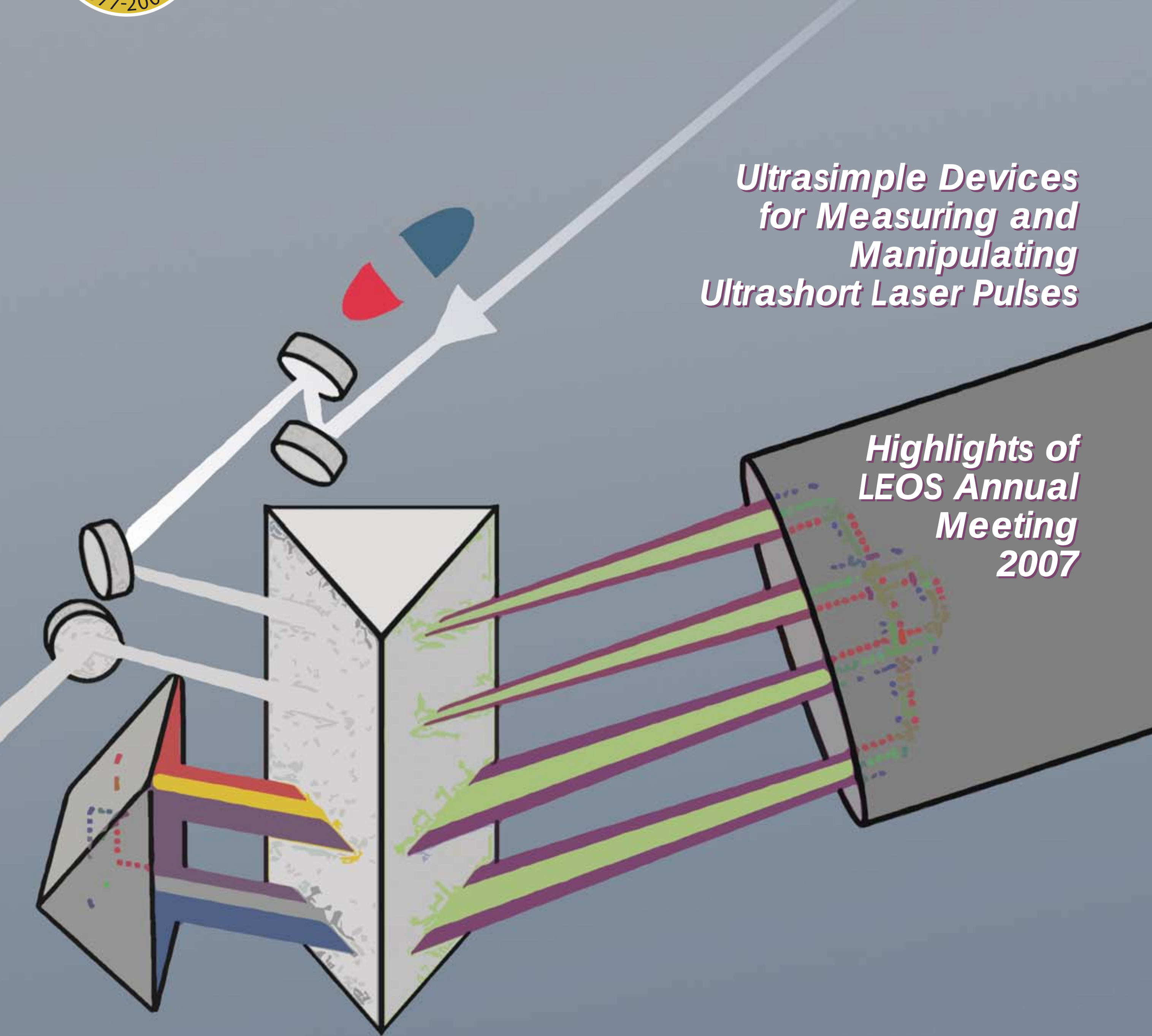
December 2007
Vol. 21, No. 6
www.i-LEOS.org

IEEE LEOS 30th Anniversary 1977-2007

IEEE LEOS NEWS

THE SOCIETY FOR PHOTONICS

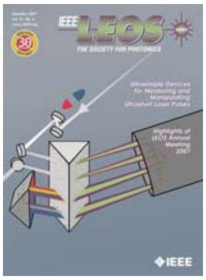


Ultrasimple Devices for Measuring and Manipulating Ultrashort Laser Pulses

Highlights of LEOS Annual Meeting 2007

IEEE


FullWAVE 6.0
BeamPROP 8.0
ModeSYS 4.6
GratingMOD 3.0
FemSIM 3.0
DiffractMOD 3.0
BandSolve 4.0
MOST 2.0
Artifex 4.4
MetroWAND 3.5
LASERMOD 2.2
OptSIM 4.7
SOFTWARE TOOLS FOR
FULL SPECTRUM PHOTONIC & NETWORK DESIGN AUTOMATION
RSOFT
Design Group



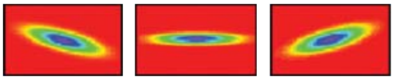
Page 11, Figure 10:
The compact, easy-to-use, distortion-free, and alignment-free single-prism pulse compressor

IEEE LEOS NEWS
THE SOCIETY FOR PHOTONICS

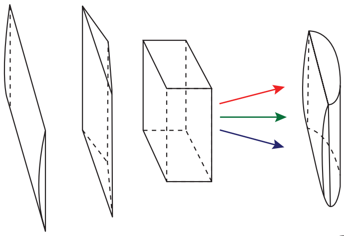
December 2007 Volume 21, Number 6

FEATURES

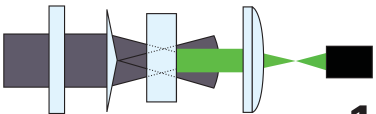
DEPARTMENTS



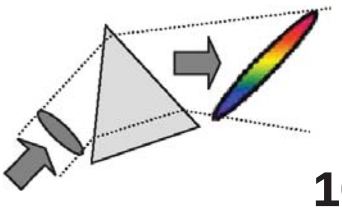
6



8



10



10

COLUMNS

Editor's Column

KRISHNAN PARAMESWARAN

As the 30th anniversary year of LEOS ends this month, we highlight events that took place during our 20th Annual Meeting, held in Orlando in October. To start things off, the conference chairs Dr. Ekaterina Golovchenko and Prof. M. Selim Ünlü have written a nice summary of conference highlights.

Over 600 people attended the conference, which included exhibits by several photonics companies. Two of these firms (Discovery Semiconductor and Swamp Optics) have contributed the feature articles in the current issue. More than half of LEOS members work in industry, and the society is greatly enhanced by corporate participation in our events, so we encourage all companies to contribute articles that will be of interest to LEOS members.

A popular event at the meeting was a visit to the Center for Research in Electro-Optics and Lasers (CREOL) at the University of Central Florida. Students and staff organized tours and a reception, which are nicely described in an article by Amitabh Ghoshal, Vice-President of the CREOL Association of Optics Students.

This 30th year of LEOS has been a tremendous success on many levels. Please join me in congratulating Prof. Alan Willner on completing an outstanding tenure as LEOS President. His energy and enthusiasm are infectious, and the Society is in great shape going forward.

As always, please feel free to send any comments and suggestions to k.parameswaran@ieee.org. I wish everyone a successful end of the year, and look forward to hearing from you in 2008!

Krishnan Parameswaran

LEOS Newsletter is published bimonthly by the Lasers and Electro-Optics Society of the Institute of Electrical and Electronics Engineers, Inc., Corporate Office: 3 Park Avenue, 17th Floor, New York, NY 10017-2394. Printed in the USA. One dollar per member per year is included in the Society fee for each member of the Lasers and Electro-Optics Society. Periodicals postage paid at New York, NY and at additional mailing offices. Postmaster: Send address changes to LEOS Newsletter, IEEE, 445 Hoes Lane, Piscataway, NJ 08854.

President's Column

ALAN E. WILLNER

"(In)Coherent Reflections of Alan Willner, LEOS Member"

"The greatest reward for working in this field is the opportunity to interact with {LEOS} colleagues and to all I offer my thanks and friendship." Gary Eden, when receiving the 2005 Aron Kressel LEOS Award.

I write my last column with much happiness. Indeed, it was a wonderful privilege and deep pleasure to serve my community as President of LEOS. I am greatly enriched by having worked closely with numerous dedicated, bright, and selfless individuals. There is really no better way to express my grateful feelings than to quote Gary Eden above. No commentary is required.

"John Wayne, American." Inscription on a special U.S. postage stamp after the actor passed away.

At this year's LEOS Annual Meeting, I was handed a conference registration badge. Below my name, it said simply "Member." No ribbons, no special Presidential designation. I was so proud to wear that badge since the most prized affiliation is LEOS Member. This reminded me of an instance when I was at AT&T Bell Labs, and someone pointed out an article that was co-authored by the President, an Executive Director, and a Member of Technical Staff at Bell Labs. The by-line simply stated that all three were "Members of the Technical Staff," a title that remained their most fundamental, valuable and unchanging essence.

LEOS is not about seeking honor but about *bestowing* honor. People are asked to serve and are nominated for awards. As stated in *Ethics of our Fathers,* ***"Let the honor of your fellow be as dear to you as your own."*** That is what we are all about.

As President, I served our community and enjoyed it. My term is nearly over, and I happily hand over the position to the extremely capable hands of John Marsh, LEOS President 2008. Although I will be LEOS Past President for the next 2 years, I remain with the title of ***LEOS Member***, thrilled to be part of our community and willing to volunteer for our society.

LASER: Light Emission by Stimulated Emission of Radiation

What starts a laser? It is spontaneous emission. It has been said many times that you need to be both good and lucky to have a successful career. Even the most coherent thing we know needs to have a good design (i.e., stimulated emission inside a resonant cavity) and requires luck (spontaneity). LEOS has helped me personally to be good and lucky. Publications, awards, committees – all important venues for being good. However, LEOS' high-quality activities and publications create many points of contact that maximize the probabilities of being lucky and making the right connection. I am a case in point. I had just been offered a position at AT&T Bell Labs to work with Ivan Kaminow when the June 1988 LEOS Newsletter arrived in my mailbox. As a young student, I was impressed that the section highlighting CLEO had a photo of Ivan. I asked several people, and it was clear that Ivan was a famous fellow. Deal sealed, and I went to work for him. How many people do I presently interact with that I met casually 20 years ago at a LEOS event? Many!

"Youth is wasted on the young." George Bernard Shaw, Nobel Laureate in Literature.

(continued on page 13)

University/Industry Research Highlights

Ultrasimple Devices for Measuring and Manipulating Ultrashort Laser Pulses

Saman Jafarpour and Rick Trebino

Abstract

We describe two powerful and easy-to-use devices essential for every ultrafast laser lab. One compresses pulses to their shortest length, and the other measures them.

Introduction

As ultrafast optics finds more and more applications in more and more disciplines, accurate, complete, and easy-to-use devices for pulse manipulation and measurement become more and more important. Unfortunately, obsolete devices continue to find use, yielding at best incomplete and inaccurate measurements and at worst badly distorted experimental results and incorrect scientific conclusions. We have recently introduced significantly improved devices for the full and reliable characterization and for the distortion-free compression of ultrashort laser pulses. These devices are easy to use, alignment-free, and very accurate and should significantly improve essentially all ultrafast experiments.

Obsolete Measurement Techniques

In the 1960s, it was realized that no device had sufficient temporal resolution to measure even the (many ps long) ultrashort laser pulses of the time. A shorter event was required, but, because ultrashort pulses are the shortest events ever created, none was available. The shortest event available was the pulse itself. So the pulse would have to be used to measure itself. While that isn't quite good enough—it needs to be *shorter*—it was all that could be done. The result, for better or for worse, was the intensity autocorrelation (or just autocorrelation, for short). It involves splitting the pulse into two, variably delaying one with respect to the other, and spatially overlapping the two pulses in some nonlinear-optical medium, such as a second-harmonic-generation (SHG) crystal (See Figure 1). Varying the delay and measuring the second-harmonic pulse energy as a function of delay yields the autocorrelation, and since no second harmonic is generated when the pulses don't overlap in time, the autocorrelation yields a rough measure of the length of the pulse.

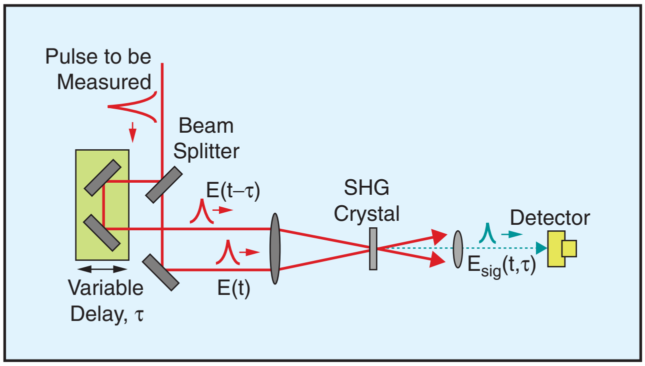


Figure 1. Experimental layout for an intensity autocorrelator using second-harmonic generation. A pulse is split into two, one is variably delayed with respect to the other, and the two pulses are overlapped in an SHG crystal. The SHG pulse energy is measured vs. delay, yielding the autocorrelation trace.

SWAMP OPTICS LLC, 6300 POWERS FERRY ROAD, SUITE 600-345, ATLANTA, GA 30339-2919, USA (RICK.TREBINO@SWAMPOPTICS.COM)

The autocorrelation usually doesn't reveal the structure within a pulse or weak satellite pulses before or after a pulse. Indeed, the autocorrelation doesn't even yield the pulse intensity vs. time because many very different intensity curves can have the same autocorrelation. Mathematically, the attempt to retrieve the intensity vs. time from an autocorrelation is known as the *one-dimensional phase-retrieval problem*, a well-known ill-posed problem. Worse, the autocorrelation says nothing at all about the pulse phase (color) vs. time. Variations in the phase vs. time are, in many ways, even more important than those in the intensity because essentially any optic that the pulse traverses introduces phase distortions into the pulse, and they can badly distort any experiment performed using such a pulse.

The autocorrelation's tendency to wash out structure in the intensity is well known. But this shortcoming is most evident in the measurement of complicated pulses. In fact, for complex pulses, it can be shown that, as the intensity increases in complexity, the autocorrelation actually becomes simpler and approaches a simple shape of a narrow spike on a pedestal, independent of the intensity structure. To sum up the capabilities of the autocorrelator: it gives a rough measure of the pulse length, plus or minus 30% or 40%. And because the autocorrelation is always much smoother than the pulse intensity, it makes very ugly pulses look pretty and somewhat ugly pulses look very pretty.

As a result, laser sales representatives tend to prefer autocorrelation. However, laser purchasers should not because it can hide important potential flaws in the lasers they buy and use (or the pulse distortions generated elsewhere in their setups).

The "interferometric autocorrelation," which is simply an intensity autocorrelation performed with collinear beams, and so also includes the SH from the individual beams in addition to that from the combination of them, is better, yielding some information about the pulse phase. But it really adds only about the same information as the pulse spectrum, and no one has ever found a way to extract the full pulse intensity or phase from it. Like the intensity autocorrelation, many very different pulses can have the same or very similar interferometric auto-


AUTOMATICALLY-GENERATED CODE FLYING AT MACH 9.8.
THAT'S MODEL-BASED DESIGN.
When NASA made history by launching the X-43A, automatically-generated flight code was at the controls for the vehicle's propulsion and stability systems. Engineers developed the autopilot within a radically reduced timeframe using Model-Based Design and Simulink. To learn more, go to mathworks.com/mbd
MATLAB® & SIMULINK®
The MathWorks
Accelerating the pace of engineering and science
©2006 THE MATHWORKS, INC.

correlations, and so it is also an ill-posed problem. This is why autocorrelators do not come with software; no program can retrieve any useful information from one.

Nearly always, what is done is to assume a pulse intensity shape and/or phase when using any type of autocorrelation. Unfortunately, the resulting pulse length depends sensitively on the shape chosen. So users have tabulated ratios of the autocorrelation width and pulse length for different pulse intensity shapes. For example, a Gaussian-intensity pulse has a ratio of √2. So if one knows (somehow) that his pulse is Gaussian in shape, then he can measure the autocorrelation and divide its width by √2, or 1.41 to determine the pulse length. Another pulse shape, hyperbolic secant squared, has a ratio of 1.54. A rectangular pulse shape has a ratio of 1. Since no autocorrelator user ever knows his actual pulse shape, there has been a tendency to use the largest ratio that can possibly be imagined (1.54), in order to be able to claim the shortest pulse (there is tremendous competition to claim the shortest pulse). This became the custom in the days when autocorrelators were the only available device for measuring pulses. But today, we know that it's rare for pulses to have a hyperbolic secant squared pulse shape, and most pulses are actually considerably longer than that obtained in this manner. But this incorrect custom persists.

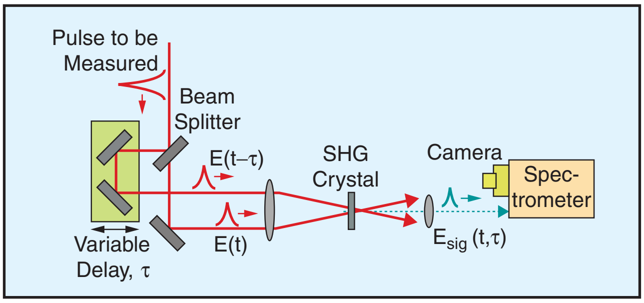


Figure 2. SHG FROG: a spectrally resolved autocorrelation. There are many different nonlinear-optical processes that can be used in FROG, and so it is customary to add a prefix of the nonlinear process to the term FROG, here second-harmonic generation.

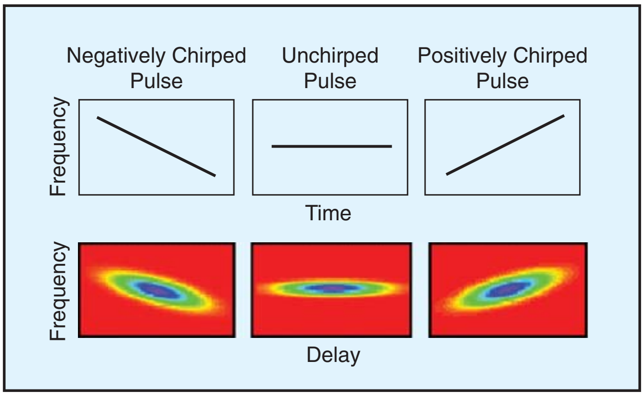


Figure 3. Spectrograms (bottom row) for linearly chirped Gaussian pulses using a version of FROG that uses polarization-gating to measure the pulse. The spectrogram, like the musical score, reflects the pulse frequency vs. time. It also yields the pulse intensity vs. time. SHG FROG traces differ from these in that they are symmetrical with respect to time.

Worse, in view of these issues, it generally isn't possible to sense from an autocorrelation when other pulse distortions (such as spatio-temporal distortions like spatial chirp or pulse-front tilt) or systematic error in the measurement are present.

As a result, autocorrelation is no longer an acceptable measure of most ultrashort pulses unless the pulse is at an exotic wavelength, where better methods are not available.

Accurate Measurement of Short Pulses

Frequency Resolved Optical Gating (FROG) was the first (and it remains the best) technique for fully characterizing a laser pulse intensity and phase vs. time and frequency[1]. FROG is not a big stretch of the imagination from autocorrelation; it is simply a spectrally resolved autocorrelation. See Fig. 2.

FROG operates in the *time-frequency domain* and has both temporal *and* frequency resolution simultaneously. A well-known example of such a measurement is the *musical score*, which is a plot of a sound wave's short-time spectrum vs. time. A mathematically rigorous version of the musical score is the spectrogram, $\Sigma g(\omega,\tau)$:

$$\Sigma_g(\omega,\tau) \equiv \left| \int_{-\infty}^{\infty} E(t)g(t-\tau)\exp(-i\omega t)\,dt \right|^2$$

where g is a variable-delay *gate function* used to gate the unknown function *E*.

Like a musical score, the spectrogram intuitively displays the pulse instantaneous frequency (color) vs. time. And the pulse intensity vs. time is also evident in the spectrogram. Indeed, acoustics researchers can easily *directly* measure the intensity and phase of sound waves, which are many orders of magnitude slower than ultrashort laser pulses, but they often choose to *display* them using a time-frequency-domain quantity like the spectrogram. Importantly, knowledge of the spectrogram of *E(t)* is sufficient to essentially completely determine *E(t)* (except for a few unimportant ambiguities, such as the absolute phase, which are typically of little interest). Thus, determining the pulse intensity and phase from the spectrogram and FROG are well-posed problems.

As a matter of fact, FROG is a general term referring to many techniques with different geometries. Figure 2 shows the geometry known as SHG FROG, but there are many others, each using a different nonlinear-optical process. In its simplest form, FROG is any autocorrelation-type measurement in which the autocorrelator signal beam is spectrally resolved. Instead of measuring the autocorrelator signal energy vs. delay, which yields an autocorrelation, FROG involves measuring the signal spectrum vs. delay. As in autocorrelation, FROG must use the pulse to measure itself. And the SHG FROG trace has the expression:

$$I_{FROG}^{SHG}(\omega,\tau) = \left| \int_{-\infty}^{\infty} E(t)E(t-\tau)\exp(-i\omega t)\,dt \right|^2$$

So making a FROG trace yields an intuitive measure of the pulse. But how do we retrieve the pulse intensity and phase from its measured FROG trace?

It turns out this problem is mathematically equivalent to a well-known solved problem: the *two-dimensional phase-retrieval problem*, which has an essentially unique solution and is a *solved* problem when certain additional information regarding E_{sig} is available (and it is in FROG). This is in stark contrast to the one-dimensional phase-retrieval problem that we encountered in autocorrelation, in which the ambiguities are many, aren't known, and cannot be removed, despite additional information. The two-dimensional phase-retrieval problem has only "trivial" ambiguities, such as an absolute phase or a translation in time. This is what is meant by *essentially unique*. The solution isn't totally unique, but it's good enough because we don't care about the trivial ambiguities, which are few, well known, and can usually be removed easily if necessary.

A useful and important feature that's unique to FROG is the presence of feedback regarding the validity of the measurement data. One type of feedback results from the fact that the FROG trace is a time-frequency plot, that is, an NxN array of points, which are then used to determine N intensity points and N phase points, that is, 2N points. There is thus significant over-determination of the pulse intensity and phase. As a result, the likelihood of a trace with significant systematic error corresponding to an actual pulse is very small.

In practice, FROG has been shown to work very well in the IR, visible, and UV and the x-ray. It has been used to measure pulses from a few fs to many ps in length. It has measured pulses from fJ to mJ in energy. And it can measure simple near-transform-limited pulses to extremely complex pulses with time-bandwidth products in excess of 1000. It can use nearly any fast nonlinear-optical process that might be available. FROG has proven to be a marvelously general technique, and one that works. If an autocorrelator can be constructed for a given pulse, then making a FROG is straightforward since measuring the spectrum of the output pulse is usually easy.

FROG has other advantages. Figure 4 shows two different measurements of the spectrum of a very broadband light pulse ("continuum"). On the left is a FROG measurement (accumulated over ~10^{11} laser shots), and on the right is a simple spectrometer measurement (accumulated over 10^6 laser shots). The continuum spectrum contained much fine-scale structure that fluctuated greatly from pulse to pulse, and which averaged out

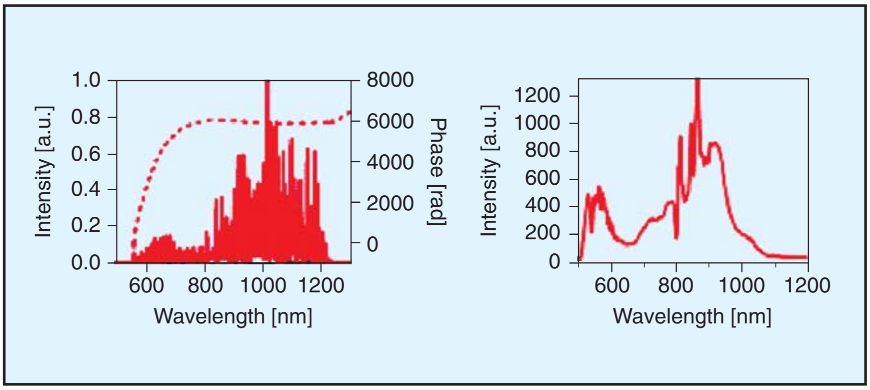


Figure 4. Measurements of the spectrum of a broadband continuum pulse. The FROG measurement (left) reveals the spectral structure, which washes out in the spectrometer measurement (right).

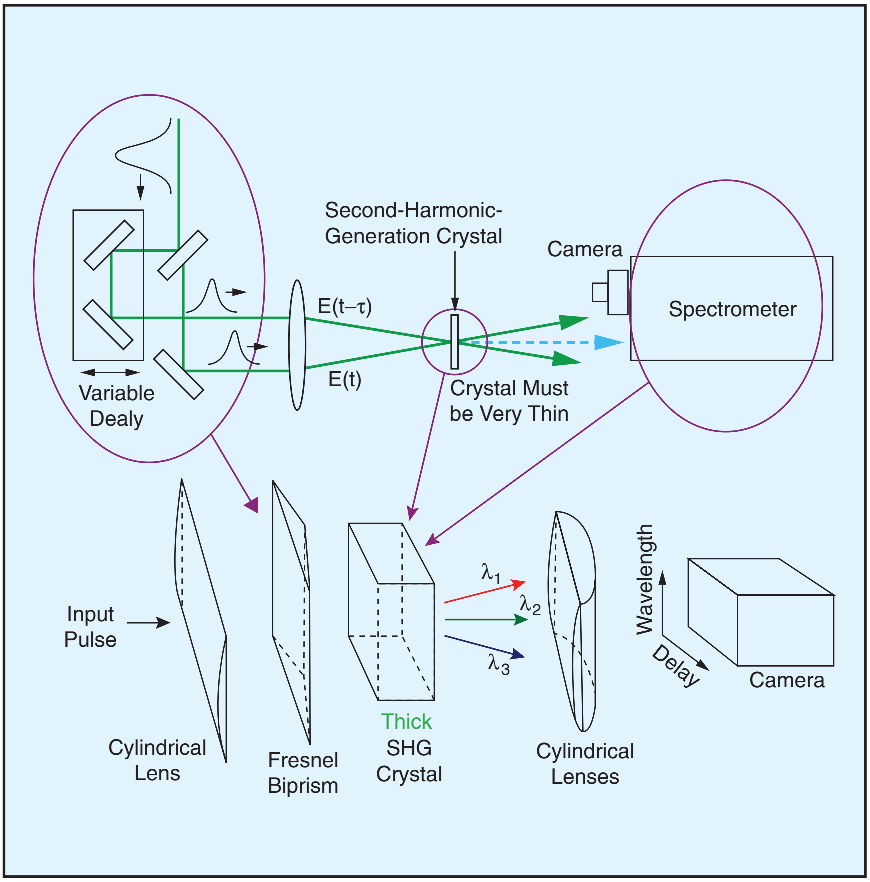


Figure 5. Top: SHG FROG. While SHG FROG is the simplest intensity-and-phase ultrashort-pulse-measurement device, there are a few components of it that we'd like to eliminate to simplify it. Bottom: GRENOUILLE, which involves replacing the complex elements of SHG FROG with simpler ones. GRENOUILLE uses a Fresnel biprism to replace the beam splitter, delay line, and beam-recombining optics. It maps delay to position at the crystal. GRENOUILLE also utilizes a thick SHG crystal acting as both the nonlinear-optical time-gating element and the spectrometer. A complete single-shot SHG FROG trace results. Most importantly, however, GRENOUILLE has zero sensitive alignment parameters.

in the spectrometer spectrum. FROG, on the other hand, because it has both time and frequency resolution, sees the structure—despite the fact that it averaged over many more pulses. This structure was confirmed (with much difficulty) by single-shot spectral measurements using a spectrometer.

Ultrasimple FROG: GRENOUILLE

A few years ago, we developed a simple FROG device. It (see Figs. 5 and 6) involves first replacing the beam splitter, delay line, and beam combining optics with a single simple element, a Fresnel biprism. Second, in seemingly blatant violation of the SHG phase-matching-bandwidth requirement (the SHG crystal should have a bandwidth greater than that of the pulse to be measured), it uses a very *thick* SHG crystal, which not only gives considerably more signal (signal strength scales as the approximate square of the thickness), but also simultaneously replaces the thin crystal *and* the spectrometer! The resulting device, like its other relatives in the FROG family of techniques, has a frivolous name: GRating-Eliminated No-nonsense Observation of Ultrafast Incident Laser Light E-fields (GRENOUILLE, which is the French word for "frog").

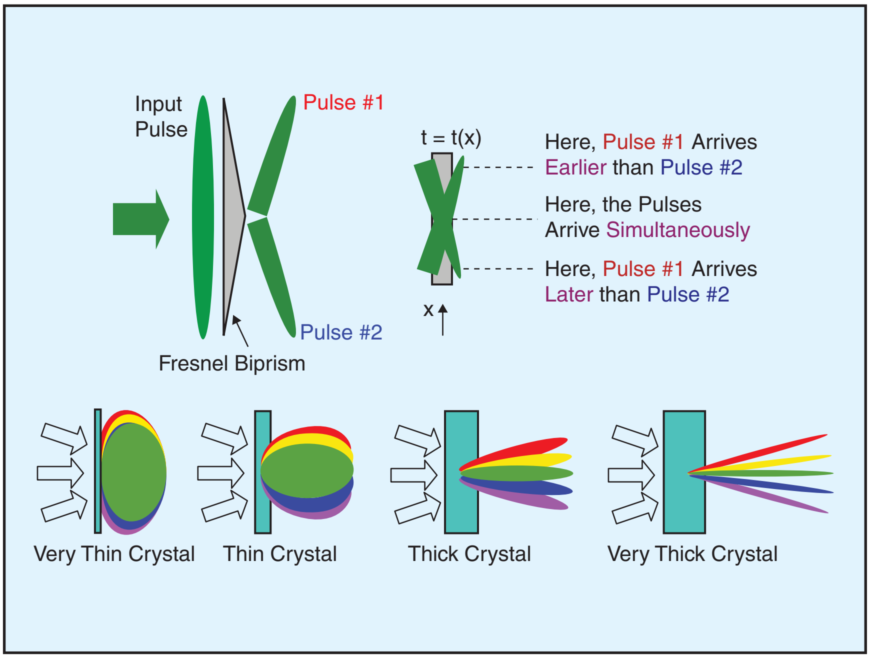


Fig. 6. Top: The Fresnel biprism maps delay onto transverse position, so imaging the crystal onto a camera yields all the delays on a single pulse. Bottom: A thin crystal is usually required to measure a pulse because we must generate the second harmonic for ("phase-match") all frequencies in the pulse, and a thin crystal would measure only a fraction of the pulse spectrum. In GRENOUILLE, however, the crystal is deliberately too thick, but this allows it to spectrally resolve the second harmonic, while simultaneously creating it. As long as the beam as sufficient divergence to phase-match the entire spectrum, it works.

