Student Presentation Session II

2:00 pm – 2:30 pm

Chunpo Pan — Long Haul Coherent Fiber-Optic Communication Systems without Optical Dispersion Compensation

Coherent transmission has been proven to be an efficient way to improve data throughput in optical communication systems. Both transmit and receive lasers in coherent systems have finite linewidth, and impose independent phase noises to the signal. The higher order modulation format we employ, the less phase noise the system can tolerate. Hence higher order coherent transmission has higher requirement on the laser linewidth. It was recently noticed that digital signal processing equalizers might also amplify the impairments caused by laser phase noise, especially in long-haul transmission. Hence, phase noise has become a bottleneck for long-haul higher order coherent transmission systems with digital dispersion compensation. In my study I propose a code-aided expectation-maximization (CAEM) method, which will be used to equalizer the received signal. Over a long block of symbols, such a method iteratively estimates the phase noise of each symbol. It takes into consideration the time correlation of the laser phase noise as well as its interaction with amplifier noise. I have shown in simulation results that given a certain type of laser, CAEM can reduce bit error rate by over 60% at the cost of 6.25% data rate overheat. This enables us to go for higher order modulation formats such as 16QAM.

Sinisa Colic — Low Frequency-Modulated High Frequency Oscillations in Seizure-Like Events Recorded from in-vivo MeCP2-Deficient Mice

Rett syndrome is a neurodevelopmental condition caused by mutations in the gene encoding methyl CpG-binding protein 2 (MeCP2). Seizures are often associated with Rett syndrome and can be observed in intracranial electroencephalogram (iEEG) recordings. To date most studies have focused on the low frequencies oscillations (LFOs), however recent findings in epilepsy studies link high frequency oscillations (HFOs) with epileptogenesis. In this study, we examine the presence of HFOs in the male and female MeCP2-deficient mouse models of Rett syndrome and their interaction with the LFOs present during seizure-like events (SLEs). Our findings indicate that HFOs (200-600 Hz) are present during the SLEs and in addition, we reveal strong phase-amplitude coupling between LFOs (6-10 Hz) and HFOs (200-600 Hz) during female SLEs in the MeCP2-deficient mouse model.

Brian Keng — Automated Debugging of Missing Input Constraints in a Formal Verification Environment

In the past decade, formal tools have increased functional verification efficiency by exhaustively searching for hard to find bugs. Often the counter-examples returned are not due to design bugs but due to missing constraints that are needed to model the surrounding environment. These types of false positives have become a great concern in the industry today. To address this issue, input constraints are typically added by the engineer to restrict the input space a formal tool is allowed to explore. These constraints are difficult to generate, as they are usually implicit in the documentation or implementation of adjacent design blocks. As a consequence, this process reduces the efficiency of formal methodologies because missing input constraints must be determined before deep design bugs can actually be detected.

In this work, we present an algorithm to automatically generate missing input constraints given a failing counter-example. The process begins by building a filtering function that models the failing behaviors from the counter-example. Next, using this function a list of fixed cycle properties are generated and filtered to return a set of candidate input constraints for use in debugging. Experimental results show that the generated properties provide a strong intuition as to what input constraints may be missing."

Jason Grenier — Three-dimensional optical circuits in fibers: New frontiers in ultrafast laser fabrication

Optical fibers form the backbone of the Internet and are also routinely used for medical applications. The fiber core, which guides the light through the optical fiber, represents less than 1 percent of the total volume, leaving room to add much more functionality to this compact and highly utilized platform. Femtosecond lasers have opened new possibilities in 3D mirco- and nano-fabrication and therefore offer a unique opportunity to fabricate additional light guiding structures with more advanced filtering and sensing capabilities anywhere inside the optical fiber. Furthermore, microfluidic channels (mircon-size pipes in which fluids can flow) can be also be laser-fabricated allowing light guiding structures to probe fluids to make sensitive measurements. Our aim is to create compact and functional optical and optofluidic microsystems for sensing that underpins the possibility for creating complex laboratory diagnostics on a compact optical fiber. This talk will overview the current progress and future opportunities towards these lab-on-fiber applications."