CREOL welcomes new faculty member Professor Daniel van der Weide. Currently at the University of Wisconsin at Madison, Professor van der Weide will join our faculty this Spring of this year and become the Florida 21st Century Scholar Endowed Chair in Lasers and Medicine. He has been a Professor of Electrical and Computer Engineering at the University of Wisconsin at Madison, where his group works on micromachined high-frequency electromagnetic sensors; localized microwave spectroscopy on biomolecules and semiconductor devices using multifunctional scanning probes and antennas; and THz spectroscopy with integrated antennas and nonlinear transmission lines, as well as RFID antennas and applications.

Continued on page 4
I just finished with my ninth Industrial Affiliates Day as Director and/or Dean. As always the staff did a wonderful job of putting Affiliates Day together and carrying out all the details that people don’t see. It really is a large effort, and I want to thank everyone sincerely.

At the SPIE Defense and Security Symposium banquet March 19 in Orlando, M.J. Soileau, vice president of UCF’s Office of Research and Commercialization and Founding Director of CREOL, received the SPIE gold medal, the highest honor awarded by the international society. Research faculty member Leon Glebov, won SPIE’s Dennis Gabor Award for outstanding accomplishments in technologies relating to holography. And Shin-Tson Wu, Provost Distinguished Professor of Optics, received SPIE’s G. G. Stokes Award for exceptional contributions to the field of optical polarization.

As I retire from the Dean’s position in January 2009 (That’s when Bahaa Saleh will take over the reins), I want to acknowledge the great job our staff has done throughout the years on this and many other activities and the day-to-day operation. Thank You!

I would like to personally thank Jim Pearson for his years of service to CREOL both before he joined us when he supported CREOL’s efforts ~20 years ago while running the optics division of United Technologies in West Palm Beach, and more recently as Director, Research and Administration at CREOL. He is retiring from this position, and now lives in Georgia, but is still helping us out part time.

I also must reflect on what “CREOL” has done during these years. We became the first college devoted to optics in the US; we more than doubled our external funding level; we are the only unit in the state to have been funded for two rounds of Centers of Excellence funding which initiated the Florida Photonics Center of Excellence and the Townes Laser Institute which also added some 9 new faculty positions for CREOL (Jeb Bush did well for us); we also built a 21,000 sq. ft. addition enabled by funding from the US Department of Commerce because we included business incubator space in the addition. (This also is the only way we could grow since we had run out of space in the old building!) On the other hand we lost our business manager, Tom O’Neal, who initiated the UCF Technology Incubator which went on to become the #1 high-tech business incubator in the country in 2004 (we were the original investors in this venture). Then, we spun off several companies in the incubator as well as licensed considerable technology.

The reputation of CREOL nationally and internationally is based on our faculty and students – here we also have excelled! I am pleased to be able to turn over a very successful CREOL to Bahaa Saleh with opportunities to further build our capabilities.

For the past weeks and for the foreseeable future I seem to be eating breakfast lunch and dinner out. This is because we have five searches ongoing simultaneously, and we have scheduled up to four candidate interviews in a single week. The searches are for faculty positions in Biophotonics, Integrated Photonics, Quantum Optics, Fiber Lasers, and Ceramic Lasers. It will be interesting to see if my belt still buckles at the end of this.

Dr. Eric Van Stryland, Dean
CREOL, The College of Optics & Photonics
“CREOL’s Spring Thing 2008 was an unforgettable celebration of CREOL culture. Industrial Affiliates and UCF’s CREOL family enjoyed a day of fun and adventure with world-class cuisine and music by The Quantum Beats. Much thanks to M.J.!”