A Fresnel biprism (a prism with an apex angle close to 180°) is a device usually used in classrooms to illustrate interference. When a Fresnel biprism is illuminated with a wide beam, it splits the beam into two beamlets and crosses them at an angle yielding interference fringes. While fringes aren't relevant to pulse measurement, crossing beams at an angle is exactly what is required in conventional single-shot autocorrelator and FROG beam geometries, in which the relative beam delay is mapped onto horizontal position at the crystal (see Fig. 6). But, unlike conventional single-shot geometries, beams that are split and crossed by a Fresnel biprism are automatically aligned in space and in time, a significant simplification. Then, as in standard single-shot geometries, the crystal is imaged onto a camera, where the signal is detected vs. position (i.e., delay) in, say, the horizontal direction.

FROG also involves spectrally resolving a pulse that has been time-gated by itself. GRENOUILLE combines both of these operations in a single thick SHG crystal. As usual, the SHG crystal performs the self-gating process: the two pulses cross in the crystal with variable delay. But, in addition, the thick crystal has a relatively small phase-matching bandwidth, so the phase-matched wavelength produced by it varies with angle (see Fig. 6). Thus, the thick crystal also acts as a spectrometer.

Two additional lenses complete the device (see Fig. 7). The first (cylindrical) lens must focus the beam into the thick crys-

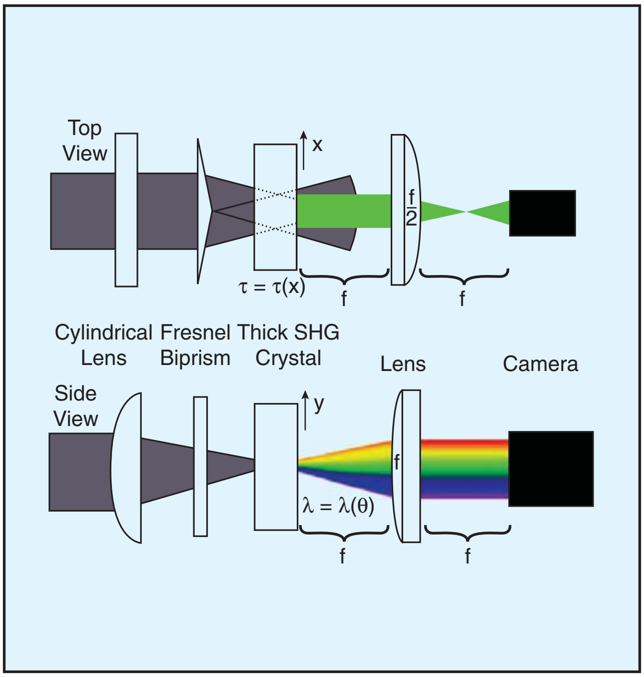


Figure 7. Side and top views of the GRENOUILLE beam geometry of Figure 5. Here, convenient focal lengths are shown for the two final cylindrical lenses (f and f/2).

tal tightly enough to yield a range of crystal incidence (and hence exit) angles large enough to include the entire spectrum of the pulse. After the crystal, a lens then maps the crystal exit angle onto position at the camera, with wavelength a near-linear function of (vertical) position. It has a different focal length in the horizontal direction, so it can image the crystal onto the camera in order to map delay onto horizontal position at the camera.

GRENOUILLE has many advantages. It has few elements and so is inexpensive and compact. It naturally operates single-shot. And it is considerably more sensitive than current devices. Furthermore, since GRENOUILLE produces (in real-time, directly on a camera) traces identical to those of SHG FROG, it yields the full pulse intensity and phase (except the direction of time, which can easily be determined with an additional measurement). In addition, the feedback mechanisms on the measurement accuracy that are already present in the FROG technique work with GRENOUILLE, allowing confirmation of—and confidence in—the measurement. And it measures the beam spatial profile. Even better, it measures all of the very common first-order spatio-temporal pulse distortions (see Fig. 8), including spatial chirp[2] and pulse-front tilt[3]. But best of all, GRENOUILLE is extremely simple to set up and use: it involves no beam-splitting, no beam-recombining, and no scanning of the delay, and so has zero sensitive alignment degrees of freedom. Once set up, it never needs re-alignment

The original GRENOUILLE device was designed and implemented to measure common femtosecond pulses centered at 800nm. Today, different GRENOUILLE models measure ultrashort pulses centered at different wavelengths from the visible to standard optical telecommunication wavelengths. They measure pulses as short as several fs to several picoseconds. Since FROG is based on the measurement of the second harmonic spectrum, it can easily perform high-resolution spectroscopy (and temporal characterization), where direct spectroscopy with the same resolution will either be impossible or much more expensive.

Perhaps the most important feature of GRENOUILLE, however, is that it yields as complete and honest a measure of a pulse as is currently possible. As a result, laser salesmen hate it. But users of ultrashort-pulse lasers love it.

Pulse Distortion and Compression

Because GRENOUILLE can measure the above spatio-temporal distortions, we have been using it to measure them (whether we want to or not!). And because a convenient diagnostic for these distortions hasn't been available before, no one has been able to check for them, and we find them everywhere! The most common culprit causing them is the ubiquitous *pulse compressor*, which is usually a sequence of prisms, which, when not properly aligned, introduces massive amounts of these distortions. Unfortunately, such distortions limit pulse intensity and again distort any experiment using pulses contaminated with them.

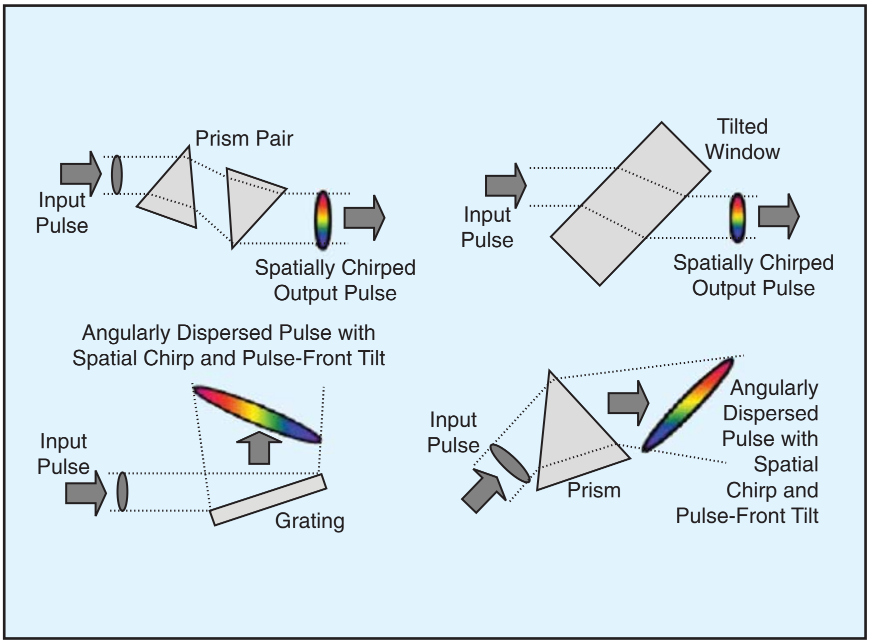


Fig. 8. Spatio-temporal distortions in ultrashort pulses.

Why is pulse compression necessary? Very simply, different colors propagate at different velocities so that, after passing through material, different colors experience different delays, a ubiquitous effect called *group-delay dispersion (GDD)*. For wavelengths less than those used in optical telecommunications (about 1550 nm), red colors always propagate faster than blue colors and so precede the blue wavelengths in the pulse, and one says that the pulse is *positively chirped*. Chirped pulses are nearly always undesirable in applications, and their increased length and resulting lower intensity make them even less desirable. Because ultrashort

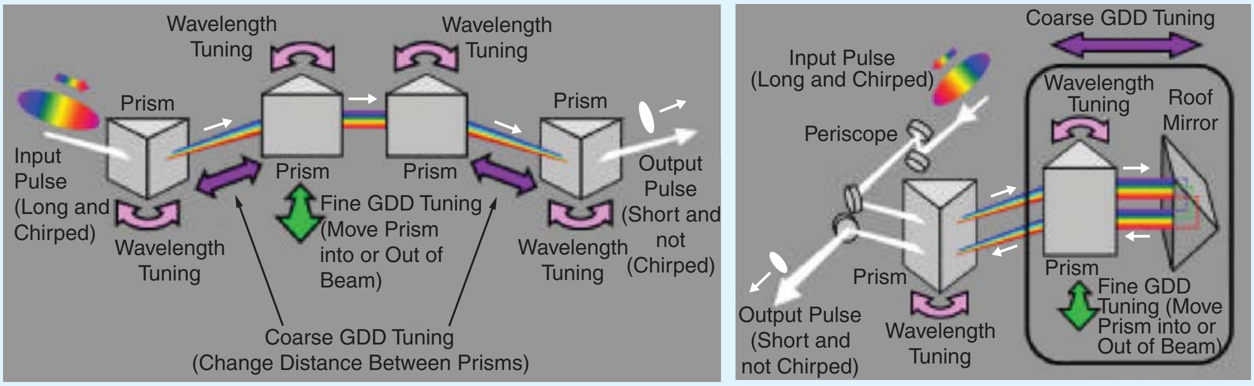


Figure 9. The original 4-prism (left) and the common 2-prism (right) pulse compressors for eliminating chirp in pulses. Unfortunately, these devices are notorious for introducing spatio-temporal distortions and are very difficult to align properly.

pulses have broad spectra, GDD is a large effect for them and generally results in significant pulse lengthening after propagation through even a few mm of material.

Indeed, in essentially all applications, the pulse is focused and so must pass through a significant amount of glass *in the lens or microscope objective*, and this glass cannot be avoided. Simply passing through a microscope objective significantly lengthens the pulse, significantly decreasing the intensity of the pulse at the focus. This reduces the sensitivity in all multi-photon microscopy techniques, and it can also hurt the resolution, too.

Indeed, the laser companies intentionally sell longer-pulse lasers to the imaging community because these pulses have less bandwidth and so lessen the effect of GDD. Of course, because the pulses are longer to begin with, they're also longer at the sample, so images made with such pulses have considerably less sensitivity. Unfortunately, while laser companies could sell lasers with negative chirp, they don't in practice because each user has a different amount of GDD in his microscope objective and in the beam path from the laser to the sample.

Fortunately, pulse compressors (see Figure 9) solve this problem. They consist of sequences of four prisms that yield a path for which red colors travel a longer optical path than blue colors, and so have *negative* GDD. Specifically, the trick is that the redder colors pass through the thicker regions of the second and third prisms, allowing the bluer colors to catch up with them.

The original four-prism pulse compressor is shown in Figure 9. Unfortunately, when the center wavelength is tuned or the input beam wanders, all four prisms must be rotated by precisely the same amount (thick pink arrows). Also, coarse and fine tuning of the GDD are separate. Worse, coarse-tuning the GDD requires changing the separations between the first two and last two prisms, maintaining them precisely equal (thick purple arrows).

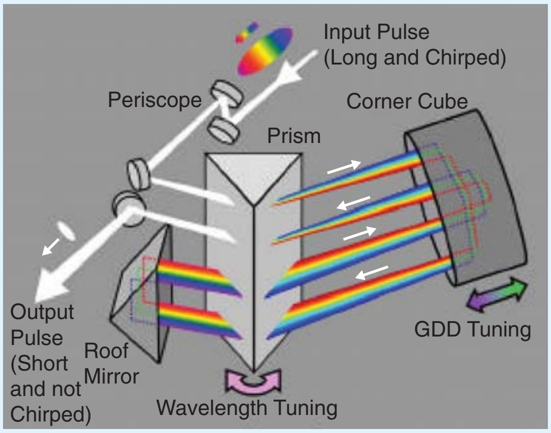


Figure 10. The compact, easy-to-use, distortion-free, and alignment-free single-prism pulse compressor

A two-prism pulse compressor (Figure 9, right) avoids the need for maintaining equal prism separations (note only one thick purple arrow). Unfortunately, when the center wavelength of the input pulse changes, both prisms must still be rotated by precisely the same amount (thick pink arrows). And this design still requires a complex arrangement for coarse and fine-tuning the GDD. As a result, the two-prism pulse compressor is difficult to align properly and so usually introduces significant spatio-temporal distortions.

Ultrasimple Pulse Compressor

Because we see so many spatio-temporal distortions from pulse compressors in ultrafast set-ups, we decided to do something about them. And we've invented a pulse compressor that is inherently free of them! The trick is that it uses only one prism and so cannot ever introduce such distortions. And we have discovered that it has a wide range of other advantages, too!

Swamp Optics' new single-prism pulse compressor[4] is shown in Figure 10. The corner cube not only retro-reflects the beam back to the prism so that four passes through the prism are possible, but it also inverts the beam in space so that the second and third passes through the prism occur as if the prism is inverted, as required for a pulse compressor. And it re-inverts the beam so that the final pass occurs with the correct un-inverted orientation. The very precisely manufactured corner cube guarantees that the beams are always parallel. And the single prism guarantees that the prism apex and incidence angles are always correct! It's easy to show that this device avoids *all* of the distortions of two- and four-prism designs. And note that only the one prism angle need be rotated when the input wavelength changes, and only one distance need be changed to tune the GDD. This simplicity yields a perfectly non-distorting, more accurate, smaller, and much less expensive device.

Conclusion

Quality pulse characterization and accurate compression are always important when using ultrashort laser pulses. So we've recently introduced two easy-to-use, alignment-free devices that greatly facilitate ultrafast experiments for scientists and engineers from all disciplines, which will improve the ease of use, accuracy, sensitivity, and even the cost of any experiment.

Acknowledgements

We would like to thank the National Science Foundation (NSF) for supporting the projects that resulted in these commercial systems.

References

[1] R. Trebino, *Frequency-Resolved Optical Gating: The Measurement of Ultrashort Laser Pulses* (Kluwer Academic Publishers, Boston, 2002).

[2] S. Akturk, M. Kimmel, P. O'Shea, and R. Trebino, "Measuring spatial chirp in ultrashort pulses using single-shot Frequency-Resolved Optical Gating," Opt. Expr. 11, 68-78(2003).

[3] S. Akturk, M. Kimmel, P. O'Shea, and R. Trebino, "Measuring pulse-front tilt in ultrashort pulses using GRENOUILLE," Opt. Expr. 11, 491-501(2003).

[4] S. Akturk, X. Gu, M. Kimmel, and R. Trebino, "Extremely simple single-prism ultrashort- pulse compressor," Opt. Expr. 14, 10101-10108 (2006).

Biography

Rick Trebino was born in Boston, Massachusetts on January 18, 1954. He received his B.A. from Harvard University in 1977 and his Ph.D. degree from Stanford University in 1983. His dissertation research involved the development of a technique for the measurement of ultrafast events in the frequency domain using long-pulse lasers by creating moving gratings. He continued this research during a three-year term as a physical sciences research associate at Stanford.

