Session 1

Posters:

FIBER OPTIC SENSING ELEMENT WITH MULTIPLE OVERLAPPING IMPERFECTIONS

Eli Vilge, Moshe Levantovsky, Valery Chernyak, Anatoly Babchenko

Department of Applied Physics, Jerusalem College of Technology,

21 Havaad Haleumi st., P.O.B. 16031,

Jerusalem 91160, Israel, Tel: 972-2-6751212, Fax:972-2-6751045,

e-mail: babchenk@jct.ac.il

Plastic Optical Fibers (POF) have been used as a bent sensing element in a wide range of applications. During the measuring process, the fiber is repeatedly bent, which causes increasing losses of light radiation. Radiation losses in the POF further increase with side imperfections that have been created on the fiber's surface where an imperfections area is implemented on the fiber's core, after removing the cladding.

The bent imperfected fiber can be regarded as a fiber containing dynamic microbends – which increase or decrease in size, depending on the change in macrobending exerted on the fiber. The amount of change and the initial size of the microbends are determined by the properties and style of the imperfection created on the surface of the fiber's core.

The sensitivity of these sensors strongly depends on the imperfection patterns. The present work reports the use of intensity-modulated POF sensing systems based on multiple overlapping imperfected fibers with tip-imperfections.

A mechanical system was constructed to measure changes in bending radii. The U-shaped bent plastic optical fiber was held between two parallel walls. The walls were moved by a micrometer screw with a resolution of 10 μm over a range of 25mm. The radius of the bent fiber equals to half the distance between the walls. Measurements were carried out using a 0.5 meter long, poly-methyl-methacrylate resin fiber CK-40, with a 1mm outer diameter (980 μm core diameter) and a step-index profile, manufactured by Mitsubishi.

Structural imperfections were created abrading the core in the different directions to the fiber axis (0, 90, 50 degree and multiple overlapping scratches). Light was inputted into the optical fiber from a 650nm light-emitting-diode (LED) and output was measured with a PIN silicon photodetector with a spectral response of 0.45 A/W. In all experiments, a 8mm2 area of the fiber was imperfected.

The output voltage as a function of the bending radius is presented. The fiber's sensitivity to bending were evaluate over the radius range of 50mm to 25mm for the fiber with

imperfections in its direction (0 degree), for the fiber with imperfections perpendicular to the fiber's axis (90 degree), for the fiber with imperfections at a 50-degree angle to the fiber, for the fiber with imperfections at 100-dgree overlapping the 50-degree angle and for the fiber with imperfections at 45-dgree overlapping the 50-degree angle.

The results clearly demonstrate the significant increase in sensitivity for sensors based on plastic optical fibers with multiple angular overlapping imperfections. Additional studies showed the possibility of boosting the sensitivity by increasing the scratch depth of the imperfected zone. These preliminary results may be useful for developing highly sensitive measurement systems using bent polymer optical fibers.

Terrestrial Demonstrator for Communication and Ranging Laser Inter-Satellite Link System

E. Pinsky[1], E. Shamay[1], D. Zehavi[1], M. Guelman[2], A. Kogan[2], M. Orenstein[2]

[1]RAFAEL Ltd., P.O.B 2250, Haifa 31021, Israel, ephip@rafael.co.il
[2]Asher Space Research Institute, Technion, Haifa 32000, Israel

A ground demonstrator consisting of two identical terminals that represent two formation flying satellites in orbit is presented. They constitute a dual optical link that establishes and maintains a free space communication and ranging with strict constraints on size, weight and power consumption.

A 2.5 GBps data link over a terrestrial path of 3 km with perturbations of atmospheric turbulence, attenuation and aerosols backscattering will be demonstrated at the first phase of the program. The channel is also used to measure the inter-satellites' range with centimeters accuracy regardless of inter-terminals' distance. The second phase will be to design a space system with the same data rate and range accuracy for distances up to 1000 km in space.

The link has two modes of operation that are implemented in a single optical channel – Acquisition mode where the received power is maximized by a novel cooperative control technique, and tracking mode where data communication link and precise ranging is established. In addition, a single laser serves both as a beacon for the acquisition and as a transmitter for the data link.

