Invited lecture

LONG-RANGE, HIGH-RESOLUTION BRILLOUIN FIBER SENSORS

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Date: **November 5th, 2014** || Hour: **12:30-13.30 h**
Location: **ITEAM Meeting Room, Building G, access D, 4th floor, (Cubo amarillo).**
Universitat Politècnica de València, Camino de Vera s/n, 46022 Valencia.
http://www.upv.es/plano/plano-2d-es.html

Abstract

The analysis of stimulated Brillouin scattering (SBS) interactions along optical fibers is being used in the distributed sensing of temperature and strain for 25 years. SBS is maximal when the difference between the optical frequencies of two counter-propagating waves, a pump and a signal, matches the Brillouin frequency shift of the fiber. The Brillouin shift, in turn, varies with both temperature and strain. Distributed sensing is based on the reconstruction of the position-dependent Brillouin gain spectrum along the fiber.

In Brillouin optical time-domain analysis (B-OTDA), an intense pump pulse is used to amplify a counter-propagating continuous-wave (CW) signal, and the output signal power is monitored as a function of time. The spatial resolution of the fundamental B-OTDA configuration is restricted to the order of 1 m by the SBS lifetime of about 5 ns. Numerous schemes have been proposed and demonstrated for B-OTDA resolution enhancement. State-of-the-art B-OTDA had reached 2 cm resolution over a measurement range of 2 km. Higher resolution was obtained using the complementary technique of Brillouin optical correlation domain analysis (B-OCDA). B-OCDA relies on the close relation between the strength of the Brillouin interaction at a given location, and the temporal cross-correlation between the complex envelopes of the pump and signal waves at that point. State-of-the-art frequency-modulated B-OCDA reached mm-scale spatial resolution, and 24,000 resolution points.

In this seminar, I review several advances in B-OCDA, and in the combination of B-OTDA and B-OCDA, which were proposed and demonstrated by our group and collaborators over the last two years. These include the modulation of continuous pump and signal by a binary phase sequence; the employment of specialty sequences known as Perfect Golomb Codes; a hybrid B-OTDA / B-OCDA setup, in which a pulsed pump and a continuous signal are jointly modulated by periodic phase sequences; and the extension of the pump wave amplitude modulation to long sequences with particularly low correlation sidelobes. Using these methods, Brilloin analysis is performed over a 4 km-long fiber with 2 cm resolution, and the entire set of over 200,000 points is interrogated.

Short Biography

Dr. Avi Zadok received his Ph.D. in Electrical Engineering from Tel-Aviv University in Israel, in 2007. Between 2007-2009 he was a post-doctoral research fellow at the Department of Applied Physics, the California Institute of Technology (Caltech), with the group of Prof. Amnon Yariv. Since 2009 he is leading his own research group at the Faculty of Engineering, Bar-Ilan University in Ramat-Gan Israel, where he was appointed Associate Professor in 2013. His research interests are in silicon photonics, hybrid material integration in photonic devices, fiber-optic sensors and microwave photonics. Dr. Zadok is coauthor of 100 papers in scientific journals and conference proceedings.

Please confirm your attendance by sending an email to Prof. Salvador Sales, ssales@dcom.upv.es.