In 1986, he moved to Sandia National Laboratories in Livermore, California, where he studied higher-order wave-mixing, nonlinear-optical perturbation theory using Feynman diagrams, and ultrashort-laser-pulse techniques with application to chemical dynamics measurements and combustion diagnostics. There he developed Frequency-Resolved Optical Gating (FROG), the first technique for the measurement of the intensity and phase of ultrashort laser pulses.

In 1998, he became the Georgia Research Alliance-Eminent Scholar Chair of Ultrafast Optical Physics at the Georgia Institute of Technology, where he currently studies ultrafast optics and applications.

Prof. Trebino has received several prizes, including the SPIE's Edgerton Prize, and he was an IEEE Lasers and Electro-Optics Society Distinguished Lecturer. He is a Fellow of the Optical Society of America, the American Physical Society, and the American Association for the Advancement of Science. His interests include adventure travel, archaeology, and primitive art.

President's Column

(continued from page 3)

NOT! I was struck by the number of students that attended the LEOS Annual Meeting this year. How can a person NOT be energized about our vibrant future when seeing the camaraderie they display and the high quality papers they deliver!! As I looked out at the packed Awards Reception, I saw our youth and our elders, such as Henry Kressel (LEOS' first President), Tom Giallorenzi, and Gordon Day. I felt warm and cozy being blanketed by the bedrock from our past and the hope from our future. I will state that my most pleasurable activity as President was signing the Graduate Student Fellowship Certificates, knowing that I am the representative of something very special to a young person and helping to plant a seed for a bright future!

LEOS Has Out-sized Technical Influence

We are blessed with a plethora of outstanding people, and our technologies have impacted many aspects of society. Just for fun, I scanned the list of winners of the IEEE Medal of Honor, IEEE's highest award, during the 30 years of LEOS' history. Of the past 30 winners, an astounding 10 are associated with technologies that are part of LEOS. This monumental contribution comes from a society that represents less than 2% of the IEEE membership!! What would communications, medicine, consumer electronics, spectroscopy, manufacturing, sensing, and lighting be without us? I am tingling with anticipation just by thinking about other markets that could be dramatically influenced by our technologies.

Lesson Learned

"Ben Zoma said: Who is wise? He who learns from all people." Ethics of Our Fathers.

Perhaps the most valuable lesson I learned is that our members approach issues from very different viewpoints, but nearly everyone has the best interests of the society at heart. Once I truly absorbed this, I would listen to differing opinions and just marvel at the insights that our people have, even if I disagreed with them. My respect of, appreciation for, and closeness to these people only increased.

Due to being intimately involved with governance, my appreciation for LEOS as an organization also dramatically increased. As our guiding principle, LEOS exists for our members. A simple yet powerful example of this is the _ page advertisement in a previous LEOS Newsletter for educational activities by a different professional photonics society, that being SPIE. I don't think you will find Newsweek Magazine being advertised in the pages of Time Magazine, since they are competitive corporations. LEOS is a non-profit organization that has the best interests of its members at heart, and if taking a course by SPIE has value to the members, then that's considered good.

I am extremely proud to be a member of such an organization.

Heartfelt Appreciation

In my first column in Feb. 2006, I listed a cadre of people whom I owed a debt of gratitude from before becoming LEOS President. The list of people to whom I am indebted has grown significantly. Due to simple practical limitations of space, I will limit my deepest appreciation to just a few individuals:

to Rich Linke, my outstanding partner.
to Gail Walters, the heart and soul of LEOS.
to all Staff, whom I greatly respect and who are my extended family.
to Scott Hinton, my wise mentor.
to John Marsh, the extremely able keeper of our future.
to my students, from whom I have learned more than they have learned from me.
to my colleagues, who make every professional activity both exciting and enjoyable.
to my teachers, primarily Drs. Ivan Kaminow, Tingye Li, and Richard Osgood.
to my parents, whose guidance, support, encouragement and love will always be with me.

Most importantly, I want to give my most heartfelt appreciation to my loving wife, Michelle, and our wonderful children, Moshe, Asher, Ari, and Jacob. Michelle was with me at my first LEOS volunteer activity (LEOS Annual 1992 in Boston) and was with me as I finished being LEOS President (LEOS Annual 2007 in Orlando). My volunteer activities are due to her understanding and patience. My family is my rock.

Respectfully submitted,
Alan E. Willner
University of Southern California

LEOS Staff and Willner family at the 2007 Annual Meeting in Orlando.

Industry Research Highlights

Ultra-Fast Coherent Optical System for Active Remote Sensing Applications

Abhay M. Joshi

Coherent optical detection, utilizing high-power handling ultra-fast balanced p-i-n photodiodes, is essential to provide remote sensors with superior range, resolution, and sensitivity.

Introduction

Active optical remote sensing involves illuminating a distant target with a pulsed laser beam and analyzing the reflected or backscattered optical signal to ascertain its properties, such as location, velocity, material composition, temperature, and stress. Its numerous applications include battlefield target recognition and tracking, atmospheric monitoring, structural monitoring, collision avoidance systems, and terrestrial mapping. The maximum propagation distance in Laser Detection and Ranging (LADAR) as well as Optical Time Domain Reflectometry (OTDR) sensors is limited by the resulting signal attenuation. It is possible to improve the sensor range by increasing the transmitted pulse energy. As this is usually accomplished by employing wider laser pulses, it limits the resolution of the target location and the bandwidth of the recoverable information. Therefore, it is necessary to employ detection mechanisms that can operate satisfactorily at low optical power levels without sacrificing sensor bandwidth. This criterion is fulfilled by coherent detection.

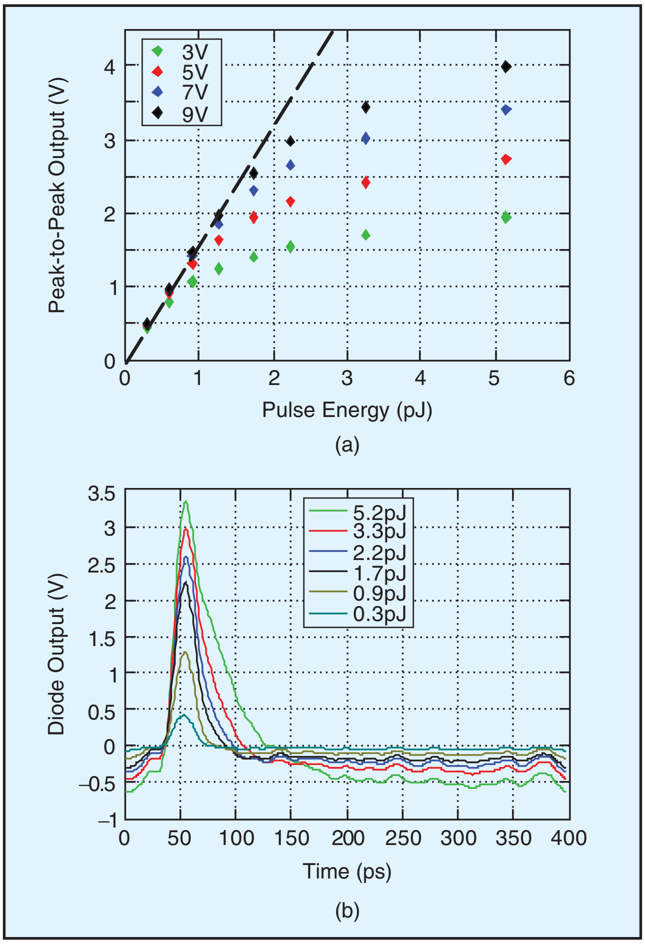


Figure 1. (a) Peak-to-peak output voltage of graded-index lens coupled Dual Depletion Region photodiode at different diode bias conditions. The photodiode was illuminated with a 1550 nm wavelength mode-locked laser with 2.5GHz repetition rate and 4 ps optical pulse width. (b) Impulse response of the photodiode at 9 V bias for various optical pulse energies.

ABHAY M. JOSHI
DISCOVERY SEMICONDUCTORS, INC.
EWING, NJ
WWW.CHIPSAT.COM

Why Coherent Detection?

Optical sensors are broadly classified into two categories – direct and coherent detectors. Direct detectors are essentially square law devices that are sensitive to the intensity of the received electromagnetic signal. In contrast, coherent detection involves mixing the received signal with an optical local oscillator (LO) in a balanced photodiode to downconvert it to a suitable microwave intermediate frequency (IF). Balanced photodetection suppresses the laser intensity noise and improves the noise figure of the sensor. Coherent detection is a linear process that is sensitive to the amplitude, phase, and polarization of the received signal. As a result, information embedded in the signal phase, such as Doppler shifts and vibration signatures, can be easily recovered. The inherent linearity of coherent detection allows for translation of mature microwave technology into the optical domain. For example, RF adaptive filtering following photodetection enables channel equalization, atmospheric turbulence compensation, and efficient background light filtering. Similar operation in the optical domain would require high Q-factor optical filters, as is necessary for direct detection sensors. The ratio of the RF powers generated in a coherent link to that in a direct detection link is

$$\frac{P_{opt,LO}}{P_{opt,S}} = \frac{I_{DC,LO}}{I_{DC,S}}$$

, where $P_{opt,\,LO}$ and $I_{DC,LO}$ are the optical LO power and the resulting DC photocurrent respectively. $P_{opt,S}$ and $I_{DC,S}$ similarly characterize the received optical signal. Thus, coherent systems provide shot noise-limited gain by utilizing high LO powers, thereby increasing the sensing range.

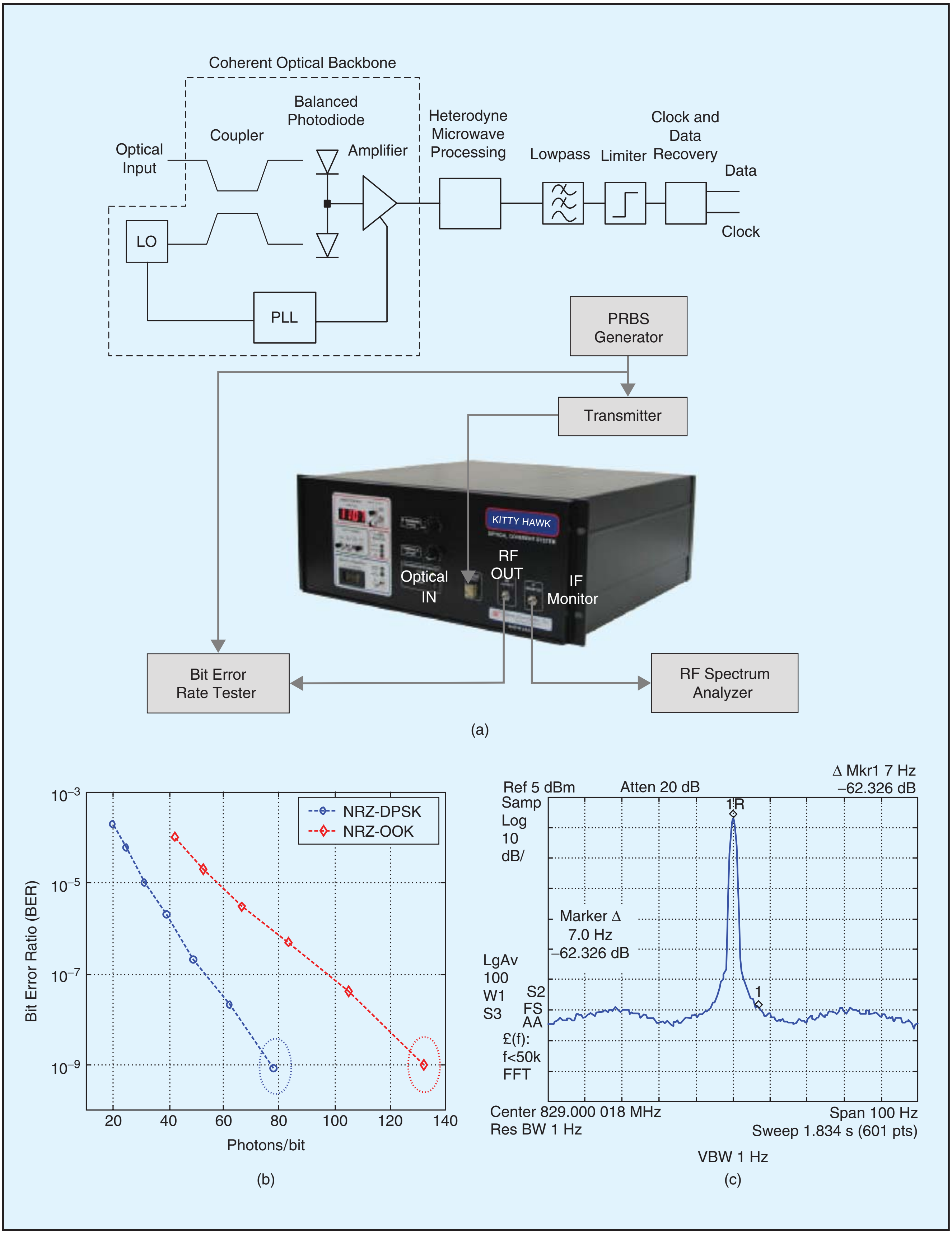


Figure 2. (a) Block diagram of Discovery Semiconductor's optical coherent system, "Kitty Hawk". (b) Sensitivity curves for Non-Return-to-Zero On-Off Keyed and Differential Phase Shift Keyed links. (c) Intermediate frequency spectrum at the balanced photodiode output.

Ultra-Fast Photodiodes Capable of Handling High Optical Power

Due to the availability of high power lasers that can be used as the LO, the coherent gain in practical systems is limited by the power handling capability of the photodiodes. Our InGaAs p-i-n photodiodes exhibit linear behavior for a peak-to-peak pulse output of >2.5V (see Fig. 1). The high linearity is due to a combination of our proprietary dual-depletion region (DDR) diode structure and optical beam reshaping using graded-index lens coupling[1]. Beam reshaping reduces the peak photocurrent density for a given optical power and can increase the 1 dB compression point of the photodiode by ~5 dB. This technique is made possible by the top-illuminated geometry of the DDR structure that allows high current handling and bandwidth exceeding 40 GHz.[2] DDR photodiodes have dark currents of the order of few nanoamperes and are commercially available for operation at wavelengths from 0.8 µm to 2.2 µm.

Coherent Optical System

The most challenging task in implementing an optical coherent system is the generation of a LO signal that precisely tracks the received optical carrier frequency. The linewidth of the resulting IF signal determines the precision with which the optical phase is detected. Our commercially available optical coherent system, *Kitty Hawk*, based on our proprietary phase locked loop (PLL) design, can achieve IF linewidth <1 Hz and –62dBc noise at 1 Hz resolution bandwidth (see Fig. 2). Utilizing this PLL, we have demonstrated amplitude and phase modulated 10 Gb/s coherent communication links with record sensitivities of 132 and 72 photons per bit respectively[3]. This demonstration is a testament to the accuracy with which both amplitude and phase can be recovered from a weak optical signal. Preliminary investigations into system performance in the presence of laboratory induced atmospheric turbulence have proven satisfactory.

PIN vs. APD – Which is more suitable for Coherent Detection?

It is possible to detect small optical signals using Geiger mode and linear avalanche photodiodes (APDs). However, these devices are unable to handle large optical signals (LO) as they are essentially small-signal devices. In coherent systems, the LO power can be adjusted according to the received optical power level, and acts as a built-in automatic gain control. As a result, the system presented here has superior dynamic range and reliability than its alternatives. Moreover, PIN photodiodes are superior to APDs in terms of bandwidth and noise.