Atmospheric artifacts in the terrestrial demonstration are considered as well. Random modulations induced by the atmospheric turbulence degrade quality and may increase converging time of the Cooperative Extremum Seeking Algorithm (CESA). Modulation data generated from actual measurements was combined with the simulation. Preliminary results indicate a converging process, even with turbulence effects.

In-Fiber Microphones for Speech Detection

Ran Aharoni[(1)], Lior Klein[(2)], David Vaknin[(3)] and Zeev Zalevsky[(1)]

[(1)]School of engineering, Bar-Ilan Univ., Ramat-Gan 52900, Israel
[(2)]Physics Dept., Bar-Ilan Univ., Ramat-Gan 52900, Israel
[(3)]IST engineering, Rehovot, Israel

In this paper we present special optical device for detection of acoustic signal and especially speech signals, as well as to allocate the position of the speaker. An in-fiber Mach-Zehnder interferometer is generated using special tapering rig. The interferometer allows accurate and sensitive detection of speech signals. Along this special fiber many Mach-Zehnder interferometers are fabricated while each is resonating and operating in a different wavelength. Therefore by using wavelength multiplexing one can not only recover the speech signals but also to allocate the position of the speaker. Initial experimental results and fabrication attempts are presented.

Nano Photonic Opto-Electronic Transistor and XOR Gate on Silicon Chip

Ofer Limon and Zeev Zalevsky

School of Engineering, Bar-Ilan University, Ramat-Gan 52900, Israel

In this paper we present an opto-electronic approach allowing the realization of a transistor or an electro optical modulator as well as a logic XOR gate. The information is photonic and the signal that controls the device is electronic. The proposed device includes special structure based on silicon and metal which produces a controlled relative phase shift as well as amplitude modulation at its optical outputs. Such an effect is used for the realization of the mentioned data processing devices. The module has length dimension of only few microns, high operating rate, low power consumption and high energetic efficiency. The paper presents the numerical investigation of the device.

Nano Photonic All-Optical Transistor on Silicon Chip

Ofer Limon[(1)], Arkady Rudnitsky[(1)], Menachem Nathan[(2)], Luca Businaro[(3)], Dan Cojoc[(3)], Annamaria Gerardino[(4)] and Zeev Zalevsky[(1)]

[(1)]School of Engineering, Bar-Ilan University, Ramat-Gan 52900, Israel
[(2)]Faculty of Engineering, Tel-Aviv University, Tel-Aviv 69778, Israel
[(3)]CNR - National Institute for Matter Physics (INFM) TASC laboratory, LILIT group, Italy
[(4)]CNR - Institute for Photonics and Nanotechnology (IFN), Rome, Italy

In this paper we present an all-optical transistor realized on a silicon chip. The proposed transistor has nano scale dimensions and high extinction ratio. The operation principle based on spatially non uniform variation of light absorption of a compact Mach-Zehnder waveguide interferometer made out of silicon while it is being illuminated with visible light. Such a transistor may be used as an interfacing link between micro electronic processing circuits and optical information transmission links. The paper presents the fabrication and the experimental characterization of the suggested device. Since the operation principle is not based upon high Finesses resonator, it is less sensitive to wavelength changes and it has higher operation rate.

Semiconductor-Oxide-Semiconductor Photo-Activated Transistor

Doron Abraham[(1)], Avraham Sheli[(1)], Yossef Shappir[(2)], Michael Rosenblu[(3)] and Zeev Zalevsky[(1)]

[(1)]School of engineering, Bar-Ilan Univ., Ramat-Gan 52900, Israel
[(1)]School of Applied Science, Hebrew Univ. of Jerusalem, Jerusalem, Israel
[(3)]Physics Dept., Bar-Ilan Univ., Ramat-Gan 52900, Israel

In this paper we present the numerical design and initial experimental investigation of a device called the semiconductor-oxide-semiconductor photo-activated transistor. This is a novel semi-conducting device controlled by light. The transistor overcomes the speed barrier of currently existing technology and releases bottle necks in networks by increasing the operation speed by a factor of 100 and approaching the tens GHz processing rates per transistor. The proposed device also exhibits low power consumption and high modularity. The novel principle of the device is that the passage of the information current is controlled by light, while the information itself is still electronic, without changing the external voltage. This significantly reduces the response time since the external RC constant is no longer relevant.