EUROGRAM

***E**UROPEAN **O**FFICE OF **A**EROSPACE **R**ESEARCH AND **D**EVELOPMENT*

Jan-Feb 2005

Table of Contents

C4ISR ..... Dr. Paul Losiewicz 1
Chemistry and ESEP ..... Lt Col Matt Morgan 2
Lasers and Electro-Optics ..... Mr. Sandy Smith 3
Life Sciences ..... Lt Col Valerie Martindale 4
Materials ..... Maj Kevin LaRochelle 7
Mathematics ..... Dr. Jim Greenberg 8
RF Technology ..... Lt Col Michael Milligan 9
Space Technology ..... Dr. Barrett Flake 10
Conference Support 12
Window on Science 14
Contact Information 18

Note: The figures in this publication are meant to be viewed in color.

Dr. Paul Losiewicz: C4ISR

Site Visit: University College Dublin. Information Hiding Laboratory Department of Computer Science The IHL is operated by Dr. Neil Hurley and Dr Guenole Silvestre. Three presentations were given by their working group on comparisons of lattice schemes and DSSS schemes, Neural Nets and Support Vector Machines, comparative trade-offs for speed, capability, and robustness to ambient noise, and the advantages of Scalar-Costa schemes for blind detection. The IHL began to do more work in steganalysis after 9/11, and developed an application called "the Stego-Wall". The Stego-wall consists of a steganalysis module integrated inside a firewall, which enables the automatic assessment of whether the multimedia data traveling through it to and from the Internet carries secret information or not. The Stego-wall focuses on blind detection, using Distortion Compensated Dithered Modulation (DC-DM), a more efficient variation of Scalar-Costa.

Approved for public release, distribution is unlimited. AFOSR S&P # 05-70

In addition the IHL has been working on Digital audio fingerprinting and basic theory of computation of limits of maximum likelihood (ML) of detection.

Window On Science: EOARD provided grants to Dr. Jana Dittmann and Dr. Claus Vielhauer of Otto-von-Guericke University, Magdeburg, and Dr. Andreas Westfeld, Technische Universitat, Dresden, to attend the SPIE 2005 Electronic Imaging: Multimedia Processing and Applications Security, Steganography, and Watermarking of Multimedia VII Conference in San Jose. Over 70 papers were presented at the session, *22% sponsored by the AFRL/IFEC Digital Data Embedding Technology group, AFOSR and EOARD*.

Grant Awarded: Dr. Alexander Tarakanov was awarded a cost extension to "Development of Mathematical Models of Immune Networks Intended for Information Security Assurance" to expand his immuno-computing Formal Immune Network (FIN) model to include a cytokine-modeled FIN (cFIN). This is the last software emulation task required prior to actual implementation of the emulator in hardware. Dr. Tarakanov co-authored "Immunocomputing: Principles and Applications," winner of book-of-the-year recognition by the International Institute for Advanced Studies in Systems Research and Cybernetics. AFRL lab evaluator is Mr. Joseph Giordano AFRL/IFGB.

Grant Awarded: Dr. Alexander Smirnov, Computer Aided Integrated Systems Laboratory, St. Petersburg, was awarded a grant under Office of Naval Research contract 'Ontology-driven Information Integration from Heterogeneous Sources for Operational Decision Making Support". The task "Context-sensitive access to electronic documents", addresses AFRL/HE interests in information access activities during operator training and decision making. AFRL evaluator is Dr. H. Barbara Sorensen, AFRL/HEA, Warfighter Training Research Division.

Both awardees are affiliated with the Saint Petersburg Institute for Informatics and Automation of Russian Academy of Sciences (SPIIRAS).

Back to Table of Contents

Lt Col Matt Morgan, Chemistry and ESEP

New Project: Paul Davies from the University of Cambridge in the UK, is working on Optical Characterization of Micro Particles in Molecular Plasmas. Understanding the role of nano and micro sized particles in industrial processes and in the atmosphere using plasmas has become very important. Dr. Davies proposes to develop a novel, sensitive and non-invasive diagnostic technique for probing the chemical composition of solid particle surfaces in dusty plasmas. Specifically, pulsed tuneable lasers will be used to excite whispering gallery modes (wgms) in individual silica microspheres trapped in a plasma crystal. This novel chemical probe will link the particle composition to the chemical composition of the plasma.

Project Concluded: Dr Eugene Terentjev at the Cavendish Laboratory in Cambridge, UK, submitted his final report on Nematic Elastomer Nanocomposites as Electromechanical Actuators. The purpose of the project was to explore a novel actuation system based on elastomer composite with aligned carbon nanotubes (CNT). The initial pursuit of electromechanical actuation effect was deflected into more fundamental studies of nanocomposite formation, alignment and development of ways of characterizing their properties. The main actuation investigated in detail was the stimulation by IR radiation. The study focused on underlying mechanism, establishing its dependence on the degree of nanotube alignment in the rubbery matrix. The grant provided only a small support for a pilot study of preparation and actuation response of new elastomer nanocomposite systems, showing possible directions of future work. However, it enabled the work to proceed and also stimulated active collaboration between Dr. Terentjev's group and that of Dr. Richard Vaia (AFRL/ML). This research will result in the two publications. One publication will be an article in the journal, *Nature Materials*. The other will be a chapter in the forthcoming book *Polymeric Nanostructures and Their Applications* by American Scientific Publishers, edited by H.S. Nalwa.