Dr. Eric Van Stryland, Dean
CREOL, The College of Optics & Photonics
The common theme running through Professor van der Weide’s research is the interface. “I like to invent ways of translating between the properties of a hidden world and signals created or perceptible by human beings. While the interface is varied, the signals of interest to me lie in the microwave through infrared electromagnetic spectrum, centered in the terahertz, which lies between the electrical and optical worlds, and has properties of both: radio-wave generation, emission and propagation principles merge with quasi-optical techniques for managing beams and measuring absorption spectra of materials. Central to the ability to apply terahertz energy is, again, the interface: the antenna that translates between photons that propagate through space and the motion of electric charge spoken and understood by circuits,” said van der Weide.
“Straddling the world between electronics and optics enables creative advancement by importing concepts from one into the other, a principle I learned from my Ph.D. advisor, David Bloom, whose mantra was, “optics as electronics, electronics as optics.”

“I have explored this principle by using circuits, nonlinear transmission lines, which can generate sub-picosecond electrical pulses with utility similar to that of ultrafast lasers that excite photoconductive switches for terahertz spectroscopy and imaging. The broad spectra of these pulses require wideband yet efficient radiators, similar to antennas needed for ultrawideband (UWB) radar. Thus, antennas for terahertz radiation can be scaled for UWB applications, such as medical imaging. For example, I have had very fruitful collaborations with Professors Susan Hagness and Barry Van Veen at the University of Wisconsin, designing antenna arrays and UWB reflectometers for imaging tumors in the breast.

While short-pulse, time-domain terahertz spectroscopic imaging has very important applications for detecting contrast from concealed threats (explosives, weapons, biological hazards), I am also developing means of modulating these pulses for ranging (e.g. eliminating effects of standing waves) and for short-haul secure communications. These techniques have proven sufficiently valuable to start a company, Tera-X, with a colleague, John Grade. Recognizing the limitations of power available from such short-pulse circuits, as well as the lack of terahertz amplifiers, Professor John Booske and I have been developing micromachined traveling wave tubes for both unprecedented gain and power in the terahertz regime.

While spectroscopic imaging and communications are exciting areas for terahertz electronics, instrumentation for measuring complex reflection and transmission is also of interest to me. In the radio-frequency and microwave regime, such instruments are commercially available as vector network analyzers (VNAs); these are as important to microwave engineers as oscilloscopes are to those who work at lower frequencies. I have long been fascinated with new ways to measure the properties of networks, and of finding new applications for these coherent instruments, such as in biological research and medical imaging. Here again, the interface is central: the coaxial connector that is the primary commercial interface to microwave networks is also the primary limitation to further application of VNAs. For example, more and more circuits are being designed with balanced, rather than single-ended (i.e. coaxial-like) transmission lines. This requires a four-port VNA to measure a two-port balanced circuit, with the expense and complexity of four connectors instead of two. Furthermore, the cost of a precision coaxial connector often dominates the cost of the network: the interface becomes more expensive than the circuit being measured!

Recognizing this limitation led me to develop near-field scanning probes to directly sense and excite electric and magnetic fields at microwave frequencies, scalable to the terahertz. By circumventing the coaxial connector, a new world of measurements emerges, with ramifications beyond integrated circuits into biological applications, such as our recent results sensing conductance and capacitance fluctuations of single molecules in lipid membranes. By micromachining silicon into coaxial tips with radii of 10 nanometers, yet with heights of more than 50 micrometers, we have developed a new interface between the world of single-molecule dimensions and that of microwave and terahertz instrumentation.

Revealing the microwave dielectric contrast available between water, lipids and biomolecules such as proteins has opened up even more opportunities for the interface. We have been both sensing and even influencing the conductance states of single membrane-bound proteins such as $\gamma$-hemolysin ($\gamma$-HL) and alamethicin with this near-field interface. We have also developed larger, resonant near-field antennas for sensing the conformational states of proteins in solution, and have measured

Continued on page 14
The annual CREOL Industrial Affiliates Day was held Friday, April 18, 2008. This year's speaker program had the theme “BioPhotonics and Bio-Applications” with an excellent lineup of invited speakers (see below) that included a talk by new CREOL faculty member Dr. Dan van der Weide, an overview of current CREOL research activities involving industrial partners by Dean Eric Van Stryland, a presentation by CREOL Student of the Year Giorgios Siviloglou (advised by Dr. Demetrios Christodoulides), poster papers by CREOL graduate students – with the Outstanding Poster Award, sponsored by Gary and Connie Washam, going to Claudiu Cirloganu – and tours of several CREOL labs conducted by members of the CREOL Association of Optics Students (CAOS).

After welcoming remarks by UCF Provost Terry Hickey and Dean Eric Van Stryland, the morning seminar session was opened by Dr. Rox Anderson, Professor of Dermatology at Harvard University, Director of the Wellman Center for Photomedicine, and Professor of Health Sciences and Technology at MIT. Dr. Anderson spoke on “Unmet Technology Challenges in Laser Medicine.” The challenges he outlined included real-time, wide-field, high-resolution molecular imaging for real-time cancer detection; integrated, real-time, “see-and-treat” platforms; and optical diagnostics that can replace biopsies. He also discussed some interesting aspects of tattoos and tattoo removal.

Yaron Silberberg, Professor, Physics of Complex Systems at the Weizmann Institute of Science, spoke on “Nonlinear Microscopy.” A number of optical techniques are being used to advance this science and its use in many applications. Among the techniques Dr. Silberberg outlined were multi-photon fluorescence (2- and 3-photon, second- and third-harmonic generation), Coherent Anti-Stokes Raman Spectroscopy (CARS), “STED” Microscopy, which uses nonlinear saturation to create contrast allowing resolution down to ~20 nm using near IR wavelengths, and the use of femtosecond lasers to create tailored temporal pulse shapes.

James Fujimoto, Professor of Electrical Engineering and Computer Science at MIT spoke on “Biomedical Imaging using Optical Coherence Tomography.” The current high-impact area for OCT is ophthalmology, although other medical applications are being developed. Dr. Fujimoto outlined a number of variations of OCT such as use of femtosecond pulsed lasers (highest resolution – 1-2 μm), adaptive optics combined with ultra-high resolution OCT, and frequency-swept OCT, which provides acquisition speeds 100 times faster than standard OCT and doesn’t require a spectrometer or interferometer, and which allows real-time imaging of flow as well as tissue motion and structure.
Christopher Contag, Assoc. Professor of Pediatrics, Radiology, Microbiology, and Immunology at Stanford University, spoke on “In-vivo Studies of Biology using Bioluminescence Imaging”. Dr. Contag outlined how bioluminescence imaging provides access to new information in the context of living tissue such as gene expression (timing, patterns); data before, during, and after treatments; and pharmacology and drug delivery in a living animal. These data can be used to reveal nuances of disease mechanisms and of therapeutic responses, particularly molecular-targeted therapies that deactivate specific genes.

Dr. Aristide Dogariu, Professor of Optics at CREOL, The College of Optics and Photonics, spoke on “Scattering Phenomena in Biomedical Optics”. Although scattering phenomena due to the random, inhomogeneous nature of biological media often make standard imaging difficult, Dr. Dogariu explained how by using correlated scattering measurements of coherent light, a significant amount of information can be obtained, that can supplement or even replace deterministic measurement data such as imaging, spectrometry, etc., giving information about the size distribution and density of scattering centers, their statistical motion, etc. This information is often the data of interest that is usually gleaned from real images.

The final invited talk of the day was given by Dr. Daniel van der Weide, Florida 21st Century Scholar Endowed Chair in Lasers in Medicine at CREOL, The College of Optics and Photonics. Dr. van der Weide spoke on “Infrared and Terahertz Combs for Fast Spectroscopy” and the use of far-infrared and terahertz sources for nanoscale probes. One important application he outlined for these technologies was standoff chemical imaging for detection of things like IEDs (improvised explosive devices). The invited speaker presentations can be viewed on the CREOL website by visiting http://www.optics.ucf.edu/Partnerships/Affiliates/AffiliatesDay2008/Default.aspx and clicking on the appropriate link.