Conclusion

The optical coherent system presented here was developed with focus on the exacting standards of the telecommunication industry. However, it can also serve as the backbone for both free space and fiber based remote optical sensors, such as LADAR and OTDR systems. Faithful recovery of the optical phase will be instrumental in enhancing sensor functionality, including remote vibrometry and polarimetery, allowing better target characterization and identification. Combined with high power handling ultra-fast balanced photodiodes, challenging demands on the range and resolution of future remote sensors can be met.

Biography

Abhay M. Joshi is the President and CEO of Discovery Semiconductors, Inc. He received an M.S.E.E. degree from the New Jersey Institute of Technology (NJIT), Newark, NJ, in 1989. He has 20 years of extensive experience in designing and fabricating InGaAs optical receivers for space based remote sensing projects.

References:

[1] A. Joshi and D. Becker, *GRIN Lens-Coupled Top-Illuminated Photodetectors for High-Power Applications,* ***MWP 2007***, paper 9017.

[2] A. Joshi and X. Wang, DC to 50 GHz wide bandwidth InGaAs photodiodes and photoreceivers, **Proc. SPIE CR73**, pp. 181-196, 1999.

[3] Wree, D. Becker, D. Mohr, and A. Joshi, *10 Gb/s optical heterodyne receiver for intersatellite communication links*, **Proc. SPIE 6709**, paper 6709-31.

Special LEOS Annual Meeting

Highlights of LEOS Annual Meeting 2007

Ekaterina Golovchenko, Conference Chair and LEOS Vice-President for Conferences

M. Selim Ünlü, Program Chair and LEOS Vice-President for Membership & Regional Activities (Americas)

The LEOS Annual Meeting is one of the most significant events of the year for the society. It brings together experts from all over the world to discuss the latest trends and advances in photonics. The unique feature of LEOS Annual is its breadth with a very diverse group of researchers and engineers that come from different areas including biophotonics, displays, lasers, and optical communications. We start to think about ourselves in a broader sense as "The Society for Photonics" as we embrace emerging photonics fields while maintaining leadership in traditional areas of lasers and electro-optics. A special meeting on the future branding of the society was held by our outgoing president Prof. Alan Willner during the conference. The informal discussion was very lively and will continue over the next year.

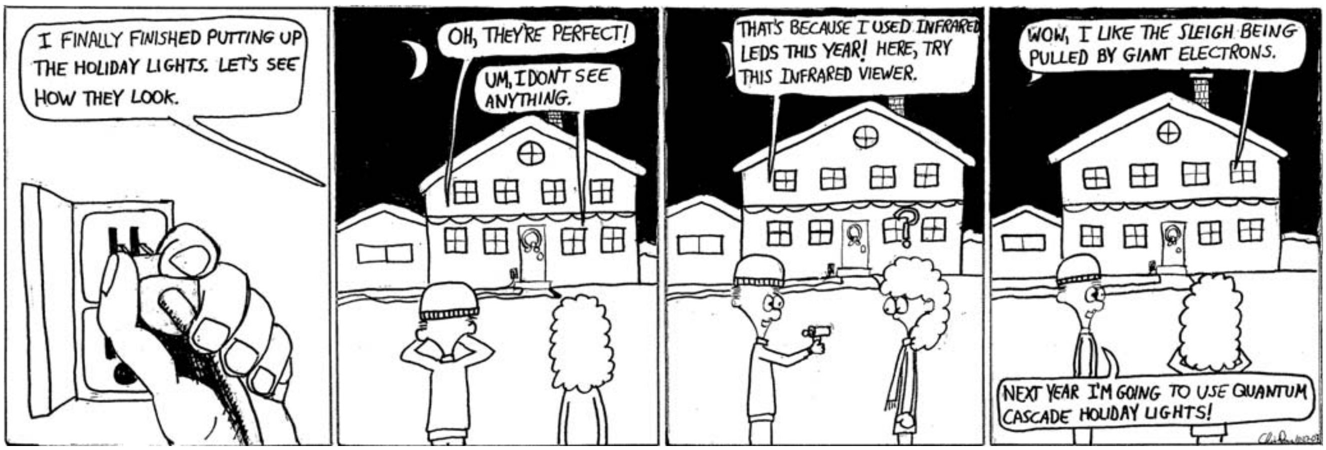
This year is special for us – it is the 30th Anniversary of the society. This occasion gives us an opportunity to reflect upon the past and plan for the future. As part of the celebration, the conference plenary session featured a talk by LEOS founding president Dr. Henry Kressel entitled "Thirty Revolutionary Years". The other plenary speakers Dr. Steve Korotky (filling in for Dr. Rod Alferness), Prof. Richard Friend, and Prof. Jim Fujimoto gave talks spanning subjects from optical communications to organic LEDs and biophotonics, reflecting the major transformation in the scope of technical fields covered by LEOS since its inception. These talks were recorded and will be available on the LEOS portal (www.i-leos.org) in the near future.

Both the conference attendance and the paper submission rate have been steady over the last several years. In 2007, the conference featured about 150 invited and 350 contributed papers and the overall registration was over 600. The papers selected for presentation at the conference go through a competitive review process. The technical committees use the overall technical quality of the papers as their main selection criterion, but also consider coverage of emerging fields and opportunities for student members. In future, LEOS will tighten acceptance criteria with the goal of enhancing the conference standing as a prime event in photonics.

The student paper contest involved six excellent finalists and the selection committee had no easy task in selecting a winner. We congratulate Koji Otsuka of Kyoto University in Japan for winning the 2007 LEOS Annual Meeting Best Student Paper Award.

Finally, we would like to highlight the Sunday program of the conference. A new tradition, begun a couple of years ago, involves the Careers in Research Forum, session on Creative Teaching Methods and a welcome reception. These events are very popular and informative opportunities for both students and seasoned professionals to interact and share information. Prior to these events, the first half of Sunday featured Short Courses taught by industry and research leaders. LEOS Annual is very proud to be the first conference in the field that offers **short courses free of charge** for IEEE LEOS members including student members. If you have not yet experienced the benefits of our Sunday program, do not miss this opportunity in 2008! Mark your calendars and see you all at LEOS Annual Meeting 2008, November 9-13, in Newport Beach, California.

"Nick" Cartoon Series



Tour of CREOL during LEOS Annual Meeting

Amitabh Ghoshal, Vice-President of CREOL Association of Optics Students; email: aghoshal@creol.ucf.edu

The IEEE/LEOS chapter of the College of Optics and Photonics at the University of Central Florida and the CREOL Association of Optics Students (CAOS) organized a tour for approximately 60 attendees of the 20th LEOS Annual Meeting in Orlando, Florida. The tour was led by chapter President K. Shavitranuruk and Vice-President Sharad Bhooplapur, with support from other CREOL students.

The tour of CREOL began with a presentation by the Dean, Dr. Eric Van Stryland, before attendees visited six labs in the College. The laboratories visited were the Infrared Systems Lab, the Photoinduced Processing Group, the Biophotonics and Virtual Reality Labs in the Optical Diagnostics and Applications Group (ODALab), and the Femtosecond Lab of the Non-linear Optics Group. The evening culminated in a reception in the CREOL lobby.

The Infrared Systems Lab section of the tour was presented by graduate students James Ginn, Pete Krenz, and Wilson Caba, as well as research engineer Guy Zummo. The lab's primary area of research is the extension of RF technology, such as frequency selective surfaces, antennas, and imaging systems, into higher frequencies. The first portion of the tour focused on fabrication capabilities, including a class 1000 clean room located in the lab and CREOL's high-resolution electron-beam lithography system. The tour transitioned to the group's unique testing systems, including three Twyman-Green interferometers (LWIR, MWIR, NIR), visible and IR ellipsometers, and a spectrum radiometer.

With fabrication and testing capabilities presented, the group proceeded to outline specific research areas. James discussed current research underway on infrared metamaterials, including infrared frequency selective surfaces, meander-line waveplates, and reflectarrays. Pete demonstrated recent advances in the field of antenna-coupled bolometers and infrared uncooled imaging systems. Wilson described at length research in millimeter wave imaging, including landmine detection and through-barrier imaging. The lab tour concluded with a discussion of the group's second lab, which contains a line tunable THz laser with spectral range of 300 GHz to 7 THz.

Work done in the Photoinduced Processing Group was presented by graduate student Oleksiy Andrusyak and research scientist Dr. George Venus. The Photoinduced Processing Group was started in 1995 by Dr. Leonid B. Glebov. Today, the group operates six laboratories within the CREOL facility and a spinout company (OptiGrate) in nearby Central Florida Research Park. A full production cycle is implemented at CREOL. A glass synthesis and processing lab provides melting, annealing, cutting, grinding, and polishing of the photo-thermo-refractive (PTR) glass, along with the first level of flatness and glass homogeneity control. Measurements of refractive index, absorption spectra, surface profile, optical homogeneity by proprietary liquid-cell shearing interferometer, and flatness and refractive index spatial distribution are done in an optical testing lab. The hologram recording laboratory routinely records the world's best holograms, particularly volume Bragg gratings which are now being used in a wide variety of applications. A high-power testing laboratory specializes in measurements of parameters of glass and optical elements (e.g. diffractive gratings) under exposure to high-power CW radiation. This lab includes vibration-isolated tables, two 100-W single-mode Yb-doped fiber lasers operating at 1085 and 1096 nm, a 1-W Yb-doped fiber laser tunable from 1080 to 1100 nm, an IR net-

Graduate student Oleksiy Andrusyak describing the use of high quality in-house fabricated gratings photo-induced in glass to spatially combine lasers in the Photoinduced Processing Group's Lab.

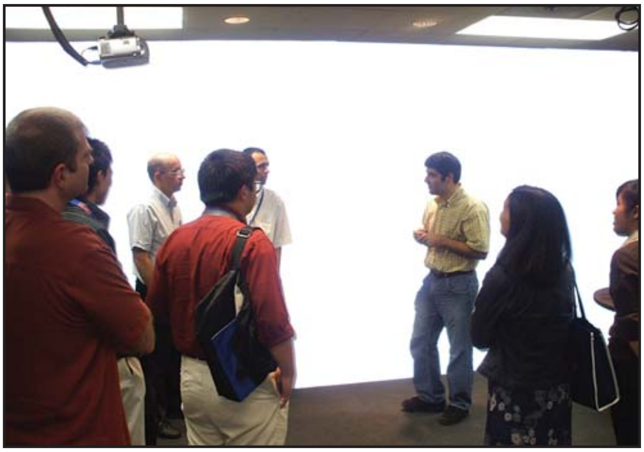
Dr. Lazaro A. Padilha presenting the work at the NLO Group's Femtosecond Lab.

work camera, and an IR beam profilometer. The Femtosecond laboratory investigates non-linear hologram recording as well as some pulsed-laser applications of volume Bragg gratings. The high-power applications laboratory investigates some of the most popular applications of volume Bragg gratings. Main research directions in this area include high-power diode laser development, spectral narrowing, laser wavelength stabilization and control, spatial mode selection, and spectral beam combining. A tabletop system that spectrally combines five 150-W Yb-doped fiber lasers operating near 1064 nm, using volume Bragg gratings in PTR glass, provides the highest spectral power density among similar systems around the world.

The Biophotonics Lab is one of two major research thrusts for the Optical Diagnostics and Applications Lab, run by Dr. Jannick Rolland. The primary project of the Biophotonics Lab is the Optical Coherence Imaging project (2002-present), which innovates in technology for microscopic imaging using the low temporal coherence properties of broadband light sources. Such technology allows imaging up to a few millimeters inside biological tissues with 1-micron resolution. Innovative solutions to handle the trade-offs in imaging speed, invariant resolution across the sample, and sample size constitute the focus of research, together with quantitative image quality assessment in a closed feedback loop with technology optimization. Main results from this project include optical spectral shaping, catheters less than 2 mm in diameter for lung imaging using Bessel beam optics, dynamic focusing optics with no moving parts for skin imaging, portable compact electronics, a novel instrument for Optical Coherence Tomography combined with two photon absorption spectroscopy, and a framework for task-based image quality assessment. Main academic collaborators on this project include researchers at the University of Arizona and the University of Florida. Graduate students primarily involved in this project are Supraja Murali and Kye-Sung Lee.

The second thrust of the Optical Diagnostics and Applications Lab was presented in a tour of the Virtual Reality Lab, which concentrates on creating head-worn displays (HWDs) for use in various industries. HWD design is inherently an interdisciplinary subject, fusing optical engineering, electronics, user interface design, new optical materials, manufacturing techniques, and human perception and physiology for assessing these displays. Various optical design forms are investigated. In order to achieve compact, lightweight systems, designs employ aspheric, diffractive, or holographic elements. Various applications drive the design of HWDs having various requirements. Research in HWDs is conducted in close collaboration with end users from various application domains, in a closed design feedback loop with human perception assessments. Designs include a 60° FOV, full color off-axis instrument, various types of ultra-compact (6g per eye) head-mounted projection optics with external or internal projection screens, eye tracking integration, conformal head tracking, and recently eyeglasses displays. Major collaborators on this project include MSU, Optimax Corp., Nvis Corp., and Linz University in Austria. This work at the ODA Lab is led by graduate student Ozan Cakmakci.

In the five laboratories of CREOL's Nonlinear Optics (NLO) Group, the NLO properties of different materials can be studied, at time scales from nanoseconds to tens of femtoseconds, at wavelengths spanning 270 nm to 18 microns. This research group is led jointly by Dean Eric Van Stryland and Associate Dean David Hagan. The Femtosecond Lab, which the LEOS tour group visited, is equipped with state-of-the-art femtosecond lasers and characterization tools. A kHz amplified Ti:Sapphire laser at 775 nm and 140 fs with 2 mJ of energy per pulse pumps three different OPG/OPA (optical parametric generator /amplifier) sources. Two of these instruments deliver 100 fs pulses that can be tuned from 270 nm out to 10 microns. A third, the so called TOPAS-*White*, delivers pulses from 500 nm to 1600 nm with pulse widths as short as 10 fs. This laboratory concentrates on the study of nonlinear optical processes such as two- and three-photon absorption, excited state absorption, lifetime dynamics, and nonlinear refraction in a wide variety of materials. These include organic molecules, semiconductor quantum dots, metal nanoparticles, and new nanocomposite materials. A strong white-light continuum, generated in

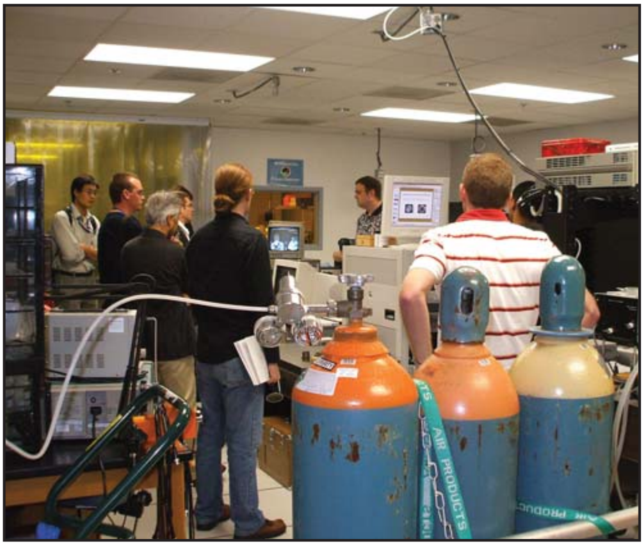

Graduate student Ozan Cakmakci answering questions about the head-mounted display project in front of a retroreflective screen in the Virtual Reality lab of the ODALab Group.