Back to Table of Contents

Mr. Sandy Smith, Lasers and Electro-Optics

Conference Report: The DEW-2005 Conference was held 17-18 Jan 05 in London, United Kingdom. This is an annual, well attended conference that focuses on weapons applications of lasers and microwaves. The six presentations by US authors were all top level overviews, devoid of any real technical details, of DEW systems on MTHEL, Zeus Ordnance Destroyer, and future, largely undefined systems. The nine European presentations were much more technical, and avoided system level details of any kind. Notable among these were a presentation by QinetiQ in the UK on atmospheric effects on high power laser beams, and an excellent discussion of bundling fiber lasers to achieve high brightness weapon class lasers by Crystal Fibre of Denmark. The material presented in the conference was certainly not worth the very expensive conference registration fee, but the contact with Crystal Fibre will lead to two proposals being submitted to EOARD.

Visit to University of Leeds: I visited the Applied Materials Science Department at the University of Leeds, hosted by Professor Animesh Jha. His department performs research in material laser processing, and also in developing solid state laser materials. He discussed his ideas for tunable mid-infrared laser materials, including those doped with Cr^{2+} and Fe^{2+}, and also ideas for laser pumping of materials doped with U^{3+}. I toured the facilities, which include an experimental fiber draw-tower, a laser spectroscopy lab, and an extensive materials preparation facility. I also received a quick tour of the terahertz experimental laboratory, although this facility is in the Microwave Department, and not part of Prof. Jha's facility. The THz group at Leeds is perhaps the largest in Great Britain, with 12-13 full time staff, and about 8 fully equipped

labs. Dr. Ken Schepler, AFRL/SNJ, has an interest in the mid-infrared laser materials, and Prof Jha is preparing a proposal to EOARD. There were also interesting discussions on THz radiation transported through fibers, and Prof Jha may submit a proposal on that subject as well.

Conference Report: The 20th Advanced Solid State Photonics Conference was held 7-9 Feb 05 in Vienna, Austria. This conference is usually held in the United States, and this is only the second time for it to be held in Europe. The attendance, at 320, and the excellent quality of the oral papers and poster sessions is testimony to its success in the European venue. A large majority of the papers were from Europe, with contributions also from Japan, Australia, South America, and the US. Two papers were given that reported work supported by EOARD. The Helical Core Fiber Laser project with Opto-Electronic Research Centre (ORC), Southampton Univ, reported over 60 Watts output in an M^2<1.4 beam at 1043 nm wavelength. This outstanding demonstration demonstrates a novel approach to achieving high laser power in a large, multimode fiber laser and could be expanded by orders of magnitude. The erbium doped fiber laser pumping a thulium doped fiber laser, also by the ORC, described results of over 160 Watts output from the erbium doped fiber laser, a world record for this type of laser. Another interesting paper was given by Ioffe Institute, announcing a 72% wall plug efficiency, 16 Watt laser diode. A proposal to EOARD from this group on expanding this technology to diode array modules, for pumping solid state lasers is likely. This conference was very useful from an EOARD perspective, with several meetings between European Researchers, US Points of Contact, and me that paved the way for several new research efforts. I expect five proposals within the next few weeks as a result. Lastly, the conference chairman was very generous from the podium in his recognition of EOARD financial support, and included a few sentences in describing our functions in Europe.

Back to Table of Contents

Lt Col Valerie Martindale; Life Sciences

Project Concluded: Professor Zdenek Trefny, Cardiological Laboratory, Czech Republic, "Quantitative measurement of systolic force and heart rhythm coherence: analysis for human factors assessment." This project refines work done on a non-invasive method of monitoring heart function. (www.measurement.sk/2003/S2/Trefny.pdf) Two software modules for quantitative seismographic signal evaluation were developed, one for systolic force measurement and the other for monitoring heart rate and heart rate variability, as well as a suite of analytical tools to interpret the measurements. This research offers a way to monitor and analyze operator state in real time. The wearable telemetry device is of particular interest for cognitive stress monitoring. Professor Trefny is seeking a patent on the software.

Project Concluded: Dr. Lindy Castell, University of Oxford, United Kingdom, "Acute Sleep Deprivation and Immune Cell Changes." Increasing evidence suggests that sleep

is important for proper function of the immune system. Recently, it was established that adults with chronic partial sleep restriction respond poorly to influenza vaccination. This study aims at uncovering the links between observable changes in immune cells and their associated cytokines, and in particular the marked decrease in plasma leptin in 60% of subjects observed in an earlier study. Results indicate dietary glutamine supplementation counters at least some of the effects of one night of sleep deprivation on the immune system. Glutamine supplementation also improves cognitive function following one night of sleep deprivation. The hoped-for leptin results did not materialize due to a higher within-group variability in leptin levels than in previous studies. Of equal interest, one night of "recovery sleep" (ad libitem) was sufficient to restore immune parameters to within normal limits. The mechanism by which normal sleep promotes healthy immune function is unknown.