Dr. James Pearson
Director, Research and Administration
M.J. Soileau Awarded SPIE Gold Medal

M.J. Soileau, UCF Vice President for Research and Commercialization and Founding Director of CREOL, received the SPIE Gold Medal, the highest honor awarded by the international society. Beginning in 1977, the Gold Medal Award has been awarded annually in recognition of outstanding engineering or scientific accomplishments in optics, electro-optics, or photographic technologies or applications.

Leon Glebov Wins Dennis Gabor Award

Research faculty member Leon Glebov was awarded SPIE’s Dennis Gabor Award in recognition of his discovery and practical implementation of photo-thermo-refractive glass as a new medium for recording high-efficiency volume holographic gratings, and for his pioneering studies of photo-ionization physics of pure and doped glasses which enabled both the discovery and development of relevant technologies. The Dennis Gabor Award is presented annually in recognition of outstanding accomplishments in diffractive wavefront technologies, especially those which further the development of holography and metrology applications.

Shin-Tson Wu Receives G.G. Stokes Award

Shin-Tson Wu, Provost Distinguished Professor of Optics, received SPIE’s G. G. Stokes Award in recognition of his exceptional contributions to liquid crystal displays, tunable photonics, and adaptive-focus lenses. This award is presented annually for exceptional contributions to the field of optical polarization.
Bahaa Saleh Wins Distinguished Service Award

The Optical Society (OSA) has awarded Bahaa Saleh, recently selected as the next Dean of CREOL, The College of Optics & Photonics, the Distinguished Service Award in recognition of his distinguished service to the Optical Society and the optics and photonics community, and for leadership in the area of publications.

2008 Jan Rajchman Prize Awarded to Shin-Tson Wu

Dr. Shin-Tson Wu, head of the Liquid Crystal Display research group within CREOL, has been chosen as the winner of the 2008 Jan Rajchman Prize, the highest honor conferred by the Society for Information Display.

University Award for Excellence in Distinguished Research: Demetrios Christodoulides

Demetrios Christodoulides, a Provost’s Distinguished Research Professor was awarded the University Award for Excellence in Distinguished Research. Christodoulides is a theoretician and researcher in the field of nonlinear optics. His theoretical work in predicting a unique class of light beams has been followed by research that has observed and demonstrated their existence.

Winston Shoenfeld Elected Chair, Florida Chapter of the American Vacuum Society (FL-AVS)

Dr. Winston Schoenfeld was elected in March as Chair of the Florida Chapter of the American Vacuum Society.

CREOL Faculty & Students Featured in SPIE Professional

The April 2008 issue of “ SPIE Professional” featured CREOL students Toufic Jabbour, Supraja Murali and Leo Siiman among the 15 winners of Newport Spectra-Physics Research Excellence Travel Awards. Glenn Boreman is pictured along with several others participating in the RioAO-OPTILAS 2007 conference in Campinas, Brazil where Glenn was an invited speaker and sponsored by SPIE’s visiting lecturer program. Oleksiy Andrusyak is recognized as winner of the IPG Photonics Award for an outstanding paper at Photonics West 2008. Also, Jannick Rolland, Mubarak Shah, and Kathleen Richardson are among the new SPIE Fellows elected for 2008.

ODALab News
Jannick Rolland Elected SPIE Fellow

Multiple Awards to ODALab Students

In her role as director of the CREOL Optical Diagnostics and Applications Lab (ODALab), Professor Rolland has been elected as a SPIE Fellow for specific achievements in optical system engineering and design, including applications for emerging biomedical technologies. The ODALab is focused on the development of biotechnology for 3D imaging and 3D visualization. Activities in the ODALab aim at fostering interdisciplinary basic and applied research in novel optical instrumentation for 3D optical imaging and visualization systems, image analysis, and assessment methodology. Applications include 3D imaging and 3D visualization, medical imaging and visualization, personal displays for task assistant, and optical testing for optical fabrication.