James Ginn, a graduate student working in the IR Lab, shows his work to visitors on the tour.

high-pressure Kr gas, has been developed as an excitation source for Z-scan measurements. This source enables nonlinear spectrum characterization at speeds 10 times that obtained using single wavelength Z-scan with tunable OPG/OPA. The work being done in the Femtosecond Lab was presented to the LEOS tour group by research scientist Dr. Lazaro A. Padilha.

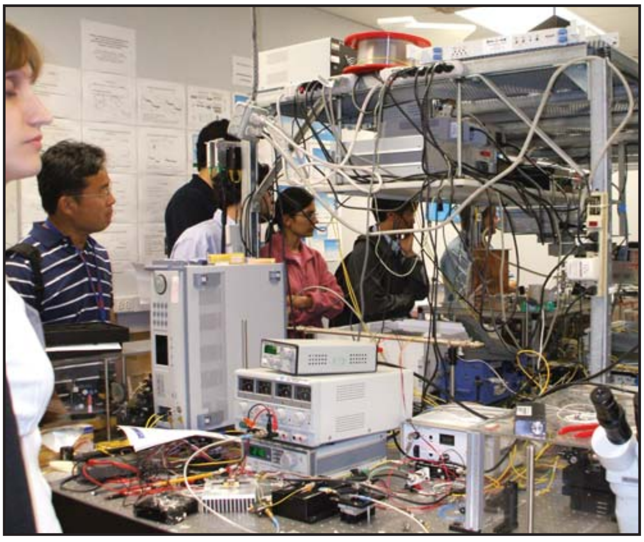
The Ultrafast Photonics Group, lead by Dr. Peter J. Delfyett, opened the doors of the Low Noise Optical Clocks Lab (one of the seven labs of the group) to the visitors, where they were introduced to ultra-low noise fiberized semiconductor based modelocked lasers. The working principles of their quietest laser, having a timing jitter of only 400 attoseconds, was explained. The Low Noise Optical Clocks Lab is also involved with Optical Comb Applications, such as arbitrary waveform generation, optical code division multiplexing, and photonic analog to digital converters. Graduate student presenter Sarper Ozharar also described the latest filtering and modulation techniques, then answered several questions.

The IEEE/LEOS chapter has been in existence since January 2003, and currently has more than 60 members. It is a part of CAOS (the CREOL Association of Optics Students), which also includes the SPIE, OSA, and SID student chapters under its umbrella. The chapter is active in organizing various events, such as hosting distinguished academic speakers, as well as bringing in people from industry to inform the university community about cutting-edge tools. Two of the most recent events organized by the chapter included a talk by Dr. Do-Kyeong Ko entitled "Recent progress in optical science and high field physics research in APRI", and a presentation by Matthew Frank of RSoft Design Group Incorporated on "Advanced Design Tools for Passive and Active Optoelectronics". The IEEE/LEOS student chapter is looking forward to hosting a Distinguished Lecturer in spring 2008, as well as organizing Optics Day, which is a campus-wide Optics outreach event, with CAOS and the other professional student organizations. Please visit our LEOS Student Chapter website at http://ieee.creol.ucf.edu/ for more news.



James Ginn describes his work in Dr. Glenn Boreman's IR Lab

Dean Van Stryland gives an overview of the College



Dr. Delfyett Lab

Reception for LEOS visitors in the CREOL Lobby

IEEE/LEOS Awards

Call for Nominations

Nominations for 2008 LEOS Quantum Electronics and LEOS Distinguished Lecturer Awards are now being solicited for submission to the LEOS Executive Office. The deadline for nominations is 16 February. In order to facilitate the nomination procedure, nomination forms are found on pages 22 and 23.

A list of previous winners and awards information is available on the LEOS web site: www.i-LEOS.org.

IEEE/LEOS Quantum Electronics Award
The Quantum Electronics Award is given for exceptional and outstanding technical contributions that have had a major impact in the fields of quantum electronics and lasers and electro-optics. This award is given for truly excellent and time-tested work in any of the fields of interest of LEOS. It may be given to an individual or to a group for a single outstanding contribution or for a long history of significant technical work in the field. No candidate shall have previously received a major IEEE award for the same work. Candidates need not be members of the IEEE or LEOS. The award will be presented at the Conference on Lasers and Electro-Optics/Quantum Electronics and Laser Science Conference (CLEO/QELS 2008).

IEEE/LEOS Distinguished Lecturer Awards
The Distinguished Lecturer Awards are presented to honor interesting speakers who have made recent significant contributions to the field of lasers and electro-optics, or who have industrial or entrepreneurial experience at a senior level in the fields of interest to LEOS. The program is designed to honor excellent speakers who have made technical, industrial or entrepreneurial contributions of high quality and to enhance the technical programs of LEOS chapters. Consideration is given to having a balance of speakers who can address a wide range of topics of current interest in the fields covered by LEOS. The term for the Lecturers is July 1 of the year of election until June 30 for the following year. Candidates need not be members of the IEEE or LEOS.

Call for Fellow Nominations

Nominations are being accepted for the IEEE Fellows class of 2009. The rank of IEEE Fellow is the institute's highest member grade, bestowed on IEEE senior members who have contributed "to the advancement or application of engineering, science and technology." The deadline for nominations is 1 March 2008.

Senior members can be nominated in one of four categories: application engineer/practitioner, research engineer/scientist, educator or technical leader. The Fellows Web site contains additional information on the nomination process including access to the Fellows Nomination Kit, lists of Fellows who may be available as references as well as the history of the IEEE Fellows program. Please visit the Fellows website at < http://www.ieee.org/fellows>.

Call for Nominations - 2009 IEEE Photonics Award

The IEEE Photonics Award is presented for outstanding achievements in photonics. The recipient of the award receives a bronze medal, certificate, and cash honorarium. The nomination deadline is 31 January 2008.

For nomination forms, visit the IEEE Awards Web Site, www.ieee.org/awards, or contact IEEE Awards Activities, 445 Hoes Lane, Piscataway, NJ, USA, 08855-1331; tel: +1 732 562 3844; email: awards@ieee.org.

Nomination Form for IEEE/LEOS Awards

Please check the appropriate award category:

☐ Quantum Electronics (16 Feb deadline)

☐ Streifer Scientific Achievement (30 April deadline)

☐ Engineering Achievement (30 April deadline)

☐ Aron Kressel (30 April deadline)

Separate forms are available for the Distinguished Lecturer, Distinguished Service, Young Investigator, and John Tyndall Awards

1. Name of Nominee (for joint nominations, give the names, address information of the co-workers on a second sheet.

____

2. Nominee's Address ____

____

____

____

3. Nominee's Phone: ____________________ Fax: ____________________

   Email: ____

4. Proposed Award Citation (20 words or less)

____

____

5. On separate sheets attach:

   a. Statement of specific contribution(s) that qualify Nominee for Award, as well as other related accomplishments (**maximum of two pages**).

   b. Nominee's curriculum vita

   c. Endorsers: List the names, affiliations, addresses, and emails of individuals who have agreed to write letters of support. (Minimum of three supporting letters required; maximum of five permitted. No more than five letters will be reviewed by the Committee. Letters may accompany nomination or be submitted directly to IEEE LEOS prior to the nomination deadline.) Letters of recommendation are to be considered confidential and are not to be released to anyone other than IEEE-LEOS awards staff.

6. Your name: ____

   Phone: ____________________ Fax: ____________________

   Email: ____

Send nomination information with supporting material to:
IEEE/LEOS Awards Committee; 445 Hoes Lane; Piscataway, NJ 08854
Fax: +1 732-562-8434; email: soc.leo@ieee.org

Nomination Form for
IEEE/LEOS Distinguished Lecturer Award

Deadline: 16 February

1. Name of Nominee:

____

2. Nominee's Address ____

____

____

____

3. Nominee's Phone: ____________________ Fax: ____________________

Email: ____

4. Suggested Topic of Nominee's Lecture:

____

____

5. On separate sheets attach:

   a. List the nominee's most significant contributions that qualify the Nominee for this award as well as other related accomplishments. Include invited talks that the Nominee has given on his/her research. (maximum of two pages).

   b. Nominee's curriculum vita

   c. Endorsers: List the names, affiliations, addresses, and emails of individuals who have agreed to write letters of support (**Three supporting letters required**; no more that three letters will be reviewed by the Committee. Letters may accompany nomination or be submitted directly to IEEE/LEOS prior to the nomination deadline.) Letters of recommendation are to be considered confidential and are not to be released to anyone other than IEEE-LEOS awards staff.

6. Your name: ____

Phone: ____________________ Fax: ____________________

Email: ____

Send nomination information with supporting material to:
IEEE/LEOS Awards Committee; 445 Hoes Lane; Piscataway, NJ 08854
Fax: +1 732-562-8434; email: soc.leo@ieee.org

11-07

LEOS Profiles: 2007 Award Recipients

2007 William Streifer Scientific Achievement Award recipient

Shun Lien Chuang is currently the Robert MacClinchie Distinguished Professor of Electrical and Computer Engineering at the University of Illinois at Urbana-Champaign. He received his B.S. degree in electrical engineering from National Taiwan University in 1976, and the M.S., E. E., and Ph.D. degrees in electrical engineering from the Massachusetts Institute of Technology in 1980, 1981, and 1983, respectively. Since 1983, he has been on faculty at the University of Illinois at Urbana-Champaign. He was a visitor at AT&T Bell Laboratories (1989), the SONY Research Center (1995), and NTT Basic Research Laboratories (1997). He was also a visitor at NASA Ames Research (1999), Fujitsu Research Laboratories (2000), Cavendish Laboratory, University of Cambridge (2002), and ONERA, France (2004). He has been conducting research on strained quantum-well and quantum-dot semiconductor lasers, modulators, and infrared detectors. His recent interest is on slow light, wavelength conversion, and nanolasers using semiconductor quantum dots.

Shun Lien Chuang

He is the author of *Physics of Optoelectronic Devices* (New York: Wiley, 1995). He has published more than 300 journal and conference papers and given many invited talks at conferences and institutions. He served as an Associate Editor of the *IEEE Journal of Quantum Electronics* (1997-2002). He was a Feature Editor for a special issue in *Journal of Optical Society of America B on Terahertz Generation, Physics and Applications* in 1994. He also edited a feature section on Mid-Infrared Quantum-Cascade Lasers in the June 2002 issue of the *Journal of Quantum Electronics.*

He received the Engineering Excellence Award from the Optical Society of America in 2004 and the IEEE-LEOS Distinguished Lecturer Award for 2004-2006. He is a Fellow of the American Physical Society, the IEEE, and the Optical Society of America. He has been cited many times for Excellence in Teaching at the University of Illinois. He received the Andersen Consulting Award for excellence in advising in 1994 and was selected as an Associate at the Center for Advanced Study (campus honor) at the University of Illinois in 1995. He was also awarded a Fellowship from the Japan Society for the Promotion of Science to visit the University of Tokyo in 1996.

2007 Engineering Achievement Award recipients

The three founders of u²t Photonics AG receive the 2007 LEOS Engineering Achievement Award for the successful transfer of research results achieved at the Heinrich-Hertz-Institute to leading-edge commercial products encompassed with setting up a growing business achieving leadership in the market for 40G receivers. u²t was founded by Andreas Umbach, Günter Unterbörsch, and Dirk Trommer in January 1998 as a spin-off company of the Heinrich-Hertz-Institut für Nachrichtentechnik Berlin GmbH (HHI). In the late nineties the three scientists realized an increasing interest in the components they had developed. They decided to serve this demand and founded u²t.

From left to right: Dirk Trommer, Andreas Umbach, and Günter Unterbörsch

Andreas Umbach was born 1961 in Offenbach/Main, Germany. He studied physics at Technische Hochschule Darmstadt and at Technische Universität Berlin, where he received his Dipl. Phys. degree. His diploma thesis on the spatial resolution of scanning Auger microscopy was carried out at the Fraunhofer Institut für Mikrostruktur-Technologie.

In 1989 he joined the Heinrich-Hertz-Institut in Berlin. His work in the department of microfabrication technology concentrated on the development of Indium-

Career Section (cont'd)

Phosphide process technology e.g. for the fabrication of High Electron Mobility Transistors (HEMTs) and waveguide-integrated photodiodes. As a project manager he was engaged in the design and technology of high-speed photodetectors and on the integration of optoelectronic millimeter-wave integrated circuits.

Andreas Umbach has authored and co-authored numerous articles and publications and served as a technical committee member e.g. of the international conference on Optical Fiber Communications. He is a member of the German Physical Society (DPG), of the IEEE and of the Lasers and Electro-Optics Society (LEOS). Today Andreas serves as CEO of u^{2}t Photonics AG.

Günter Unterbörsch was born in Bergisch-Gladbach, Germany, in 1957. He received the diploma degree in physics from the University of Wuppertal, Germany, in 1983 working on superconductivity at millimeter waves.

In 1984, he joined the photonics division of the Heinrich-Hertz-Institut für Nachrichtentechnik, Berlin, Germany, where his work was concentrated on III-V material and device characterization. Since 1989 he directed the development of monolithic integrated optical receivers.

Günter Unterbörsch has worked for more than 20 years in the field of mm-wave applications. At HHI he worked at InP based optoelectronic devices covering the range from device physics, simulation and design to all needed measurement techniques like rf and noise measurements. Furthermore, he worked on packaging issues especially looking for best rf-performance.

He has specialized building new types of optical receivers which led to many papers. For example, he developed one of the first pinFETs and pinHEMTs, the first integrated balanced and the first narrowband 60 GHz receiver with other colleges. In that time he managed various technology projects and worked then in the management of HHI.

Günter Unterbörsch acts with a special focus on new measurement and packaging techniques and is also involved in developing new components. Günter Unterbörsch holds a diploma in Physics and in 2000 he, Thomas Engel and Andreas Umbach received the prize of the German ITG.

Dirk Trommer was born 1961 in Wolfsburg, Germany. He studied physics at Technical University in Berlin were he received his Dipl. Phys. degree in 1987 working on secondary ion mass spectroscopy.

In 1987 he joined the Heinrich Hertz Institut in Berlin where he worked on design and technology of indiumphosphide-based optoelectronic integrated circuits, photonic integrated circuits, ultrafast photodetectors and WDM - devices. As project manager he was engaged in international cooperative projects.

Dirk acts as the CTO of u^{2}t Photonics AG and is in particular responsible for the continuous improvement of u^{2}t's ultrafast photodetector and modulator and chips.

u^{2}t, based in Berlin, Germany, provides innovative optoelectronic components for fibre-optic systems and networks worldwide. Results of latest device research are directly transferred into products. Core competence is the development of ultrafast optoelectronic components for applications such as communication superhighways and microwave photonic systems, which require operating frequencies of 40 GHz and beyond. Driven by the success of its products in the market, the company had to expand quickly and has broadened its portfolio by offering tuneable optical pulse sources and 43 Gbit/s photoreceivers. u^{2}t is known today as a well-established supplier for high-speed optoelectronic components. u^{2}t combines electrical rf-packaging techniques and optical module technology to build 50 GHz photodiodes. Balanced photodetectors and balanced photoreceivers were developed in time to support the research and development of 40 Gbit/s DPSK (differential phase shift keying) modulation formats.

The accumulated excellence in the fields of high-speed devices and systems and the close cooperation with customers and suppliers make the difference.

