. 3181-3186, 2006.

J. Maycock, C. P. McElhinney, B. M. Hennelly, T. J. Naughton, J. B. Mc Donald, B. Javidi, "Reconstruction of partially occluded objects encoded in three-dimensional scenes by using digital holograms", *Applied Optics*, 45, pp. 2975-2985, May, 2006.

R. F. Patten, B. M. Hennelly, D. P. Kelly, F. T. O'Neill, Y. Liu, J. T. Sheridan, "Speckle Photography: Mixed domain fractional Fourier motion detection," *Opt. Lett.*, Vol. 31, No. 1, pp. 32-34, 2006.

J. T. Sheridan, J. V. Kelly, M. R. Gleeson, C. E. Close, F. T. O'Neill, "Optimized holographic data storage: diffusion and randomisation," *J. Opt. A: Pure Appl. Opt.*, Vol. 8, No. 3, pp. 236-243, 2006.

U. Gopinathan, D. S. Monaghan, T. J. Naughton, J. T. Sheridan, "A known-plaintext attack on Fourier plane encryption algorithm," *Opt. Exp.*, Vol. 14, pp. 3181-3186, 2006.

D. P. Kelly, J. T. Sheridan, W. T. Rhodes, "Finite-aperture effects for Fourier transform systems with convergent illumination: **Part I**. 2-D System analysis," *Opt. Comm.*, Vol. 263, No. 2, pp. 171-179, 2006. (Received 20 October 2005, revised 23 January 2006, accepted 26 January 2006. Available online 17th February 2006).

D. P. Kelly, B. M. Hennelly, J. T. Sheridan, W. T. Rhodes, "Finite-aperture effects for Fourier transform systems with convergent illumination: **Part II**. 3-D System analysis," *Opt. Comm.*, Vol. 262, No. 2, pp. 180-188, 2006. (Received 20 October 2005, revised 23 January 2006, accepted 26 January 2006. Available online 17th February 2006).

D. P. Kelly, F. T. O'Neill, J. E. Ward, R. F. Patten, B. M. Hennelly, Y. Liu, J. T. Sheridan, "Re-interpreting speckle photography with the optical fractional Fourier and the linear canonical transforms," *Asian Journal of Physics*, INVITED REVIEW, Vol. 15, No. 3, pp. 297-312. (2006).

J. V. Kelly, M. R. Gleeson, C. E. Close, F. T. O'Neill, J. T. Sheridan, S. Gallego, C. Neipp, "Temporal response and first order volume changes during grating formation in photopolymers," *J. Appl. Phys. (JAP)*, Vol. 99, No. 11, 7 pages, Art. No. 113105, (June 1st 2006). (Accepted January 2006).

D. P. Kelly, B. M. Hennelly, W. T. Rhodes, J. T. Sheridan, "Analytic and numerical analysis of linear optical systems," *Opt. Eng.*, Vol. 45, pp. 1-12, Article Number 088201 (September 5th 2006).

B. M. Hennelly, D. P. Kelly, R. F. Patten, J. E. Ward, U. Gopinathan, F. T. O'Neill, J. T. Sheridan, "Metrology and the Linear Canonical Transform," *J. Mod. Opt.*, Vol. 53, No. 15, pp. 2167-2186, (October 2006).

M. R. Gleeson, J. V. Kelly, C. E. Close, F. T. O'Neill, J. T. Sheridan, "The effects of absorption and inhibition during grating formation in photopolymer materials," *J. Opt. Soc. Am. B*, Vol. 23, No. 10, pp. 2079-2088, (ID 68367 - October 2006).

D. P. Kelly, J. E. Ward, B. M. Hennelly, U. Gopinathan, F. T. O'Neill, J. T. Sheridan, "Paraxial speckle based metrology systems with an aperture," *J. Opt. Soc. A*, Vol. 23, No. 11, pp. 2861-2870, (ID 67900 - November 2006).

D. P. Kelly, J. E. Ward, U. Gopinathan, B. M. Hennelly, F. T. O'Neill, J. T. Sheridan, "Decorrelation of speckle fields in paraxial optical metrology systems with apertures", *Opt. Lett.*, Vol. 31, No. 23, pp. 3444-3446, (Doc. ID 72193, December 2006).

Journals submitted

J. Maycock, B. M. Hennelly, J. B. Mc Donald, T. J. Naughton, Yann Frauel, Albertina Castro, B. Javidi. "Reduction of speckle in digital holography by discrete Fourier filtering", Submitted to *JOSA A* (Sept. 2006).