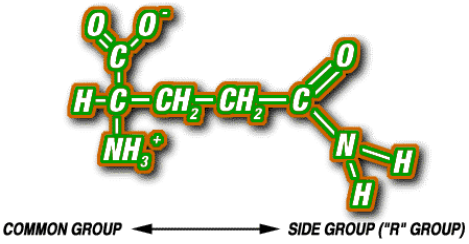

Figure 1. Structure of Glutamine

Project Concluded: Professor Martin Russell, University of Birmingham, United Kingdom, “Speaker verification using a dynamic, 'articulatory' segmental Hidden Markov Model (HMM).” This research attempted to improve current models of speaker recognition by incorporating a model of the mechanisms of human speech which account for variability. The practice resulted in an improvement in text-dependent speaker identification. Text-dependent speaker verification experiments on the YOHO corpus show a 44% decrease in false acceptance rate for a segmental HMM based system, relative to a conventional HMM-based system, for the same false rejection rate. However, the false rejection rate is too small to draw firm conclusions about the relative merits of the two approaches. To conduct text-independent speaker detection experiments on the Switchboard corpus, the researchers developed a type of ‘segmental GMM’, which models speech as a sequence of outputs of a set of linear-trajectory-based statistical segment models. At present, the conclusion is that the fact that the inclusion of dynamic segments, corresponding to trajectories with non-zero slope, consistently fails to improve speaker detection accuracy on Switchboard, suggests that these dynamic regions do not contain information which helps to differentiate between speakers in this corpus.

New Project: Dr. Maarten Kamermans, The Netherlands Ophthalmic Research Institute, The Netherlands. Dr. Kamermans will investigate the relation between photoreceptors, horizontal cell (HC) activity, and bipolar cell (BC) responses in fish, in order to understand e-vector neural coding strategy in the vertebrate retina. Literature suggests that the visual system segregates the information flow into two channels: non-opponent and opponent. Direct evidence for such channels is available in the spectral, spatial and intensity domain. This study will use, for the first time, an integrated and multidisciplinary approach: electrophysiology, morphology and quantitative modeling will be combined to create a functional description of the polarization vision machinery

implemented in the outer retina of the vertebrate eye. The investigator will measure pre- and post-synaptic responses in photoreceptors, HCs and BCs in order to determine transfer functions for information for each. These experiments will be performed in goldfish and zebrafish retinal slices. These fish are widely used for retinal research, they have UV cones and have well characterized neurophysiological properties. The responses of these neurons to polarized stimuli will be applied artificially to the neurons in the preparation, and the relation between photoreceptor and HC activity and BC processing will be derived.

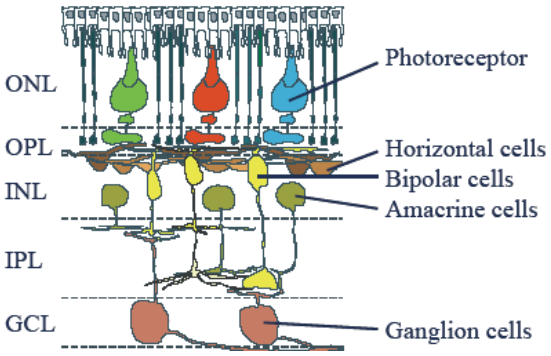

Figure 2. Schematic cross-section of the retina

New Project: Dr. Dariusz T. Sladowski, Medical University of Warsaw, Poland, "Effect of nanoparticles on complement system in cell culture model." The researcher will focus on complement activation by nanoparticles which have already been tested in cell culture. Identification of complement activation pathways will be carried out by evaluation of the concentration of pathway specific complement split products generated during human plasma exposure to nanoparticles. Three fragments will be measured: iC3b for common pathway, C4d for classical pathway and Bb fragments for the alternative pathway. Different sizes of nanoparticles such as silver (Ag; 15, 100 nm), molybdenum (MoO_3; 30, 150 nm), aluminum (Al; 30, 103 nm), iron oxide (Fe_3O_4; 30, 47 nm), and titanium dioxide (TiO_2-40nm) will be evaluated for their complement activation potential. Complement activation properties of relatively larger particles of cadmium oxide (CdO; 1 µm), manganese oxide (MnO_2; 1-2 µm), and tungsten (W; 27 µm) will be assessed. Additionally he will evaluate the effect of nanoparticles coated with lipopolysaccharide on complement activator properties.

New Project: Dr. Francesco di Nocera, University of Rome 'La Sapienza', Italy, "Cognitive Aspects and Behavioral Effects of Transitions Between Levels of Automation." Dr. di Nocera will investigate the relationship between scanpath (ocular activity) and mental workload on the basis of the consideration that high workload should produce fixations grouping (because the operator needs to focus on some specific feature of the interface/task) whereas low workload should be associated with regular patterns, indicating a regular check of the interface space. According to this hypothesis, indexes providing information about the dispersion of point patterns should indicate regularity in the case of low workload and grouping in the case of high workload. The investigator will use the Complete Spatial Randomness testing procedure for gathering this type of information. The dispersion index will be used for investigating the processes underlying shifts in the level of automation, and their consequences on operator performance. Findings will be used to investigate the cost of shifting between levels of automation, employing a dual-task paradigm and collecting performance, physiological, and subjective measures of workload.

Site Visit: Professor B.L. William Wong, Middlesex University, United Kingdom. Dr. Wong is putting together, literally, a laboratory for the study of human-computer interaction. Moving into a new facility coincided with the arrival of new equipment which allow a rapid, easy data collection. Four high resolution cameras are combined by hardware circuits to produce four simultaneous views, which can capture the screen, facial expressions, keyboard and mouse movements, and posture changes as operators interact with new hardware or software features. The system is simple enough to be taken "into the field" and set up within minutes. It complements Dr Wong's active program on information representation. An ongoing interest is in the use of multilayer displays. Such displays in which the presentation screens are separated by some thickness of clear medium (currently limited to two layers) offer a fundamentally new way of segregating presented data and/or tasks. A recently completed project showed faster response time for a simplified air-traffic control task when the aircraft were represented on different levels according to their altitude. The performance advantage was negligible in simple tasks, but became significant when the task was demanding.

