OASIS 2007 March 26-27 מרכז הידידים, ת"א

The 11th Meeting on Optical Engineering and Science in Israel

הכינוס האחד עשר לאופטיקה, אלקטרואופטיקה והנדסה אופטית

Session 1

Lectures:

OPTICALLY INDUCED FILTERS BASED ON STIMULATED BRILLUOIN SCATTERING

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Optical filters are very important for numerous current and future photonic applications. There are many existing technologies that can be utilized to implement tunable and/or adaptive optical filters including: Fiber Bragg Gratings (FBG's), Planar Lightwave Circuits (PLC's), Photonic Crystal Circuits (PCC's), Thin Film Filters (TFF's), Fabry-Perot Filters, Acousto-Optic Filters (AOF's), Arrayed Waveguide Gratings (AWG's), microelectro-mechanically-actuated tunable filters and more. Yet, a device that can offer the filter designer a very large number of controllable degrees of freedom, that can be switched from one functionality to another, and that can be straightforwardly tuned over tens of nanometers by optical means, is currently unavailable. Recently we have been studying a unique family of general purpose optical filters. These filters, which we call Optically Induced Filters (OIF's), are created in single mode fibers via Stimulated Brillouin Scattering (SBS), by an optical pump whose characteristics are carefully designed. The pump wave changes the transmission properties of the fiber and induces in it an optical filter with a desired transfer function. In contrast with many other implementations of optical filters, the transfer function of these filters, as well as their center wavelength, can be easily varied by controlling the pump characteristics. Another distinctive attribute of OIF's is the relatively high number of degrees of freedom available to the OIF's designer. This number is bigger than in alternative technologies and enables the synthesis of very high-order filters. In a preliminary experiment we have utilized SBS to implement flat-top band-pass filters with tunable center wavelengths and variable widths in the range of 1-3GHz. A very similar setup was used to implement a continuously tunable delay line which enabled a 5Gb/s pseudo random bit sequence to be delayed by up to 120ps while maintaining acceptable BER and delaying a 5GHz Single Side Band (SSB) analog signal with 1GHz wide Linear Frequency Modulation (LFM) by up to 230ps. The changing of the filter functionality, was most conveniently carried out by modifying the modulation of the pump.

Micro C.C.R. Array Passive Transmitter for Communication and Sensor Network Applications

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Abstract

Corner Cube Retro-reflectors (CCR) are well known optical devices comprising three orthogonally positioned mirror surfaces. The most significant property of such devices is that an incident beam, arriving over a range of incident angles, is always reflected back to its source. Hence, the CCR device is widely used in optical systems and in lab testing equipment. More recently, the idea of using a CCR device as a passive transmitter in free space optics has been discussed in the scientific literature. The CCR passive transmitter includes a CCR as well as a mechanism for modulating the incident beam. Thus, an incident continuous beam reaching the CCR passive transmitter can be On-Off modulated to carry data to a receiver located adjacent to the beam source. A variety of modulation techniques has been discussed in the scientific literature as well as the properties of an array of CCR's for communication applications.

In this paper we present a novel architecture for a CCR passive transmitter which is structured in the form of an array of CCR's and a mechanical deformation modulation mechanism integrated on a silicon device. The CCR passive transmitter is fabricated using Micro-Electro-Mechanical Systems (MEMS) technology and includes a modulation mechanism that can displace one of the three orthogonal mirrors. Thus, the return beam can be deflected from the direction parallel to the incoming beam. The suggested architecture is potentially a very low cost, miniature-size and a very low power consuming transmitter, meeting the requirements of sensor network nodes and short range, narrow bandwidth communication links. We present the performance of a communication link based on the novel CCR passive transmitter in the context of a distributed sensor network system.

DYNAMIC ATTENUATOR – CONTROLING OPTICAL POWER LEVELS IN NETWORKS

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The need for higher optical power in point to point communication is becoming more important in today's networks as its complexity increases. Protection and power-leveling devices with a wide dynamic range are therefore essential in the network to control and regulate the power level for its long-term reliable operation. Currently this is achieved by expensive electronic feedback control system using variable optical attenuators (VOAs) and detectors in each signal line.
We report on a new passive optical device, namely, dynamic attenuator that can limit its output power by light scattering mechanism to a pre-assigned value irrespective of input power level within a dynamic range. The device works as a normal fixed attenuator below this input dynamic power range, while it acts as a fuse protecting the network from permanent damage if the input power shoots above and beyond. We present the assembly process and the characteristics of the new passive dynamic attenuator. The device works equally well under extreme environmental conditions, namely, from -40 to 85 degrees at 85% relative humidity according to GR-1209-CORE specification for passive components. The nominal characteristics of the device (IL, ORL and PDL) are such that its placement in the network does not compromise with the quality of the transmitted signal. This device has been designed in a popular LC male to LC female plug style configuration to be able to easily install in the network. The dynamic attenuator can serve as both power regulating and protection devices in optical networks. Moreover, one can use a dynamic attenuator as a wide spectrum eye safety component, in both fiber and free-space systems.

Optical fiber anti reflective coating based on sol-gel technology

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A method of forming antireflective coating (ARC) on the surface of optical components made from glass, fused silica or quartz has been developed. The ARC is matched for near infra-red (NIR) wavelength region, included common telecommunication wavelengths of 1.3 and 1.5µm. The optical components include optical fibers and fiber optics as well as bulk optics. The method is based on the use of modified highly transparent sol-gel technology with appropriate refractive index and controlled thickness. The film is deposited on a treated surface using simple coating process. In addition to the ARC properties the sol-gel based coating provides an environmental durability and excellent mechanical properties.