D. S. Monaghan, U. Gopinathan, T. J. Naughton, J. T. Sheridan, "Key-space analysis of double random phase encryption algorithm" Submitted to *Applied Optics* (Nov 2006).

B. M. Hennelly, J. T. Sheridan, D. P. Kelly, B. Javidi, T. J. Naughton, J. McDonald, "Spread space spread spectrum technique for secure multiplexing", *Opt. Lett.*, Vol. , No. , pp. , (Submitted 2006).

D. P. Kelly, J. T. Sheridan, W. T. Rhodes, "Fundamental diffraction limitations in a paraxial 4-f imaging system with coherent and incoherent illumination," *J. Opt. Soc. Am. A*, Vol. , No. , pp. , (Submitted 2006).

M. R. Gleeson, J. V. Kelly, C. E. Close, D. Sabol, S. Liu, J. T. Sheridan, "Modelling the photochemical effects present during holographic grating formation in photopolymer materials," Vol. , No. , pp. , (Submitted 2006).

S. Harbour, J. V. Kelly, T. Galstian, J. T. Sheridan, "Optical Birefringence and scattering in near Infra Red sensitive holographic polymer dispersed liquid crystals," Vol. , No. , pp. , (Submitted 2006).

U. Gopinathan, D. S. Monaghan, B. M. Hennelly, C. P. Mc Elhinney, D. P. Kelly, J. B. McDonald, T. J. Naughton, J. T. Sheridan, "Optimal encoding of complex valued signals onto nematic liquid crystal spatial light modulators," Vol. , No. , pp. , (Submitted 2006).

J. T. Sheridan, J. V. Kelly, F. T. O'Neill, M. R. Gleeson, C. Neipp, "Comment on the paper: investigation of the diffusion processes in a self-processing acrylamide-based photopolymer system, I. Naydenova, R. Jallapuram, R. Howard, S. Martin and V. Toal," Vol. , No. , pp. ,(Submitted 2006).

B. M. Hennelly, J. T. Sheridan, U. Gopinathan, D. P. Kelly, T. J. Naughton, B. Javidi, T. Nomura, "On the behaviour and simulation of spatial light modulators in optical Fourier systems," Vol. , No. , pp. , (Submitted 2006).

C. E. Close, M. R. Gleeson, J. V. Kelly, D. Mooney, J. T. Sheridan, "Determination of diffusion rates in Acrylamide/PVA based photopolymer material," Vol. , No. , pp. , (Submitted 2006).

SPIE's International Symposium on Photonics Europe, Palais de Congres et de la Musique, Strasbourg, France (3rd - 7th April 2006).

M. R. Gleeson, J. V. Kelly, C. E. Close, F.T. O'Neill, J. T. Sheridan, "Photochemical effects during fabrication of holographic gratings in Acrylamide based photopolymer materials", Art. No. 61871D, Proc. SPIE Vol. 6187, pp. U491-U502, 2006.

J. V. Kelly, M. R. Gleeson, C. E. Close, F. T. O'Neill, J. T. Sheridan, S. Gallego, C. Neipp, "Analysis of the temporal effects on grating evolution in photopolymer", Art. No. 618704, Proc SPIE Vol. 6187, pp. U118-U125, 2006.

C. E. Close, J. T. Sheridan, M. R. Gleeson, J. V. Kelly, D. Mooney, "Modification of chain length and determination of diffusion rates in acrylamide-based photopolymer material", Art. No. 61871C, Proc. SPIE Vol. 6187, PP. U479-U490, 2006.

S. Gallego, M. Ortu'o, C. Neipp, A. Marquez, A. Belandez, E. Fernandez, J. V. Kelly, J. T. Sheridan, "3-Dimensional analysis of holographic memories based on photopolymers using finite differences method", 2006.

Y. Liu, F. T. O'Neill, J. P. Ryle, U. Gopinathan, A. J. Carr, J. T. Sheridan, "E-Field control of the optical properties of liquid micro-optical elements", Art. No. 618711, Proc. SPIE Vol. 6187: U379-U390, 2006.

J. E. Ward, D. P. Kelly, R. P. Patten, B. M. Hennelly, Y. Liu, J. T. Sheridan, "Speckle based metrology systems and Linear Canonical Transforms photography in mixed domains", Art. No. 61870W, Proc. SPIE Vol. 6187, pp. U341-U352, 2006.