Back to Table of Contents

Maj Kevin LaRochelle; Materials

I started traveling last December. Please let me know if there are particular places you would like me to go see for you. These can be conferences or site visits. You all are the experts, and I am your eyes and ears over here.

Research Project Awarded*:* "Slip Activity in Commercial Purity Titanium (CP Ti)" to Tamas H. Ungar, Department of General Physics, Eotvos University Budapest, Budapest, Hungary. The grantee shall extend the use of polymer process models to the prediction of carbon nanofiber dispersion in thermoset resins. The aim of this research project is to determine the dislocation type and density and the twin- and stacking-fault densities in titanium specimens prepared by well-defined plastic deformation procedures.

Research Project Awarded: "Ab-Initio Calculations of Structure and Properties of Nanolaminated MAX Phases**"** to Jochen M. Schneider, Materials Chemistry, RWTH Aachen University, Aachen, Germany. This project is based on state of the art (1998 Nobel Prize in chemistry) density functional theory calculation algorithms to build up models of MAX phases and provide predictions of their phase stability and expected properties. It is envisioned to systematically explore nanolaminated phases with the M2AlC formula to address the influence of the M elements (Y, Zr, Nb, Mo, La, Hf, Ta, W) on bonding strength, electronic structure, and shear modulus. The aim is to contribute towards the development of novel tribological materials. They will study the relationship between the valence electron configuration of M = Y, Zr, Nb, Mo, La, Hf, Ta, and W in M2AlC and the shear modulus of this fascinating new class of nanolaminated materials.

Site Visit: University of Wales Swansea. The materials testing facilities located within the Materials Research Centre at The University of Wales Swansea are fairly extensive of any similar UK university department. Over eighteen servo hydraulic and servo electrical test frames are employed for a wide variety of test techniques including static assessment (tensile and creep), forging simulation, low and high cycle fatigue. The equipment allows characterization across the temperature range -60°C to 1600°C under slow and high cycle frequencies and either uniaxial tension-compression or biaxial tension-torsion regimes. Recent facilities that enable biaxial thermal-mechanical fatigue (TMF) assessments of high temperature aerospace alloys have also been commissioned.

Swansea has a significant reputation in the aerospace field resulting in the majority of industrial research sponsorship coming via the Rolls-Royce University Technology Partnership. A close working relationship between Swansea and Rolls Royce provides regular financial support of research studentships together with longer term research contracts at the post-doctoral level, with RR funding significantly geared against EPSRC (UK research council) and Department of Trade and Industry (UK government) funds.

Conference Report: International Conference on Composite Science and Technology, at the American University of Sharjah, United Arab Emirates. Nasser Qaddoumi, from the American University of Sharjah, is performing research is in the area of non-destructive evaluation. He is working on developing a technology to detect and identify defects within a composite material using both open-ended rectangular and circular waveguides. He currently has the capability to plot 2-D images and is working towards 3-D images and identification of the defect or voids. The fidelity of the image is sub-micron. This would be an excellent technology for identifying cracks in wing structure or panels. It is also being considered for identification of breast cancer tumors.

Viktor and Belinda Verijenko, from the University of Kwazulu, South Africa, have developed the technology to measure maximum strain with in composite materials. This could be used in damage assessment of composite components. They invited me to an upcoming conference and site visit. The paper they presented at ICCST/5 is published in PROCEEDINGS: Fifth International Conference on Composite Science and Technology, by The School of Engineering, American University of Sharjah, Sharjah, United Arab Emirates, 2005.

Back to Table of Contents

Dr Jim Greenberg; Mathematics

Project Concluded: R. Beau, Lotto, Institute of Opthamology, University College London, “Evolving Visually Guided Behavior in Hovering Virtual Agents.” Stage I of this project involved the development of a virtual or Mosaic World in which neural net agents ‘hover’ above a 2D landscape and stage II involved evolving the virtual agents within the Mosaic World, and measuring their functional and behavioral responses. The PI, along

with co-authors Ehud Schlessinger and Peter J. Bentley, has written a paper on this work which is under review at GECCO-2005 conference.

New Project: Victor Sofonea, Romanian Academy of Sciences(Timisoara), "High order numerical schemes for Lattice Boltzmann models: Applications to flows with variable Knudsen number". Dr Sofonea will investigate the development of higher order numerical methods to solve Lattice Boltzmann equations. These algorithms/codes will be used to investigate the following two-dimensional problems: (1) heat transport between two parallel walls at rest; (2) Couette flow between moving walls which have different temperatures; (3) pressure driven (Poiseuille) flow and (4) diffusion in a two-dimensional couple. Investigation of numerical errors, spurious effects and computational efficiency will considered.

Windows on Science: EOARD sponsored Professor Berc Rustem of the Department of Computing, Imperial College-London to attend the 5th International Conference on Cooperative Control & Optimization and deliver a plenary lecture entitled "Stochastic Optimization and Worst Case Decisions". In addition to delivering his plenary address, Professor Rustem met and engaged in discussions with Drs Robert Murphey and Don Grundel of AFRL/MN and others from the Air Force Institute of Technology.

