

Report for Laser Focus World:

Event: 2011 MIIPS Ultrafast Pulse Shaping Workshop

Michigan State University August 19 - 21, 2011

Just like electronic fuel injection disrupted the car industry and eliminated the hand-adjusted carburetors, new technology known as MIIPS (multiphoton intrapulse interference phase scan), is making automated femtosecond pulse compression with pulse durations as short as 4fs possible. The most advanced ultrafast technology was showcased and discussed last weekend in East Lansing Michigan, where seven ultrafast lasers with pulse shapers were operating continuously. Participants were able to put to the test the most advanced pulse compression technology.

The MIIPS technology was specifically invented to permit the transition of ultrashort pulse lasers, whose duration is measured in millionth of a billionth of a second (a femtosecond), into industrial and medical applications. The short pulse duration allows one to cut without thermal damage. It has been found that the shorter the pulses the better, however, short pulse laser are notoriously complex and require expert optimization. With MIIPS the system is optimized automatically, greatly reducing the cost and complexity of operating femtosecond lasers.

The 2011 MIIPS Ultrafast Pulse Shaping Workshop drew participants from the US, Europe and Japan to attend lectures from Prof. Andrew Weiner (credited co-inventor of the pulse shaper) and Prof. Marcos Dantus inventor of the MIIPS pulse compression technology. Other lectures included the latest developments in femtosecond fiber lasers, which are now achieving pulse durations as short as 20fs.

The hands-on sessions included seven ultrafast laser systems that participants were allowed to interact with an unprecedented array of state-of-the-art ultrafast lasers. These were:

- (a) Spitfire (Spectra Physics) regenerative amplifier system with a MIIPS Box 640 (Biophotonic Solutions Inc.) pulse shaper installed in-between the oscillator and the amplifier. The system was delivering 37fs pulses after compression with the MIIPS software. By the push of a button, the MIIPS software was also shown to provide interferometric autocorrelation of the pulses at the amplifier output. The software creates two pulse replicas that exhibit nonlinear optical interference after second harmonic generation but don't exhibit linear interference; therefore, they are ideal for pre-amplification pulse shaping.
- (b) A Legend (Coherent) regenerative amplifier system with a pre-amplification femtoFit (Biophotonic Solutions Inc) pulse shaper was pumping a hollow core fiber from which a very broad bandwidth output was used to perform single-beam CARS. Participants were able to see how a second 640-pixel phase-and-polarization pulse shaper was use to achieve selective vibrational state excitation of oxygen and nitrogen in the room air.
- (c) A double-clad ytterbium ultrafast fiber laser built in the Dantus Research Group was shown producing 20 nJ pulses at a repetition rate of 42MHz. The pulses were being compressed by a MIIPS Box 640 (Biophotonic Solutions Inc.).

- (d) A Mantis (Coherent) Ti:Sapphire oscillator was used in conjunction with a two-photon microscope. The laser pulses were pre-compressed using the MIIPS software and a 640-pixel pulse shaper to deliver sub- 15fs transform limited pulses at the focal plane of a high numerical aperture objective.
- (e) Pulse One (Venteon) Ti:Sapphire laser output was compressed by a MIIPS Box 640 (Biophotonic Solutions Inc) pulse shaper to 5fs. The pulse duration was confirmed by the pulse shaper assisted autocorrelation.
- (f) Griffin (KM Labs) Ti:Sapphire oscillator output was compressed by a MIIPS Box 640 (Biophotonic Solutions Inc) pulse shaper down to 14fs. The laser center wavelength was tuned live from 750 to 850nm using the proprietary software.
- (g) The super-continuum from a FemtoFiber Pro (Toptica) fiber laser was compressed to sub-10fs pulse duration and carrier wavelength near 1400nm.

The MIIPS Ultrafast Pulse Shaping Workshop was hosted by Michigan State University. The co-sponsors included Lighthouse Photonics, KM Labs, Coherent, Venteon, CRi now part of Caliper Life Sciences, Toptica Photonics, the National Science Foundation and Biophotonic Solutions Inc.

Biophotonic Solutions Incorporated (BSI) has an exclusive license to the MIIPS technology developed at Michigan State University, which eliminates the need for manual laser optimization. The MIIPS technology received the 2009 PhAST/Laser Focus World Innovation Award. BSI is one of the 50 Companies to Watch in Michigan and is the recipient of the Michigan Innovation of the Year Award 2011 (PR date March 28, 2011)

For more information about the MIIPS Ultrafast Pulse Shaping Workshop, please visit [www ,](http://www.msiips.com) contact Professor Marcos Dantus [dantus@msu.edu](mailto:dantus@msu.edu), or Dr. Igor Pastirk, Chief Technology Officer of Biophotonic Solutions Inc. [Pastirk@biophotonicsolutions.com](mailto:Pastirk@biophotonicsolutions.com)

Testimonials form the workshop:

Prof. Koji Hatanaka:

“It is one of the most WONDERFUL workshops I have ever attended! Well-prepared hands-on sessions after lectures on experimental and theoretical basics and some invited talks on applications of pulse shaping are very much effective for customers to learn MIIPS pulse-shaping technology and to consider future scientific/technological applications. Actually I learned a lot from the workshop!”

Dr. Sukesh Roy, CEO Spectral Energies LLC

“This is one of the best workshops I have attended on pulse measurements and pulse shaping. The structure of the workshop encourages stimulating discussions among the attendees which generally guide people to think new ways to look at their ultrafast research programs resulting in new research projects. I strongly believe that this workshop is better than most of the short courses I have attended on ultrafast measurement in various CLEO conferences. I plan to attend this conference for the years to come.”

Dr. Thomas Binhammer, CEO VENTEON Femtosecond Laser Technologies

“The amount and diversity of the running laser + shaper combinations ranging from amplified systems to commercial laser systems with pulses below 5 fs was really amazing. It is probably unsurpassed by any other workshop I attended so far!”

Anonymous

“I was really impressed by the quality of this workshop and by the efforts made by members of the Dantus Research group as well as Biophotonic Solutions Inc. They made sure that it was easy for everyone to understand how MIIPS works and what it can be used for. I expect we will get to see even more and exciting applications of MIIPS in the future workshops!”: