

ELECTRICAL & COMPUTER ENGINEERING SEMINAR

“Ultrafast Lasers and Devices”

by

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Abstract & Biography

Ultrafast lasers have many important applications including frequency metrology, spectroscopy, imaging, communications, frequency conversion, and optical sampling. This talk will focus on devices that use third-order nonlinearities to enhance performance of ultrafast lasers. Three main topics will be covered: broadband saturable Bragg reflectors, modelocked semiconductor lasers, and bismuth-oxide nonlinear fiber.

Saturable Bragg absorbers, which add an intensity-dependent loss to a laser cavity, can either be used as the main pulse shaping mechanism in an ultrafast laser, or simply as a starting mechanism. Ultra-broadband saturable Bragg reflectors have been applied to a variety of lasers including: Cr:forsterite (1250 nm), Cr:YAG (1500 nm), and Ti:Sapphire (800 nm). High index contrast mirrors monolithically integrated with saturable absorbers enabled the production of ultrafast self-starting pulses (< 30 fs) in these lasers.

A saturable absorber has also been used for pulse shaping in a high power, modelocked semiconductor laser. Semiconductor lasers are valued for their compactness, efficiency and wavelength tunability. However, it has been difficult to generate large pulse energies and average powers from electrically-pumped semiconductor lasers. A 1550-nm monolithic passively modelocked slab-coupled optical waveguide laser produced 10-ps pulses with an average power of 250 mW and a pulse energy of 58 pJ. This is a two-order-of-magnitude improvement in pulse energy over the performance of previously reported electrically pumped 1550-nm semiconductor lasers. The laser is designed to have a large saturation energy with a small confinement factor, enabling high pulse energies.

While ultrafast pulses and broad spectra can be produced directly from lasers, highly nonlinear fiber can offer an alternative solution. A laser source coupled into nonlinear fiber can generate a very broadband spectra or supercontinuum, which can be compressed into an ultrashort pulse. Bismuth-oxide fiber exhibits a large nonlinearity due to the small effective area and nonlinear index of the host glass material. The fiber also has a relatively flat normal dispersion profile over a large wavelength range. Utilizing these features, highly nonlinear bismuth oxide fiber has been used to generate smooth unstructured continuum between 1200 to 1800 nm. After a grating compression stage, 150 fs pulses are compressed to 25 fs. Juliet T. Gopinath received the B.S. degree in electrical engineering in 1998 from the University of Minnesota. In 2000, she was awarded the S. M. degree in electrical engineering and computer science from the Massachusetts Institute of Technology. She completed a Ph.D. degree in electrical engineering and computer science at the Massachusetts Institute of Technology in June 2005. Currently, she is a staff member at Lincoln Laboratory in the Laser Technology and Applications group. Her research interests include ultrafast solid-state and fiber lasers, semiconductor saturable absorbers, semiconductor lasers, wavelength beam combining, and nonlinear processes in fibers. Dr. Gopinath is the recipient of the National Science Foundation Graduate Fellowship (1998-2001) and the LEOS Graduate Student Fellowship (2003). She is a member of OSA and IEEE/LEOS.

Please contact Prof. Carmen Menoni, Carmen.Menoni@colostate.edu, with any questions.