Conference Report: AFOSR, along with ONR-Global, DOE, and the NSF were funders of the Pan American Studies Institute in Differential Equations and Analysis. The meeting was held at the Center for Mathematical Modeling in Santiago, Chile from January 10-21, 2005 and was a truly International Conference with speakers from the US, Latin America, and Europe. The Center is one of the most active in Latin America with programs covering the full spectrum of the Mathematical Sciences. The Center is funded primarily by the University of Chile with additional substantial funding from CNRS in France. Greenberg, the LO for Mathematical Sciences at EOARD, gave one of the plenary talks on "Higher-Order Traffic Models". A complete program along with Abstracts may be found at http://pasi2005.dim.uchile.cl/index.php .

Back to Table of Contents

Lt Col Michael Milligan; RF Technology

Site Visit: Semiconductor Physics Institute, Vilnius, Lithuania, to review progress on an AFOSR/EOARD funded research project. This research investigates resistive sensors for measuring high power microwave pulses. At the end of this investigation, the contractor will design, fabricate and test waveguide-type resistive sensors. Research is progressing well, and several other in-house research efforts were discussed.

Site Visit: Astrophysical Institute Potsdam, Potsdam, Germany, to review progress on an AFOSR/EOARD funded research project. This research involves the collection and analysis of solar activity (Coronal Mass Ejections - CME) and CME signature data in the 693-741 MHz and 316-337 MHz frequency ranges using radio spectrometers. This data will be compared to CME data from satellite collection systems for correlation purposes.

Research is progressing well, and several other in-house research efforts were discussed.

New Project: "Space Weather Effects on RF Propagation," by Antonio Casimiro, University of Algarve, Portugal. The objective of this research project is to create more accurate models that examine the effects of physical parameters on RF propagation in the ionosphere and troposphere. In addition, it is anticipated that this research will contribute towards improved antenna design, channel propagation error mitigation on satellite-to-satellite and earth-to-satellite communication links, and an improved understanding of range and refraction errors for trans-ionosphere RF wave propagation.

New Project: "New Techniques for Space Weather Forecasting," by Jean-Francois Hochedez, Royal Observatory of Belgium, Brussels, Belgium. The objective of this research project is to investigate a variety of novel methods for predicting the arrival of Coronal Mass Ejections (CMEs) using a series of solar images of Extreme Ultraviolet (UV) light. The aim of the research will be to establish image characteristics and pattern recognition sequences in predicting CMEs.

Back to Table of Contents

Dr. Barrett Flake; Space Technology

Site Visit: University of Surrey, Guildford, UK. EOARD currently supports two projects at the University of Surrey Space Centre led by PI Dr. Phil Palmer. One project is investigating a solar thermal collector and receiver system that uses fiber-optic cables to transmit the solar energy. The solar thermal energy is stored for powering thrusters on satellites. During the visit a graduate student demonstrated the solar collector dish and fiber-optic system using a sun simulator. (Figure 3) For the particular experimental conditions, about 50% of the solar energy incident on a parabolic concentrating collector was transmitted through the meter long fiber-optic cable. Another graduate student working on miniaturizing resistojet type thrusters for use on nanosatellites reviewed results from computational fluid dynamics simulation of flow through a porous catalyst. Four US Air Force officers enrolled in graduate engineering programs at the University of Surrey Space Centre presented their current research efforts, including work on autonomous satellite control and variable speed control moment gyroscopes.

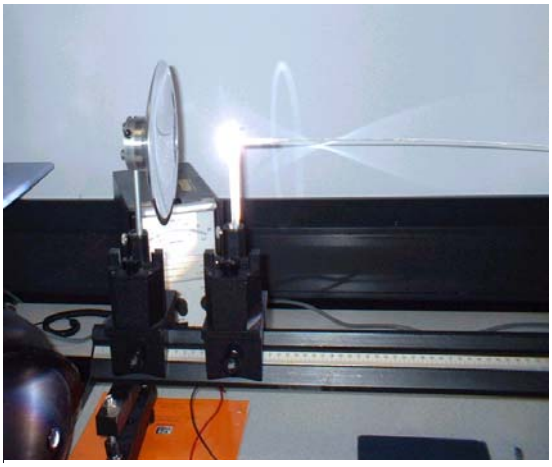

Figure 3. Experimental set up where light from a sun simulator (off to the right) is collected by the parabolic mirror and concentrated at the end of the fiber-optic cable.

Project Concluded: Mario Capitelli, University of Bari "A Model for Ammonia Solar Thermal Thruster." Recently, solar thermal propulsion (STP) engines have been investigated as a promising technology to improve the capabilities of small satellites. At the Surrey Space Centre, a microscale engine has been designed to use ammonia as propellent. The main advantages of ammonia propellent are its sufficiently low molar mass and its chemical inertia at room conditions (not as dangerous as hydrazine). To get better performance, the ammonia gas in the heat exchanger should be dissociated in N2 and H2 species, doubling the particle density. Unfortunately the dissociation kinetics, at temperatures of interest in the engine, are so slow that the complete thermal dissociation of ammonia molecules could not occur. In this project the investigators have developed a kinetic model for an ammonia mixture flowing into the nozzle investigated in previous studies. State-to-state kinetics were introduced to verify the presence of non-equilibrium vibrational distributions during the nozzle expansion.