D. S. Monaghan, U. Gopinathan, T. J. Naughton, J. T. Sheridan, "Numerical analysis of systematic errors in an optical encryption system", International Symposium on Photonics Europe, Palais de Congret de la Musique, Strasbourg, France (3rd - 7th April 2006) (PDF)

J. J. Healy and J. T. Sheridan, "New Fast Algorithm for the Numerical Computation of Quadratic-Phase Integrals" Photonics Europe (3rd-7th April 2006, Strasbourg, France)

J Maycock, C. P. McElhinney, J. B. McDonald, T. J. Naughton, B. M. Hennelly, B. Javidi, "Speckle reduction in digital holography using Independent component analysis" Proc. SPIE 6187, 618716 (2006)

J. Maycock, C. P. Mc Elhinney, B. H. Hennelly, T. J. Naughton, J. B. McDonald, B. Javidi, "Reconstruction of partially occluded objects using digital holograms" Proc. SPIE 6187, 61870V (2006)

New Optical Materials, Photonic North, Quebec, Canada, (6th & 7th June 2006).

J. T. Sheridan, J. V. Kelly, M. R. Gleeson, C. E. Close, "Photopolymer materials for holographic data storage applications," Photonics North 2006, Proc. SPIE Vol. 6343, PTs I and II, pp. 34332-34332, art. No. 634332 (Sept. 8, 2006, 12 pages),

Fifth International Workshop on Information Optics, Toledo, Spain. (June 5th - 7th, 2006).

U. Gopinathan, D. S. Monaghan, T. J. Naughton, J. T. Sheridan, "Cryptanalysis using optical encryption algorithms," Fifth International Workshop on Information Optics, Toledo, Spain. (June 5th - 7th, 2006)

International Photonics Summer School, Adaptive Optics and Microoptics, Humboldt University of Berlin, Adlershof, Berlin

U. Gopinathan, D. S. Monaghan, T. J. Naughton, J. T. Sheridan, "Polarization encoding, multiplexing and wavefront modulation using Spatial light Modulators: Application to image encryption and holographic displays", Invited talk, International Photonics Summer School, Adaptive Optics and Microoptics, Humboldt University of Berlin, Adlershof, Berlin. (7th - 11th August, 2006)

SPIE International Symposium Optical Science and Technology, SPIE's 51st Annual Meeting, (13th - 17th August 2006), San Diego, California, USA.

D. S. Monaghan, U. Gopinathan, T. J. Naughton, J. T. Sheridan, "Numerical analysis of double random phase encryption", Optics & Photonics 2006 (13th - 18th August 2006, San Diego, CA, USA) (PDF)

J. J. Healy and J. T. Sheridan, "Applications of Fast Algorithms For the Numerical Calculation of Optical Signal Transforms" Optics & Photonics 2006 (13th-17th August 2006, San Diego, CA, USA).

B. H. Hennelly, J. Maycock, C. P. Mc Elhinney, T. J. Naughton, J. B. McDonald, B. Javidi, "Analysis of partially occluded objects encoded in digital holograms using the Wigner distribution function" Proc. SPIE 6311, 63110M (2006)

C. E. Close, J. T. Sheridan, M. R. Gleeson, J. V. Kelly, D. Mooney, F. T. O'Neill, "Impacts of modifier chemicals on the rates of diffusion in Acrylamide/PVA photopolymer," Proc. SPIE Vol. 6335 -- Organic Holographic Materials and Applications IV

J. V. Kelly, M. R. Gleeson, C. E. Close, J. T. Sheridan, "Nonlocal polymerization driven diffusion model: volume changes during grating formation," Proc. SPIE Vol. 6335 - Organic Holographic Materials and Applications IV

M. R. Gleeson, J. V. Kelly, C. E. Close, F. T. O'Neill, J. T. Sheridan, "Photochemical effects during holographic grating formation in photopolymer using the nonlocal polymerisation driven diffusion model," Proc. SPIE Vol. 6335 -- Organic Holographic Materials and Applications IV

J. E. Ward, D. P. Kelly, U. Gopinathan, B. M. Hennelly, F. T. O'Neill, J. T. Sheridan, "Speckle photography based metrology systems and Linear Canonical Transforms in mixed domains," Interferometry XI, 2006. INVITED ORAL PRESENTATION

J. P. Ryle, U. Gopinathan, J. T. Sheridan, "Digital in-line holography of biological specimens," Optical Information Systems IV, DIGITAL HOLOGRAPHY I.