2007 Aron Kressel Award recipient

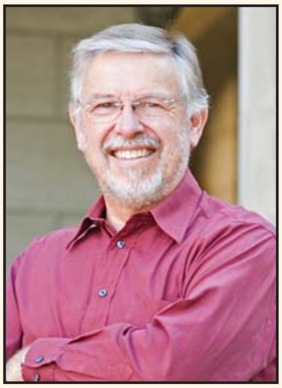
Rodney Tucker is an Australian Research Council (ARC) Federation Fellow and a Laureate Professor at the University of Melbourne. He is Research Director at the ARC Special Research Centre for Ultra-Broadband Information Networks (CUBIN). He has held positions at the University of Queensland, the University of California, Berkeley, Cornell University, Plessey Research, AT&T Bell Laboratories, Hewlett Packard Laboratories, and Agilent Technologies. He joined the University of Melbourne in 1990.

Professor Tucker is a Fellow of the Australian Academy of Science, a Fellow of the Australian Academy of Technological Sciences and Engineering, a Fellow of the Optical Society of America, and a Fellow of the Institute of Electrical and Electronics Engineers (IEEE). He served on the Management Committee of the Australian Telecommunications and Electronics Research Board from 1991 to 1993, and has been a member of the Australasian Council on Quantum Electronics. From 1995 to 1999, he served as a member of the Board of Governors of the IEEE

Career Section (cont'd)

Lasers and Electro-Optics Society. He was Editor-in-Chief of the *IEEE Transactions on Microwave Theory and Techniques* from 1988 to 1990, Guest Editor of the *IEEE Journal of Selected Topics in Quantum Electronics Special Issue on Semiconductor Lasers*, June 1995, Guest Editor of the *IEEE Transactions on Microwave Theory and Techniques, Special Issue on Microwave and Millimetre-Wave Photonics*, September 1995, and Associate Editor of *IEEE Photonics Technology Letters* from 1997 – 2006.

Professor Tucker received the BE (Elec) degree from the University of Melbourne in 1969, and the PhD degree, also from the University of Melbourne, in 1975. In 1975 he was awarded a Harkness Fellowship by the Commonwealth Fund, New York. He received the Institution of Engineers, Australia, M.A. Sargent Medal for 1995 for his contributions to Electrical Engineering and was named IEEE Lasers and Electro-Optics Society Distinguished Lecturer for the year 1995-96. In 1997 he was awarded the Australia Prize, Australia's premier international award for science and technology, for his contributions to telecommunications. He has been named one of ISI's Highly-Cited Researchers.



Rodney Tucker

Membership Section

Benefits of IEEE Senior Membership

There are many benefits to becoming an IEEE Senior Member:

- The professional recognition of your peers for technical and professional excellence
- An attractive fine wood and bronze engraved Senior Member plaque to proudly display.
- Up to $25 gift certificate toward one new Society membership.
- A letter of commendation to your employer on the achievement of Senior member grade (upon the request of the newly elected Senior Member.)
- Announcement of elevation in Section/Society and/or local newsletters, newspapers and notices.
- Eligibility to hold executive IEEE volunteer positions.
- Can serve as Reference for Senior Member applicants.
- Invited to be on the panel to review Senior Member applications.

The requirements to qualify for Senior Member elevation are, a candidate shall be an engineer, scientist, educator, technical executive or originator in IEEE-designated fields. The candidate shall have been in professional practice for at least ten years and shall have shown significant performance over a period of at least five of those years."

To apply, the Senior Member application form is available in 3 formats: Online, downloadable, and electronic version. For more information or to apply for Senior Membership, please see the IEEE Senior Member Program website: http://www.ieee.org/organizations/rab/md/smprogram.html

New Senior Members

The following individuals were elevated to Senior Membership Grade thru September - October:

Jianying Cao
Zhen Chen
Danny L. Dubrall
Alexander V. Kildishev
Nicholas Madamopoulos
Daniel M. Mittleman
Arando N. Pinto
Dinendra T. Ramachandran
Ram Sivaraman
Talabattula Srinivas
Guilin Sun
Leonard W. Winchester
Junichiro Yamashita
Jacques Beauvais
Reuven Gordon
Stephen E. Ralph
John F. Black
Anisul Haque
Balasubramanian Vengatesan
Joseph C. Boisvert
Daniel C. Kilper
Yurii Vlasov
Terry P. Bowen
Mohammad Mojahedi
Wei Xu

IEEE/LEOS Rochester Chapter – 2007 Most Improved Chapter

The Rochester-Corning LEOS chapter petitioned for chapter status and was formed toward the end of 2005 in order to better support the LEOS members in the Rochester IEEE Section. Approximately half of the members live in the Rochester, NY area and work primarily in academia, and the other half live in the Corning, NY and mainly work in industry. To date, the chapter has invited technical meeting speakers from the LEOS Distinguished Lecture program as well as more local speakers from the University of Rochester.

In the two years since forming, the founders have focused on understanding the needs and make-up of the chapter. Since the chapter's membership is approximately divided into two main groups separated by about a two hour travel time, it was important to understand how chapter events and interaction with the Rochester Section Executive Committee would be facilitated. Although the entire chapter membership is invited to each event, the technical meetings have been hosted in alternating Rochester and Corning locations to provide local event sites for the members. Invitations have also been extended to LEOS members living in the neighboring Binghamton and Ithaca IEEE Sections.

To serve the needs of members spread out over that distance, we began co-sponsoring technical meetings at different locations. In the Rochester area, our LEOS chapter has hosted speakers at the University of Rochester and also for the first time participated in the annual IEEE-Rochester Section Joint Chapters Meeting. A total of 6 society chapters within the IEEE Rochester Section participated in the event this past year. An evening affair, the meeting included dinner and a keynote speaker followed by speakers invited by the individual society chapters. The event is an opportunity for members of other Rochester IEEE society chapters to interact and become exposed to topics outside their field of expertise. At the Joint Chapters Meeting, the LEOS chapter hosted a talk by Distinguished Lecturer Jorge Rocca speaking on "Compact high repetition rate soft x-ray lasers."

In the Corning area, speaker events are usually held at the Corning Inc. Sullivan Park research facility which offers the ability to interact with the extended technical community in the area. In recent months speakers have included Distinguished Lecturer Toshihiko Baba speaking on "State-of-the-art photonic nanostructure devices." Additionally, our chapter co-sponsored its first event with the local chapter of the American Chemical Society. This was a dinner event followed by a talk from Mark Bocko from the University of Rochester speaking on an "Overview of new music technology research."

Currently, we are focusing on extending co-sponsored events in local Rochester and Corning areas as well as effectively managing the chapter's extended geographic area. To that end, upcoming co-sponsored events are being discussed with the local Optical Society of America chapter in Rochester. In addition, we are starting to rely on speakers in the extended area and possibly inviting speakers from neighboring LEOS chapters. To better communicate with the IEEE-Rochester Section's monthly Executive Committee Meeting, we are in the planning stages of implementing a conference call system. This would allow the current chapter co-chairs (in Corning) as well as a local Rochester LEOS representative to participate in the meetings. In the past, we relied mainly on providing e-mail updates to the Section Committee, but this did not allow for active participation in discussions.

In spite of our chapter's smaller size of <50 members, which is spread over a distance from Lake Ontario to the Pennsylvania border, the Rochester-Corning, NY LEOS chapter is now organized to effectively serve its members. The chapter has relied highly on the Distinguished Lecture series for speakers traveling outside the immediate area, and we found it critical that these events are held at alternating locations for greater membership access. The goal for next year is to host 2-3 talks in the Rochester area and 2-3 talk in the Corning area while continuing to look for co-sponsoring opportunities for growth. Please contact Sean Garner (garnersm@corning.com) or Carlo Kosik Williams (kosikwilca@Corning.com) for additional information.

LEOS Awards and Recognitions

Alan Willner, LEOS President, recognized the winners of the 2007 LEOS awards and several of our volunteers for their service to the Society. The awards were presented during the Awards Banquet at the LEOS Annual Meeting in Lake Buena Vista, Florida, USA.

Andreas Umbach and Dirk Trommer.

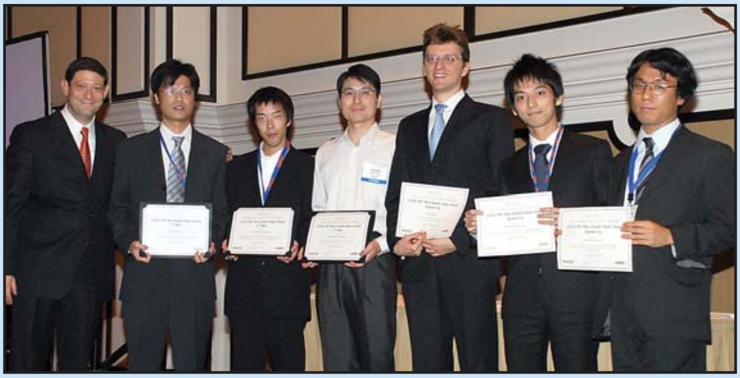
▲ The Engineering Achievement Award was presented to Dirk Trommer, Andreas Umbach, and Gunter Unterborsch, "for the research, development and fabrication of advanced ultra-high speed photodetectors."

▲ The Aron Kressel Award was presented to Rodney S. Tucker, "for contributions to the modeling and analysis and applications of high-speed semiconductor lasers."

▲ The Distinguished Service Award was presented to Mary Y. Lanzerotti, "for dedicated services as Editor of the LEOS Newsletter from 2001 through 2006, resulting in outstanding changes in this publication."

The IEEE/LEOS William Streifer Scientific Achievement Award was presented to Shun-Lien Chuang, "for contributions to the development of the fundamental theories of strained quantum-well lasers and the physics of optoelectronics devices." ▶

1st: Koji Otsuka, 2nd: Tomohiro Amemuya, 3rd: Christophe Antoine, Runners-up: Chen-Bin Huang, Yoshiaki Takata, Kai Zhao were awarded the LEOS Best Student Paper Awards. ▶



Chapter Awards

The Chapter of the Year award was presented to the Santa Clara Valley Chapter. The award for Largest Membership Increase was presented to the Poland Chapter. The Rochester Chapter was awarded the Most Improved Chapter, the award for the Most Innovative Chapter was presented to the Ukraine Chapter, and the Senior Member Initiative Award was presented to the Montreal Chapters. William E. Murray (Santa Clara Valley), Marian Marciniak (Poland), Sean Garner (Rochester), and Lawrence Chen (Montreal) accepted the awards for their chapters. ▼ ▼ ▼ ▼

William E. Murray

Sean Garner

Lawrence Chen

Marian Marciniak

Distinguished Lecturers

Alan Willner recognized Toshihiko Baba, Sergio D. Cova, Bishnu Pal, David V. Plant, and M. Selim Unlu who completed their terms as LEOS Distinguished Lecturers. ▼ ▼ ▼

David V. Plant

M. Selim Unlu

Toshihiko Baba

Conference Section (cont'd)

Board of Governors

Filbert J. Bartoli, Christopher R. Doerr, Silvano Donati, and Diana Huffaker, completed their terms as elected members of the LEOS Board of Governors. ▼

Filbert J. Bartoli

Alan recognized Jens Buus for his service to LEOS as VP of Membership & Regional Activities – Europe/Mid East/Africa, and Nan M. Jokerst for her service to LEOS as VP of Technical Affairs. ▼ ▼

Nan M. Jokerst

Jens Buus

Graduate Student Fellowships

The Graduate Student Fellowships were presented to: Amit Agrawal, Maria Ana Cataluna, Ignace Gatare Gahangara, Maria Garcia Larrode, Zhensheng Jia, Hannah Joyce, Yannick Keith Lize, Cicero Martelli, Houxun Miao, Joris Van Campenhout, Dirk van den Borne, and Lin Zhu. ▼

IEEE Daniel E. Noble Award

Dr. William Gruver, IEEE Division X Director, presented the IEEE Daniel E. Noble Award to Stephen R. Forrest, Richard H. Friend, and Ching Tang, "for pioneering contributions to the development of organic light emitting diodes (OLEDs)" ▶

Alan Willner, Richard Friend, and William Gruver

LEOS Staff at the 20th LEOS Annual Meeting in Lake Buena Vista, Florida. ▼

THE SOCIETY FOR PHOTONICS

LEOS is announcing a call for proposals for Summer/Winter Topical Meeting series 2009. The Topicals 2009 are composed of two complimentary conferences one being scheduled to take place in January in Innsbruck, Austria and another one in July in Newport Beach, California, USA. Eight topics will be selected from the proposals submitted to LEOS which will form each conference each consisting of four topics. Those submitting topic proposals, if accepted, will be expected to organize and plan the topic.

If you are an enthusiastic individual willing to spend some time managing one of the topics at the conference we encourage you to consider submitting your proposal for LEOS Winter/Summer Topical Meeting series. All LEOS related areas of research will be considered, and LEOS staff would be assisting you every step of the way and with every aspect of the conference.

Conference Description:
The Topical Meeting Series serves as an international forum to facilitate information exchange between various technical communities using or affected by rapidly growing areas of technology or "hot topics" related to the general field of Photonics. The conference is limited to 4 topicals. Each topical should target a minimum of 30 presentations and should encompass both invited and contributed papers.

To be considered the potential chairs should submit a white paper including:

1. Organizers: Preference is given to proposals with chairs from different countries **:** name, please send affiliation, country and a brief biography for each co-chair.

2. Introduction: Background, actuality, attendance, justification, i.e. is the topic widely discussed by different research and industrial groups around the world, what type of audience is targeted, etc..