Project Concluded: Richard Stone, The University of Oxford, "An Investigation of Certain Thermodynamic Losses in Miniature Cryocoolers." Stirling cycle cryocoolers developed at Oxford have typically been designed using a second order method whereby the ideal Stirling efficiency is degraded by a number of discrete loss mechanisms. In all cases the eventual machines perform less well than expected, and it always appears as if an additional thermodynamic loss is acting. This empirically calibrated loss is therefore included as part of the normal design procedure and there is anecdotal evidence that this is an approach taken by other manufacturers. Although this loss might be caused by imperfect heat transfer, existing theories do not agree with its magnitude. A project was therefore started to measure the losses in the simplest possible geometry, a linear compressor with a plain 'top-hat' cylinder head. It was hoped that by characterizing the losses in this geometry and applying them to full machines these called "compression loss" could be explained. Since the loss is quite large it could allow significant improvements to be made for future machines.

A well calibrated measurement system was developed and a linear compressor commissioned. To enable a sufficiently good energy balance to be produced electromagnetic motor losses and windage were measured. It immediately became clear that these were more significant than had been assumed in previous studies. In fact it appeared as if a significant proportion of the "compression loss" might be explained by these new measurements. With the new motor loss measurements the thermodynamic losses were measured and found to agree much better with the clearance seal and heat transfer losses expected from analytic analyses. Agreement was not perfect, however, and this is thought to be due to the incompleteness of the heat transfer theory, particularly with regard to the flow through the clearance seal. Future possibilities for work are suggested and it is hoped that these measurements can be used as a baseline for testing theoretical work which will enable efficiencies to be increased not just in Stirling type coolers, but also in pulse tubes and linear alternators.

Back to Table of Contents

Conference Support

EOARD promotes technical interchange by supporting and co-sponsoring technical workshops and mini-symposia at overseas conferences. We often receive, in return for sponsorship, proceedings and free conference registration for one or more Air Force representatives. Air Force R&D personnel attending or considering attending European conferences or seeking further details on the conferences listed below contact the program manager indicated (see footnotes). **Bi-service and tri-service support efforts** are in bold print. A listing of conferences is also available at the AFOSR conference web page.

Chemistry; Lt Col Matt Morgan

2 - 6 May 05	Petit Kursaal, Besançon (France)	9th International Conference on Squeezed States and Uncertainty Relations
6 - 8 Jun 05	Sorrento, Italy	First World Congress on Corrosion in the Military

Information Technology and C4I; Dr. Paul Losiewicz

6 - 8 Jun 05	26, Dvortsovaya emb. St Petersburg, 191186 RU	International Workshop on Autonomous Intelligent Systems

Lasers and Electro-Optics; Mr. Sandy Smith

6 - 9 Feb 05	**Vienna, Austria**	Advanced Solid-State Photonics Meeting and Tabletop Exhibit
23 - 27 May 05	Bruges, Belgium	OFS-17, 17th International Conference on Optical Fibre

Life Sciences; Lt Col Valerie Martindale

6 - 8 Apr 05	Reading, Berkshire, UK	Royal Institute of Navigation 05: Orientation & Navigation - Birds, Humans & Other Animals
20 - 24 Jul 05	Stresa, Italy	XXVII Annual Conference of the Cognitive Science Society
22 - 26 Aug 05	A Coruna, Spain	European Conference on Visual Perception

Materials; Maj Kevin LaRochelle

15 - 18 May 05	Cardiff, UK (note: 31 Mar registration deadline)	WOCSDICE 2005 (Workshop on Compound Semiconductor Devices and Integrated Circuits)

Approved for public release, distribution is unlimited. AFOSR S&P # 05-70

26 - 30 Jun 05	Santiago de Compostela	6th International Workshop on Interfaces: Interfaces by Design
27 - 29 Jun 05	Kiev	Advance Materials Workshop
4 - 6 Jul 05	Gdansk, Poland	DAMAS Damage Assessment of Structures

Sensors and RF Technology; Lt Col Michael Milligan

26 Jun - 8 Jul 05	Il Ciocco/Italy	European/American Summerschool on Superconductive Electronics

Space Technology; Dr. Barrett Flake

16 - 18 Mar 05	University of Rome	Workshop on Constructal Theory Applications to Aerospace Vehicles
4 - 8 Apr 05	Berlin Hilton Hotel	5th IAA Symposium on Small Satellites for Earth Observation
11 - 13 Apr 05	University of Leeds	Faraday Discussion 130: Atmospheric Chemistry
24 - 27 May 05	Moscow, Russia	6th Workshop on Magnetoplasma Aerodynamics for Aerospace Applications
4 - 6 Jul 05	Marseille, France	Potentially Disruptive Technologies and Their Impact in Space Programs
4 - 9 Sep 05	Leysin, Switzerland	28th International Symposium on Free Radicals
11 - 16 Sep 05	Salamanca, Spain	The 19th International Colloquium on High Resolution Molecular Spectroscopy

Back to Table of Contents

Window on Science

EOARD initiates and promotes technical liaison between Air Force and foreign scientists very effectively with the Window On Science (WOS) program, through which we can arrange and fund visits of foreign scientists to selected Air Force facilities. To nominate a WOS candidate, contact your Technical Director or your EOARD discipline representative. WOS visitors currently on contract are listed below. For further details contact the program manager indicated.