Since the beginning of the year, 5 of her outstanding Ph.D. students have received multiple awards in Optical Science and Engineering, totalling $15K.

Tobias Schmid will receive the $5,000 Michael Kidger Memorial Fellowship 2008. Tobias is a Ph.D. candidate applying and further developing Nodal Aberration Theory for guiding the design and alignment of rotationally non-symmetric systems. This award was established in 1998 to honor Michael John Kidger, a well-respected teacher and member of the optical science and engineering community.

Among the SPIE Scholarship winners is Ozan Cakmakci who has been selected to receive the William H. Price Scholarship 2008 in Optical Engineering in the amount of $3,000. Ozan is a Ph.D. candidate developing free-form optics technology for wearable displays. This scholarship was established in 1985 to honor Bill Price, a well-respected member of SPIE’s technical community.

SPIE is the world’s largest international not-for-profit society in the fields of optics, photonics, and imaging. In SPIE’s Optical Engineering category, Ph.D. candidates Florian Fournier, Kye Sung-Lee and Supraja Murali were selected by the SPIE Board of Directors and Scholarship Committee to receive multiple scholarships totaling $7,000. Florian Fournier is developing free-form optics technology for wearable displays. This scholarship was established in 1985 to honor Bill Price, a well-respected member of SPIE’s technical community. SPIE is the world’s largest international not-for-profit society in the fields of optics, photonics, and imaging.

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Creating the Future of Optics and Photonics
Most currently deployed optical fiber communication systems utilize intensity modulation and direct (IMDD) for information transmission. This technique is simple to implement, but places limits on information capacity. More advanced modulation formats encode information in the amplitude, phase and polarization of the signal, offering higher spectral efficiencies and information capacity. These formats require more complex coherent receivers to obtain the signal phase and polarization information.

Traditionally coherent receivers with complicated phase-locked local oscillators (LOs) have been considered for this purpose. However, recent advances in Analog-to-Digital (A/D) conversion technology enable the use of digital signal processing (DSP) techniques for coherent demodulation of high-speed optically modulated signals. The pairing of DSP technology with coherent optical receivers is gaining much attention as advanced modulation formats may be demodulated. Furthermore, DSP techniques can digitally compensate for various impairments of the optical equipment used (e.g. the transmitter and receiver lasers, fiber impairments, etc.) [1]. Two major functionalities which DSP may be utilized in this context are carrier phase estimation and fiber chromatic dispersion compensation (DC). This in turn translates to ultimately achieving higher information rates transmitted through optical fibers.

Another critical issue which must be addressed in optical transmission systems is compensation for optical fiber chromatic dispersion (this is generally termed channel equalization, in our case the channel being optical fiber). Chromatic dispersion is modeled as an all-pass (unity gain across all frequencies) filter with a quadratic phase as a function of frequency. The slope of this function depends on the fiber characteristics (namely the dispersion coefficient) and length. The phase response of standard single mode fiber (SSMF) is shown for several fiber lengths in figure 2. DC may be achieved by filtering the incoming signal using a filter with an opposite phase response to that of the fiber. It is important to note that DC requires the sampling rate to be twice the symbol rate (e.g. for a 10Gbaud system, 20G samples/sec are required). This is in contrast with phase estimation where only one sample per symbol is required.

![Figure 1: Feedforward carrier phase estimation, showing QPSK constellation.](image)

One of the most challenging requirements for coherent detection is locking the phase of the LO to the transmitter laser phase. This phase synchronization is required for proper demodulation of the incoming signal and is usually obtained by the use of a phase locked loop (PLL). However, the high-speed nature of optically modulated signals poses a stringent requirement on the PLL feedback path delay. Using DSP, only phase tracking (and not phase locking) is required. This task can be achieved using a feedforward technique [2] and can be done using real-time DSP. A scheme which achieves phase tracking is presented in figure 1. The figure shows how coherent detection (where both signal quadratures are detected) with subsequent DSP allows detection of advanced modulation formats such as M-ary phase-shift-keying (PSK) (in the figure quaternaryPSK), without a PLL. The digital feedforward carrier recovery scheme is compatible with specifications of commercially available lasers used today for IM/DD schemes. Estimation of the bit-error rate using this phase estimation scheme is presented in [3].
DC filtering can be implemented in two ways: finite impulse response (FIR) filtering or infinite impulse response (IIR) filtering. Design and implementation of the FIR filter is straightforward; the filter coefficients are obtained by an inverse Fourier transform of the desired transfer function. FIR filtering involves only feedforward paths and hence is highly compatible with real-time implementation. However, as the transmission distance increases, more taps are required to achieve equalization. This presents a heavy computational load and increased latency. For these reasons we suggested a scheme which achieves equalization using IIR filtering [4], as presented in figure 3. The received signal's real and imaginary parts ($y_r$ and $y_i$) are processed to obtain the real part of the dispersion-compensated signal, $x_r$. Although this scheme is quite more complicated than FIR filtering, the feedback path (inherent to IIR filtering) allows DC to be achieved with significantly less computational load (and negligible penalty), as seen in figure 3 (above right).

In summary, optical coherent receivers with subsequent DSP show great promise as enabling technologies for ultra-high information rate optical transmission systems. DSP alleviates the need to lock the phases of the LO and transmitter signal, which is one of the limiting factors for the use of coherent receivers in the optical domain. Various optical impairment issues can be addressed in the digital domain [5, 6], in particular nonlinearity compensation [7]. One of the major issues still to be addressed for successful implementation of this technology is optimization of the algorithms and implementation methods used for DSP demodulation. Current DSP speeds are not high enough to process high-speed optical signals (e.g. 10baud). Hence, parallelization and pipelining techniques must be considered [2]. Moreover, rigorous theoretical analysis of the performance of such receivers is being researched so the various parameters pertaining to the algorithms employed may be optimized.

Dr. Guifang Li (li@creol.ucf.edu)
Gilad Goldfarb (gilad@creol.ucf.edu)
Optical Fiber Communications Group
http://ofc.optics.ucf.edu
2008 Has Been a Very Successful Year for the Students of Shin-Tson Wu’s Liquid Crystal Display Group...

Zhibing Ge received the 2008 Otto Lehman Award and UCF Outstanding Dissertation Award. Ying Zhou won the Chinese Government-sponsored Outstanding Student Award, and Yi-Hsin Lin was selected as the winner of the 2008 International Liquid Crystal Society’s Glenn Brown Prize. Also, Shin-Tson Wu’s Liquid Crystal Display Group paper was recently featured on the March cover of Physical Review Letters. “In Situ Observation of Fringing-Field-Induced Phase Separation in a Liquid-Crystal–Monomer Mixture” by Hongwen Ren and Shin-Tson Wu from CREOL, The College of Optics and Photonics, and Yi-Hsin Lin from the Department of Photonics, Institute of Electro-Optical Engineering, National Chiao Tung University, Hsinchu 30010, Taiwan.

CREOL Student of the Year 2008 Presentation “Observation of Accelerating Airy Beams”

At CREOL’s Industrial Affiliates Day 2008, Ph.D. Student, Georgios Siviloglou accepted the Student of the Year Presentation 2008 award. “We report the first observation of Airy optical beams. This intriguing class of wave packets, initially predicted by Berry and Balazs in 1979, has been realized in both one- and two-dimensional configurations. As demonstrated in our experiments, these Airy beams can remain diffraction-free over long distances while they tend to freely accelerate during propagation.”