3. Motivation and Scope: conference goals, topics to be covered.

ALL TOPIC PROPOSALS MUST BE SUBMITTED NO LATER THAN: **March 8, 2008**

PLEASE E-MAIL ALL TOPIC SUGGESTIONS AND YOUR FULL CONTACT INFORMATION TO: **m.hendrickx@ieee.org**

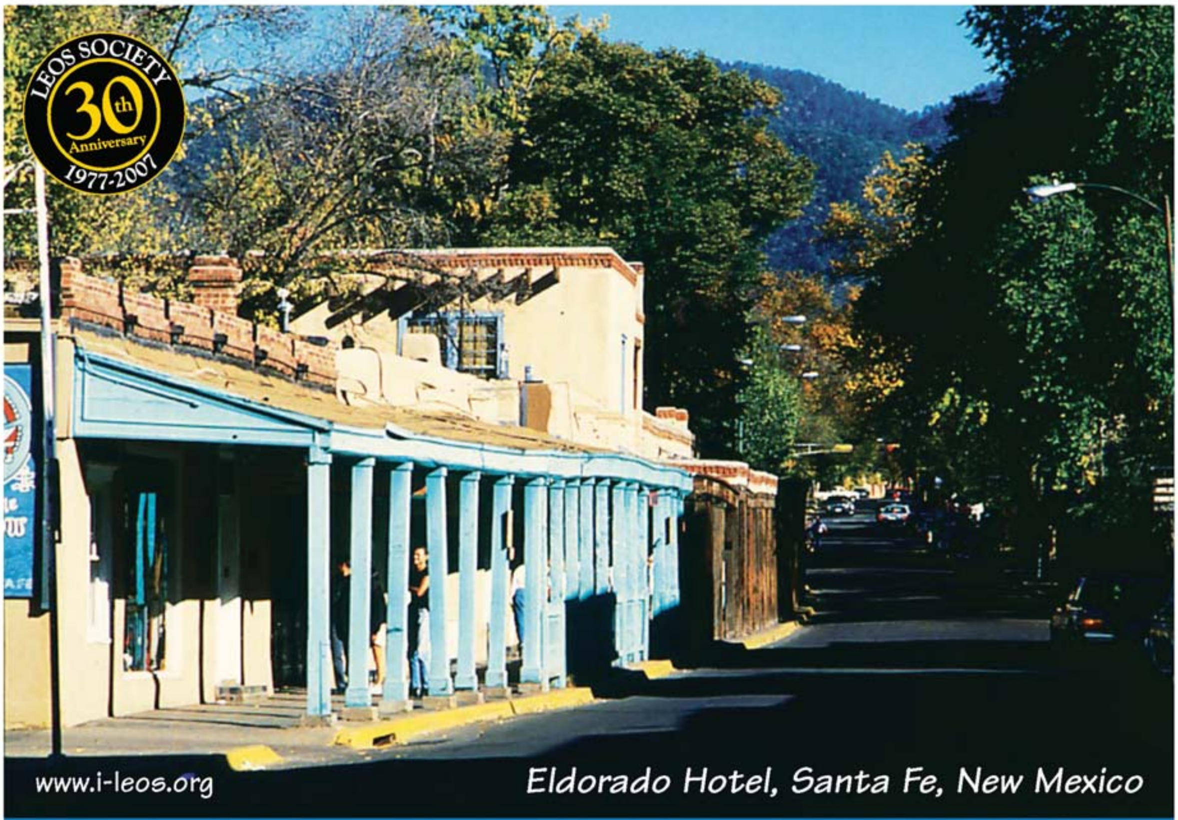


Photo: Jack Parsons

19th Annual Workshop on Interconnections Within High Speed Digital Systems

18-21 May 2008

Sponsored by the IEEE Lasers & Electro-Optics Society
and in cooperation with the IEEE Computer Society

IEEE   IEEE LEOS THE SOCIETY FOR PHOTONICS

REGISTRATION DEADLINE: 23 APRIL 2008


LEOS 2008
The 21th Annual Meeting of the
IEEE Lasers & Electro-Optics Society
9 -13 November 2008
Marriott Newport Beach Hotel & Spa
Newport Beach, CA
Paper Submission Deadline: 9 July 2008
Conference Chair: Sheryl Woodward,
AT & T Labs, Middletown New Jersey, USA
Program Chair: Chennupati Jagadish,
Australian National University, Canberra, Australia
Member at-large: Selim Unlü,
Boston University, Boston, Massachusetts, USA
IEEE
www.i-leos.org
IEEE LEOS
THE SOCIETY FOR PHOTONICS

Publication Section

Call for Papers

Announcing a Special Issue of the IEEE/OSA Journal of Display Technology on Medical Displays

Submission Deadline: 31 December 2007

The IEEE/OSA Journal of Display Technology (JDT) invites manuscript submissions for a special issue. The purpose of this special issue is to document the current status of Medical Displays through a collection of original papers. With a central theme that of medical visualization and diagnosis, topics of interests include (but are not limited to) 2D and 3D emerging grayscale and color technologies, advanced multisensory interfaces for immersive and augmented reality displays (e.g. visual haptic displays), and task-based assessment of all display types including stereo rendered 3D and 4D displays, and displays for telemedicine and telerobotics. Articles related to technological and perceptual bottlenecks are encouraged as well as semantics-driven technological solutions.

The Primary Guest Editor for this issue is **Professor Jannick Rolland**, University of Central Florida, Orlando, FL USA. Associate Guest Editors are **Professor Yongtian Wang**, Beijing Institute of Technology, P.R. China, **Professor Itoh** from Tsukuba University, Japan, **Dr. Gloria Menegaz**, University of Siena, Italy, and **Dr. Aldo Badano**, US Food and Drug Administration, Rockville, MD USA.

The deadline for submission of manuscripts is 31 December 2007 and publication is tentatively scheduled for the September 2008 issue. Manuscripts should conform to requirements for regular papers (up to 8 double-column, single-spaced journal pages in length, keywords, biographies, etc.). All submissions will be reviewed in accordance with the normal procedures of the Journal.

The IEEE Copyright Form should be submitted after acceptance. The form will appear online in the Author Center in Manuscript Central after an acceptance decision has been rendered.

For all papers published in JDT, there are voluntary page charges of $110.00 per page for each page up to eight pages. Invited papers can be twelve pages in length before overlength page charges of $220.00 per page are levied. The length of each paper is estimated when it is received. Authors of papers that appear to be overlength are notified and given the option to shorten the paper.

Authors may opt to have figures displayed in color on IEEE Xplore at no extra cost, even if they are printed in black and white in the hardcopy edition. Additional charges will apply if figures appear in color in the hardcopy edition of the Journal.

Manuscripts should be submitted electronically through IEEE's Manuscript Central:

http://mc.manuscriptcentral.com/leos-ieee. Be sure to select **"2008 Medical Displays Special Issue"** as the Manuscript Type, rather than "Original Paper." This will ensure that your paper is directed to the special issue editors. IEEE Tools for Authors are available online at:

http://www.ieee.org/organizations/pubs/transactions/information.htm

Inquiries can be directed to Lisa Jess, Publications Administrative Assistant, IEEE LEOS Editorial Office, l.jess@ieee.org (phone +1-732-465-6617; fax +1 732 981 1138).

Announcing an Issue of the IEEE JOURNAL OF SELECTED TOPICS IN QUANTUM ELECTRONICS on Organic and Inorganic Photonic Materials

Submission Deadline : January 8, 2008

The ***IEEE Journal of Selected Topics in Quantum Electronics*** invites manuscript submissions in the area of organic and inorganic photonic materials. The purpose of this issue of JSTQE is to document the recent developments in photonic materials through a collection of original papers. Advances in the science and technology of organic and inorganic materials comprising active and passive components are solicited with particular interest in materials relating to:

(a) optical fiber amplifiers and lasers,
(b) infrared transmitting or emitting glasses or crystals
(c) nonlinear crystals and polymers,
(d) organic light emitting diodes
(e) phosphors and displays
(f) photovoltaics

The Guest Editors for this issue are Dr. John Ballato, Clemson University, USA; Dr. Stuart Jackson, University of Sydney (Australia); Dr. Larry Dalton, University of Washington, USA; Prof. Giancarlo C. Righini, CNR - National Department on Materials and Devices, Italy; Prof. Setsuhisa Tanabe, Kyoto University, Japan.

Publication is scheduled for the **Autumn of 2008**.

Online submissions are REQUIRED at http://mc.manuscriptcentral.com/jstqe-leos

The following supporting documents plus manuscript are REQUIRED for online submission:

1. .doc or .pdf manuscript (double columned, 12 pages for an Invited Paper, 8 pages for a Contributed paper.)

Publication Section

Bios of ALL authors are mandatory, photos are optional. You may find the Tools for Authors link useful: http://www/ieee.org/web/publications/author/transjnl/index.html

2. Completed IEEE Copyright Form. http://www.ieee.org/about/documentation/copyright/cfrmlink.htm
3. Completed Color Agreement/Decline form. Please email c.tan-yan @ieee.org for the form.
4. .doc list of ALL Authors FULL Contact information as stated below:

Last name (Family name)/First name/Suffix (Dr/Prof./Ms./Mr)/Affiliation/ Dept./Address/ Telephone/ Fax/ Email/Alternative Email

For questions regarding this issue, email:

Chin Tan-yan
***JSTQE* Publications Coordinator**
IEEE/LEOS
445 Hoes Lane, Piscataway, NJ 08854 USA
c.tan-yan@ieee.org
Phone: 732-465-5813

For all papers published in JSTQE, there are voluntary page charges of $110.00 per page for each page up to eight pages. Invited papers can be twelve pages and Contributed papers should be 8 pages in length before overlength page charges of $220.00 per page are levied. The length of each paper is estimated when it is received. Authors of papers that appear to be overlength are notified and given the option to shorten the paper. Additional charges will apply if color figures are required.

Announcing the Joint Special Issue of the IEEE/OSA Journal of Lightwave Technology & the IEEE Transactions on Microwave Theory and Technique on: Microwave Photonics

Submission Deadline: January 30, 2008

The *IEEE/OSA Journal of Lightwave Technology* invites manuscript submissions in the area of Microwave Photonics. This special joint issue, which will be sent to subscribers of both journals, invites manuscript submissions in the area of Microwave Photonics. This issue will focus on recent progress including experimental work, theoretical developments, and applications. Topics to be covered include, but are not limited to:

1. Optical generation, distribution, and control of microwave, millimeter-wave and THz signals
2. Optically controlled microwave devices
3. Monolithic integration of photonic and microwave electronic devices and circuits
4. Microwave bandwidth optical transmitters and receivers
5. Photonic analog-to-digital conversion
6. Broadband wireless over fiber access systems, components, and channel analysis
7. Optoelectronics in ultrawideband and spread-spectrum systems
8. Microwave photonic devices and components, including ultra-high speed lasers, detectors and modulators, and their driving electronics
9. Photonic technology for array antennas and antenna remoting
10. Sub-carrier multiplexed communication systems
11. Connection technology between fiber optic and wireless systems
12. WDM in microwave photonics
13. Optical/electrical interface and compatibility issues

The Guest Editors for this issue are: **Ted Darcie (Univ. of Victoria), Andreas Stöhr (Univ. of Duisburg-Essen), Paul Yu (Univ. of Calif., San Diego)**

The deadline for submission of manuscripts is <u>January 30th, 2008</u> and publication is scheduled for the <u>August 2008</u> issue. Please upload your paper to Manuscript Central and choose the *2008 Microwave Photonics* special issue. All submissions will be reviewed in accordance with the normal procedures of the Journal.

All copyrights may be completed online or mailed to:

IEEE/LEOS, Doug Hargis
445 Hoes Lane
Piscataway, NJ 08854 USA

For all papers published in JLT, there are voluntary page charges of $110.00 per page for each page up to eight pages. Invited papers can be twelve pages in length before overlength page charges of $260.00 per page are levied. The length of each paper is estimated when it is received in the Editorial Office. Authors of papers that appear to be overlength are notified and given the option to shorten the paper; otherwise, mandatory overlength charges will be assessed. Additional charges will apply if color figures are required.

The IEEE Copyright Form can be found online at:
http://www.ieee.org/about/documentation/copyright/cfrmlink.htm

ADVERTISER'S INDEX

The Advertiser's Index contained in this issue is compiled as a service to our readers and advertisers. The publisher is not liable for errors or omissions although every effort is made to ensure its accuracy. Be sure to let our advertisers know you found them through the *IEEE LEOS Newsletter*.

LEOS Mission Statement

LEOS shall advance the interests of its members and the laser, optoelectronics, and photonics professional community by:

- providing opportunities for information exchange, continuing education, and professional growth;
- publishing journals, sponsoring conferences, and supporting local chapter and student activities;
- formally recognizing the professional contributions of members;
- representing the laser, optoelectronics, and photonics community and serving as its advocate within the IEEE, the broader scientific and technical community, and society at large.

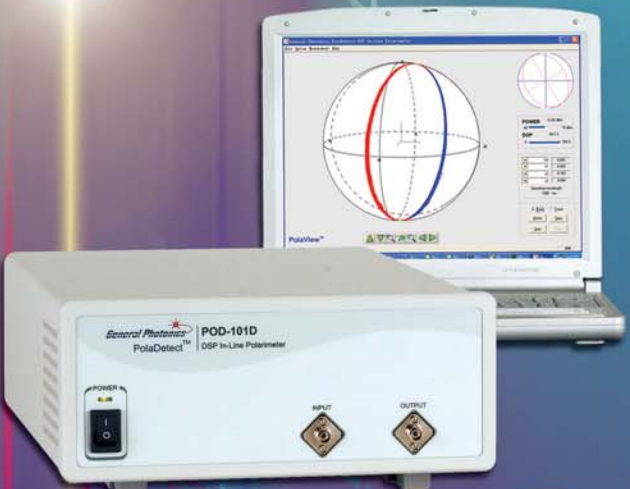
LEOS Field of Interest

The Field of Interest of the Society shall be lasers, optical devices, optical fibers, and associated lightwave technology and their applications in systems and subsystems in which quantum electronic devices are key elements. The Society is concerned with the research, development, design, manufacture, and applications of materials, devices and systems, and with the various scientific and technological activities which contribute to the useful expansion of the field of quantum electronics and applications.

The Society shall aid in promoting close cooperation with other IEEE groups and societies in the form of joint publications, sponsorship of meetings, and other forms of information exchange. Appropriate cooperative efforts will also be undertaken with non-IEEE societies.

PolaDetect™

Detect fast polarization variations in your fiber optic systems



Introducing POD-101D, a DSP (digital signal processor) powered in-line polarimeter specially designed for high-speed polarization analysis and monitoring. The instrument uses four channels to simultaneously obtain the four Stokes parameters and measure the instantaneous state of polarization (SOP) and degree of polarization (DOP) of an input light beam. A simple USB interface enables data to be transferred directly to a computer at a rate of 5Mb/s. Thanks to the high speed DSP electronics, this polarimeter easily monitors and analyzes fast polarization changes with a sampling rate up to 625Kb/s

The POD-101D comes with PolaView™ software for real-time graphic display of polarization state either on a Poincaré Sphere window for viewing SOP traces or on an oscilloscope window for tracking polarization changes over time. The oscilloscope window has three operation modes: continuous scan mode, for instantaneous display of various polarization parameters; external trigger mode, for capturing transient events; and long term monitoring mode, for recording only the polarization changes above a predetermined threshold, in order to save hard drive space. The instrument can also be used for measuring polarization extinction ratio. The POD-101D is ideal for PMD compensation, polarization stabilization, system polarization monitoring, polarization analysis, and sensor analysis.

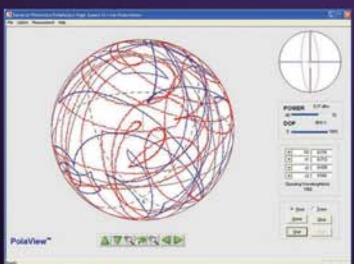
UNIQUE FEATURES:

- Up to 625Kb/s polarization sampling rate
- 5Mb/s data transfer rate
- Analog bandwidth up to 1 MHz
- Real-time Poincaré sphere display
- Continuous scan mode
- External trigger mode
- Long-term monitoring mode

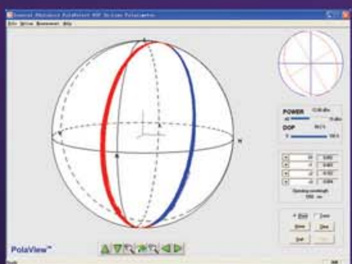
APPLICATIONS:

- PMD monitoring and compensation
- SOP/DOP monitoring
- PER monitoring
- Polarization analysis
- Polarization stabilization
- Sensor systems
- Optical SNR monitoring/measurement

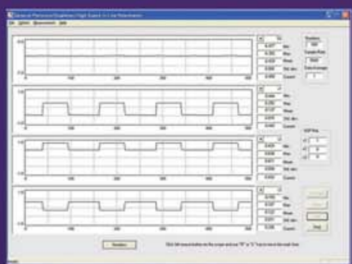
PolaView™ Display Interfaces



Poincaré Sphere display for monitoring random polarization variations



Poincaré Sphere display for monitoring periodic polarization variations



Oscilloscope display for monitoring fast polarization variations

www.generalphotonics.com

General Photonics

5228 Edison Ave., Chino, CA 91710 Tel: (909)590-5473 Fax: (909)902-5536 E-mail: sales@generalphotonics.com