Date	Traveler	Country	Subject	Location of Visit(s)
Chemistry; Lt Col Matt Morgan				
6 - 14 Jan 05	Dr. Friedhelm Werner Otto Bechstedt	Germany	Nonparabolicity and excitons in optical absorption of InN	AFOSR Indium Nitride Workshop 2 in Kailua-Kona, Hawaii.
7 - 14 Jan 05	Dr. Robert W Martin	United Kingdom	Composition and Optical Properties of InN	AFOSR Indium Nitride Workshop 2 in Kailua-Kona, Hawaii.
7 - 13 Jan 05	Dr. Valery Davydov	Russia	Optical, structural and electrical studies of InN	AFOSR Indium Nitride Workshop 2 in Kailua-Kona, Hawaii.
8 - 15 Jan 05	Dr. Martin Hermann Hans Kuball	United Kingdom	Raman scattering on InN	AFOSR Indium Nitride Workshop 2 in Kailua-Kona, Hawaii.
8 - 16 Jan 05	Pierre Ruterana	France	Structural analyisis by TEM in InN layers grown by MOCVD	AFOSR Indium Nitride Workshop 2 in Kailua-Kona, Hawaii..
8 - 14 Jan 05	Professor Evgeniya Petrova Valcheva	Bulgaria	A presentation on the nature of the interband transitions in InN	AFOSR Indium Nitride Workshop 2 in Kailua-Kona, Hawaii.
Information Technology and C4I; Dr. Paul Losiewicz				
8 - 26 Jan 05	Dr. Andreas Westfeld	Germany	'Space filling curves in steganalysis'	2005 SPIE Electronic Imaging Conf In San Jose; AFRL/IFEC DDET meeting at SUNY Binghamton
14 - 22 Jan 05	Mr. Andreas Lang	Germany	Digital Watermarking Presentation at SPIE Electronic Imaging Conference	Presenting a paper on Digital Watermarking (EOARD funded research with AFRL/IFEC) at SPIE San Jose 2005,
15 - 26 Jan 05	Mr. Rainer Boehme	Germany	Recent Advances in CRYSTAL	2005 SPIE Electronic Imaging Conf In San Jose; AFRL/IFEC DDET meeting at SUNY Binghamton

Approved for public release, distribution is unlimited. AFOSR S&P # 05-70

13 - 18 Feb 05	Dr. Corneliu Ciubotariu	Romania	Chaotic Bits in Quantum and Chaos Computing	Space Technology & Applications International Forum - 2005 (STAIF-2005) Albuquerque NM

Life Sciences; Lt Col Valerie Martindale

16 - 22 Jan 05	Dr. David Porter	United Kingdom	Predicting the Mechanical Properties of Silk	AFOSR workshop, San Diego, CA
19 - 23 Mar 05	Dr. Francesco Di Nocera	Italy	Cognitive aspects and behavioral effects of transitions between levels of automation	AFRL/HECP, Wright Patterson AFB OH
16 - 22 Apr 05	Professor Jose F Fontanari	Brazil	Evolution of communication in simulated organisms: a critical account of the current proposals	IEEE KIMAS'05 Conference, Waltham MA
23 - 29 Apr 05	Dr. David A Basketter	United Kingdom	Skin Sensitisation: Strategies for the Assessment of Risk	2005 Toxicological and Risk Assessment Conference, Fairborn, OH
30 Apr - 6 May 05	Dr. Christina Joselevitch	The Netherlands	Dendritic Potassium Channels In Mixed-Input On Bipolar Cells	ARVO Conference, Fort Lauderdale, FL
2 - 6 Feb 05	Professor Mats Larsson	Sweden	Dissociative Recombination Studies at CRYRING	AFRL/VSBX, Hanscom AFB, MA

Sensors and RF Technology; Lt Col Michael Milligan

8 - 13 Jan 05	Dr. Spomenko Mihajlovic	Serbia & Montenegro	Geomagnetic and Ionospheric Disturbances during Solar Storm Conditions	Attend Communications/Navigation Outage Forecasting System (C/NOFS) conference, sponsored by AFRL/VSB.
8 - 13 Jan 05	Norbert O Jakowski	Germany	participation in the C/NOFS Workshop held at Estes Park /Colorado	Attend Communications/Navigation Outage Forecasting System (C/NOFS) conference, sponsored by AFRL/VSB.
8 - 13 Jan 05	Professor Hermann Luehr	Germany	Communications/Navigation Outage Forecasting System (C/NOFS) Science Workshop	Attend Communications/Navigation Outage Forecasting System (C/NOFS) conference, sponsored by AFRL/VSB.

Approved for public release, distribution is unlimited. AFOSR S&P # 05-70

8 - 13 Jan 05	Professor Nikolay P Danilkin	Russian Federation	New ionograms of satellite radiosounding from 340 km height	Attend Communications/Navigation Outage Forecasting System (C/NOFS) conference, sponsored by AFRL/VSB.

