Temporally nonlocal electro-optic phase dynamics for 10 Gb/s chaos communications

Laurent Larger, Roman Lavrov, & Maxime Jacquot

FEMTO-ST / Optics dept., University of Franche-Comte, 16 route de Gray, 25030 Besancon cedex, France
llarger@univ-fcomte.fr

Since the demonstration of chaos synchronization 20 years ago, chaotic dynamics in photonic systems has been intensively explored as a mean of providing enhanced physical layer data protection in optical communications. Although many popular setups are based on chaotic behaviour of lasers subject to electrical or optical feedback, this approach is currently limited to transmission rates of 2.5 Gbit/s, and requires additional error correction to obtain sufficient link quality (due to low synchronization quality). On the other hand, chaos communications based on electro-optic feedback has been studied and demonstrated as an alternative approach, and indeed has been also successfully used in earlier field experiments at comparable bit rates. In this talk, we report on a new electro-optic approach based on the architecture of nonlocal nonlinear delayed electro-optic phase modulation. The oscillator is ruled by a 4-time scale dynamics spanning from the 10ps up to 10μs, and including two distinct time delays (a long one with 10s of ns, and a short one of about 500ps). Modeling, experimental and numerical results will explore the route to chaos of the EO phase dynamics. A full emitter / receiver scheme will be reported, together with its synchronization capability over a bandwidth greater than 10GHz. Real world data transmission over installed fiber network will be reported, with data rate as high as 10 Gbit/s over up to 100 km of fiber, and bit error rates as low as 10^{-9}. As far as we know, our recent results is representing the best performance to date in optical chaos communication. Other applications of our EO setup will be discussed, such as ultra-fats random number generator, and reservoir computing.