Academic Advisor: Demetrios N. Christodoulides; Research collaboration: Drs. Aristide Dogariu & Demetrios Christodoulides; and John Broky.
CREOL Student Awards

Zhibing Ge Receives Coveted $15,000 Otto Lehman Award

Congratulations to Zhibing Ge, Ph.D. graduate of Dr. Shin-Tson Wu, on being awarded the prestigious Otto Lehmann Award for 2008. This coveted award is dedicated to outstanding students who obtained their Ph.D. before the age of 28. The award includes a cash prize of $15,000 and recognition in a ceremony at the University of Karlsruhe.

Yi-Hsin Lin Selected as Winner of 2008 International Liquid Crystal Society’s Glenn Brown Prize

Dr. Yi-Hsin Lin, former student of Dr. Shin-Tson Wu, has been unanimously selected for the 2008 Glenn H. Brown Prize by the International Liquid Crystal Society’s Honors and Awards Committee for his dissertation on “Polarization-independent Liquid Crystal Devices.” Lin’s dissertation, derived from his research at the University of Central Florida was selected for, “developing several novel principles for the operation of polarization-independent modulators based on liquid crystals, which significantly advance the fields of liquid crystal photonics and displays.” The Award Ceremony will take place during the 22nd International Liquid Crystal Conference in Jeju Island, South Korea on Wednesday, July 2, 2008.

Ying Zhou Wins Chinese Government Outstanding Student Award

Ying Zhou has been selected as the recipient of the $5,000 Chinese Government-sponsored, Self-financed Student Study Abroad Award.

UCF Outstanding Dissertation Award 2007 ($1,000) presented to Zhibing Ge

His dissertation, “Modeling of Liquid Crystal Display and Photonic Devices,” was focused on the development of new transflective liquid crystal displays and high efficiency laser beam steering. Having graduated in fall 2007, Ge is now a research scientist with the College of Optics and Photonics.

Oleksiy Andrusyak Receives Best Student Presentation Award 2008 at Photonics West Symposium

Oleksiy Andrusyak was honored for his oral presentation at the conference on Fiber Lasers V: Technology, Systems, and Applications at SPIE’s Photonics West 2008 Symposium. Andrusyak’s presentation was titled “External and common-cavity high spectral density beam combining of high power fiber lasers” was based on the recent advances in spectral beam combining utilizing volume Bragg gratings in photo-thermo-refractive glass. Technology for manufacturing these novel optical elements was developed at CREOL by the Photoinduced Processing Laboratory headed by Dr. Leonid Glebov.

Summer 2008 Graduates

Ph.D.s:
Konstantinos Makris
Segiy Suntsov
Shinwook Lee

Masters Degrees:
David Fox
Jasen Enz
Chong Zhang
Syed Reza
Brian Dorman
Yun-Sheng Chen
Yang Zhao
Charles Reyner
Wilson Caba
Florian Fournier
Peter Krenz
Michael VonNiederhausern

Multiple SPIE Scholarships in Optical Engineering

Several CREOL students are the recipients of SPIE Scholarships in Optical Engineering for 2008, ranging from $1000 to $3,000. They are: Ozan Cakmakci, Nathan Bickel, Florian Fournier, Meizhi Jiao, Kye-Sung Lee, Supraja Murali, Alessandro Salandrino, and Oleksandr Savchyn. Additionally, Benjamin Wu, who was a summer intern in S.T. Wu’s group, won a SPIE scholarship worth $4000.

Newport/Spectra-Physics Research Excellence Travel Awards at Photonics West 2008

The Newport and Spectra-Physics Research Excellence Travel Award, provided financial assistance to graduate students from schools worldwide, including CREOL’s Toufic Jabbout, Supraja Murali, Leo Siiman enabling them to attend and present research at Photonics West 2008.

REU Program Student Earns Congressional Gold Medal

James Martin, a UCF Physics Sophomore and participant in CREOL's International REU program has been selected to receive the Congressional Gold Medal. He will be awarded the medal on June 19 at the US Capitol Building in Washington, DC. James is presently working in Martin Richardson’s research group as a first year international REU student. James recently joined CREOL’s Laser Spectroscopy Team.
both binding and kinetic properties of proteins such as bovine pancreatic ribonuclease A (RNase A) and human estrogen receptor β(ER-β). More discoveries will come as we translate these tools and techniques from the microwave into the terahertz.

**Current Research**
Quantitating and distinguishing among chemical species is commonly done by spectroscopy of molecular vibrations arising from bond forces and intramolecular structure. The frequencies of vibrational “fingerprints” range from approximately 10 to 100 THz (or 300–3000 cm⁻¹), and are measured either by Raman scattering or by direct absorption with Fourier-transform infrared (FTIR) spectrometers. While vibrational spectroscopy could in principle map chemical traffic in real time (both remotely and even at microscopic distances using near-field techniques), conventional FTIR spectrometers fail because of the weakness and incoherence of their blackbody sources.

Recently with Fritz Keilmann and his group we introduced the concept of a new type of frequency comb FTIR (c-FTIR) that overcomes these limitations. It uses a laser-based dual-beam IR source that disperses its spectrum in time, at virtually unlimited speed because it uses no moving parts. Since c-FTIR produces a coherent beam, its dramatically improved brightness enables us to sense real-time chemical content and fluctuations at considerable distances. While we demonstrate the fastest-reported time and spatially-resolved open-path FTIR for remote sensing by probing the absorption spectra of NH₃ vapor fluctuations 22 m away from the spectrometer, this new development opens the way for many more applications.

**Future Research**
I am now becoming more interested in using modulation and demodulation techniques familiar to the wireless world instead of optics. Prof. Guifang Li has done exceptional work in the area of coherent communications, and I am interested in applying coherent modulation to enhancing signal to noise ratios in physical measurements. With a colleague, Robert Marsland, Jr., I have also started a company, Optametra, to build coherent optical test equipment, and hope to use results of this work in my research, as well.

Using coherent techniques to enhance measurements can then be extended to enhance imaging, particularly microscopy. My interests in biophotonics center on using the intrinsic contrast mechanisms in samples to gain insight into the chemical composition and trafficking of living cells. A long-standing tension in biomicroscopy exists between the need to see deeply into tissue and the invasiveness (either through fluorescent dyes or physical intrusion) required to achieve this depth. Lower-energy photons penetrate more deeply, of course, but at the cost of lower spatial resolution. Is there a way to resolve (ha ha) this dilemma?

**Business Philosophy**
I’ve been interested in applying the lessons, training and perspective of business in the academic world, not at the expense of academic rigor, nor at the expense of doing research that might not have an economic payoff in the near term, but rather in the interpretation of risk vs. reward. At the University of Wisconsin, Madison, I created and taught a course entitled “Business for Engineers” that focused on how, as a scientific community, we are trying to better understand “the public domain” by applying public relations and marketing strategies. I think it’s important for researchers to recognize the social contract between their support and society’s needs and expectations; it is a high privilege to work in academia and to get to perform research for the social good. The recognition by our country that academic research is a valuable investment alongside teaching has been a distinguishing and prominent feature of the American landscape for the past century or more. As researchers, we are not being rewarded so much for being smart folks who happen to have landed professorships as we are being entrusted by society to produce results, and more importantly, trained people, that will be of benefit to current and future generations.

**Blue Sky**
I’ve had a long-standing interest in vehicles with wheels or wings. I’ve been interested in cycling since high-school, and raced bikes throughout my college career, often to the detriment of better grades and smoother skin. As a graduate student, I started to fly airplanes, and have recently concluded a long-running quest for my instrument rating, which has opened up a much wider range of weather to me.

Most importantly, I spend time with my fiancée, Elizabeth Heins, and my 3 kids, Noah, Jonah and Silke. They provide the meaning and motivation for all the work I do.

Daniel van der Weide
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