J. J. Healy, J. T. Sheridan, "New fast algorithm for the numerical computation of quadratic-phase integrals," 2006.

Y. Liu, F. T. O'Neill, J. P. Ryle, U. Gopinathan, J. T. Sheridan, "The fabrication of micro lens controlled by high-voltage," Novel Optical Systems Design and Optimization IX,

J. V. Kelly, M. R. Gleeson, C. E. Close, J. T. Sheridan, "Optimized scheduling technique for holographic data storage," Proc. SPIE Vol. 6335 - Organic Holographic Materials and Applications IV

Optical Society of America, Organic Photonics and Electronics Topical Meeting, Hyatt Regency Rochester Hotel, Rochester, New York. (9th -11th October, 2006).

C. E. Close, M. R. Gleeson, J. V. Kelly, J. T. Sheridan, "The approximate model for holographic grating formation in photopolymers," 2006.

J. V. Kelly, M. R. Gleeson, C. E. Close, F. T. O'Neill, J. T. Sheridan, "Generalized model of photopolymer behaviour for use in optimized holographic data storage scheduling algorithms," 2006.

Conference on Information Science and Systems 2006

S. Rickard and J. Healy, "Stochastic Search For Costas Arrays", Conference on Information Science and Systems 2006 (22nd-24th March 2006, Princeton, NJ, USA)

Xilinx Academic Forum Ireland 2006

J. J. Healy and J. T. Sheridan, "Algorithms and Hardware for Fast Numerical Simulation of Optical Signal Processing Transforms", XAFI'06, (22nd June 2006, Xilinx, Citywest, Co. Dublin), poster

Irish Systems and Signals Conference

J. J. Healy and J. T. Sheridan, "Time Division Fast Linear Canonical Transform" Irish Systems and Signals Conference (28th-30th June, DIT, Dublin).

Research IT Service Launch

J. Healy, S. Rickard, J. T. Sheridan, "Fast optics simulation algorithms, Costas arrays and photopolymer material simulations," Research IT Service Launch (15th November 2006, Data Centre, Daedalus Building, Belfield, Dublin 4), Invited poster

10th Irish Machine Vision and Image Processing Conference

C.P. Mc Elhinney, J. Maycock, B.M. Hennelly, T.J. Naughton, J.B. McDonald, and B. Javidi, ``Extraction and reconstruction of shape information from a digital hologram of three-dimensional objects," Proceedings of

10th Irish Machine Vision and Image Processing Conference, Derek Molloy, Ovidiu Ghita, Robert Sadleir, Eds., pp. 76-83, Dublin, Ireland, 30 August - 1 September 2006

ICO topical meeting on Optoinformatics/Information Photonics

C.P. Mc Elhinney, J. Maycock, B.H. Hennelly, T. J. Naughton, J.B. Mc Donald and B. Javidi, ``Extraction of shape information from three-dimensional objects encoded in a digital hologram," Proceedings ICO topical meeting on Optoinformatics/Information Photonics, Mario L. Calvo, Alexander V. Pavlov, Jurgen Jahns, Eds., pp 42-44, St. Petersburg, Russia, 4-7 September 2006.

CICESE, Baha, Mexico (August 2006)

J. T. Sheridan, J. V. Kelly, M. R. Gleeson, C. E. Close, "Photopolymer materials for holographic data storage applications", 2006. **Invited talk.** 2006

Upcoming Activities:

We are running a number of team building social activities in conjunction with the UCD OSA Student Chapter. We plan to bring over an invited speaker, from SPIE's invited speaker list, in the New Year.

Officer elections will be held in January 2007 at the student chapters AGM. We are looking forward to continuing our research, attending conferences, publishing papers, writing up (for some of us) and networking with our peers both here in Ireland and abroad. We are extremely grateful to SPIE for all their support and funding over the past years and hope to receive further support in the following year. This funding has been used to support chapter members travelling abroad to SPIE sponsored events and for social activities bringing chapter members together in a comfortable environment to allow them to share thoughts and ideas and have fun ☺

Once again the entire UCD SPIE Student Chapter would like to thank Dirk Fabian and Jason Hamman for their marvellous work this year and look forward to working with them next year.

Current Student Chapter Members: 20

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