Space Technology; Dr. Barrett Flake

8 - 14 Jan 05	Dr. Sergei Bobashev	Russia	Characteristics of the Magento Hydro Dynamic Diffuser Under Different Commutations of Current	AIAA Weakly Ionized Gas Conference, Reno, NV
8 - 14 Jan 05	Dr. Alexander Leonidovich Kuranov	Russia	Using MHD-Channel for Investigation of Conductivity in Plasma Combustion	AIAA Weakly Ionized Gas Conference, Reno, NV
8 - 14 Jan 05	Dr. Valentin Bityurin	Russia	Non-thermal Plasma Aerodynamics Effects Found	AIAA Weakly Ionized Gas Conference, Reno, NV
8 - 14 Jan 05	Professor Vladimir Lvovich Bytchkov	Russia	Plasma-Jet Studies for Plasma Chemical Fuel Activation	AIAA Weakly Ionized Gas Conference, Reno, NV
8 - 14 Jan 05	Professor Victor Kuchinskiy	Russia	Mechanism of Low-Temperature Plasma Effect	AIAA Weakly Ionized Gas Conference, Reno, NV
8 - 14 Jan 05	Dr. Evgueni Cheikine	Russia	Magnetohydrodynamic Control in Hypersonic Aircraft	AIAA Weakly Ionized Gas Conference, Reno, NV
8 - 14 Jan 05	Professor Igor Kossyi	Russia	Non-Self-Sustained Microwave discharge as a Method for Igniting Combustion in Gas Mixtures	AIAA Weakly Ionized Gas Conference, Reno, NV
8 - 14 Jan 05	Dr. Serguei Leonov	Russia	Mechanisms of Flow Control by Near-Surface Electrical Discharge Generation	AIAA Weakly Ionized Gas Conference, Reno, NV
8 - 14 Jan 05	Dr. Alexei Ershov	Russia	Parameters of a Plasma Jet Injected in a Supersonic Airflow	AIAA Weakly Ionized Gas Conference, Reno, NV
8 - 14 Jan 05	Professor Valery Shibkov	Russia	Ignition of Propane-Butane-Air Supersonic Stream with Surface Microwave Discharge	AIAA Weakly Ionized Gas Conference, Reno, NV
8 - 14 Jan 05	Dr. Anatoly Maslov	Russia	Single-Pulse Performance of the Spark Jet Flow Control	AIAA Weakly Ionized Gas Conference, Reno, NV

8 - 14 Jan 05	Dr. Igor Mashek	Russia	Multibeam Interferometry of Self Sustaining and Laser Induced Microwave Discharges in Air	AIAA Weakly Ionized Gas Conference, Reno, NV
8 - 14 Jan 05	Dr. Yury F. Kolesnichenko	Russia	Basics in Beamed Microwave Energy Deposition for Flow/Flight Control	AIAA Weakly Ionized Gas Conference, Reno, NV
8 - 14 Jan 05	Dr. Vladimir Levin	Russia	Transition to Irregular Regimes of Supersonic Flows over Bodies Initiated by Energy Deposition	AIAA Weakly Ionized Gas Conference, Reno, NV
8 - 14 Jan 05	Professor Sergey T Surzhikov	Russia	Supersonic Flow Around Wing with Localized Surface Gas Discharge	AIAA Weakly Ionized Gas Conference, Reno, NV
8 - 14 Jan 05	Professor Andrey F Alexandrov	Russia	Plasma Aerodynamics Investigations in MSU Physical Department	AIAA Weakly Ionized Gas Conference, Reno, NV
8 - 14 Jan 05	Dr. Anatoly Klimov	Russia	Non-premixed Plasma Assisted Combustion in Air Flow	AIAA Weakly Ionized Gas Conference, Reno, NV
8 - 14 Jan 05	Dr. Igor Timofeev	Russia	Approximated Models for Direct Current Discharge in Supersonic Gas Flow	AIAA Weakly Ionized Gas Conference, Reno, NV
8 - 14 Jan 05	Dr. Viacheslav Vinogradov	Russia	Initial Tests of Propane Combustion in Mach 2 Air Flow Under Torch Igniter Effect	AIAA Weakly Ionized Gas Conference, Reno, NV
8 - 14 Jan 05	Tatiana A Bormotova	Russia	Techniques for Predicting Interaction of Gas Dynamic Structures	AIAA Weakly Ionized Gas Conference, Reno, NV
9 - 18 Jan 05	Dr. Kirill Viktorovich Khodataev	Russia	Numerical Modeling of Combustion Assisted with Microwave Discharge	AIAA Weakly Ionized Gas Conference, Reno, NV
9 - 18 Jan 05	Dr. Andrei Starikovskii	Russia	Cathode Directed Streamer Development in Air at Different Pressures	AIAA Weakly Ionized Gas Conference, Reno, NV
9 - 18 Jan 05	Dr. Svetlana Starikovskaia	Russia	Control of Ignition of Hydrocarbon-Air Mixtures by Nanosecond Pulsed Discharges	AIAA Weakly Ionized Gas Conference, Reno, NV
9 - 18 Jan 05	Dr. Igor Esakov	Russia	Efficiency of Microwave Discharges for Ignition in High Speed Airflow	AIAA Weakly Ionized Gas Conference, Reno, NV

Back to Table of Contents

EOARD Contact Information

US Mailing Address:
EOARD
PSC 802 BOX 14
FPO AE 09499-0014

Phone:
COMMERCIAL phone/fax: (+44) (20) 7514-4950/4960
DSN: 314-235-4950/4960

The *EUROGRAM* is published bimonthly by the US Air Force European Office of Aerospace Research and Development (EOARD), Detachment 1 of the Air Force Office of Scientific Research (AFOSR), the basic research manager of the Air Force Research Laboratory (AFRL). It contains reports on research, and a summary of recent work in our primary programs. The opinions and assessments in this periodical are solely those of the authors and do not necessarily reflect official US Government, US Air Force, AFRL, or AFOSR positions.

Back to Table of Contents