Modern Optical Fiber – Communication Splitter

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Abstract- In this article, we discuss the challenges to offering their services to it).The optical fiber can be used for the many of industrial application and medical applications as well. The optical fiber consists of two media kept one inside the other. The center transparent medium of the optical fiber is called "core" and the outer is cladding. The refractive index of the core will always be higher than the refractive index of the cladding. Our work is inspired by a public fiber access network being built in Australia called the National Broadband Network (NBN) that will deploy fiber to 93 percent of premises, providing broadband access at potential data rates of 100 Mb/s and above. The Sagnac interferometer has expanded from the rotation measuring instrument into These cables had a loss figure of about 20db/km. When operating frequencies increased further the coaxial cables proved to be inadequate and loss, thereby giving rise to the need of another medium called waveguides very versatile sensing tool. Indeed, it is arguably the most successful of optical fibre sensing technologies.[1] In this paper, we review both the principles and applications of the fibre Sagnac interferometer. The background theory highlights the need to understand the conditions for reciprocity within the interferometer another through them. The electromagnetic energy traveled, along with the lengths of these cables and was confined in between the two metallic layers. These cables had a loss figure network. The applications range from the expected gyroscopes into the novel hydrophone arrays and intruder detection systems. Immediately its potential for gyroscopic measurements became apparent, and since the first demonstration, substantial research and development investment has evolved a diversity of rotation measuring instruments [2].

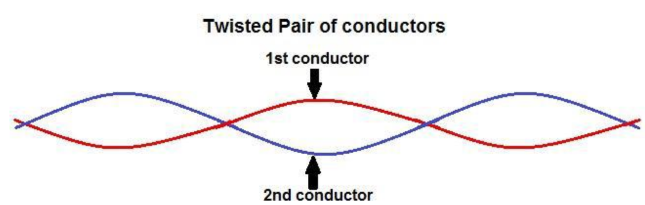
Index Terms- Sagnac, ubiquitous, Fibre-optic sensor, a chemical sensor, an enzymatic sensor, complete cell biosensor, control of biologicals, tapered optical fibre, optical chemical sensor, chemical equilibrium, biosensors, physicochemical transducer, environmental and clinical monitoring.

I. INTRODUCTION

Fiber-Optic Communication is the most modern and advanced mode of data communication which has very recent roots dating back to not more than 40 years ago, This was the major breakthrough in the field of communication. Right from this time, there has been a continuously increasing need for bandwidth for communication due to continuously increasing the number of users. More people wanted to communicate, and thus large bandwidths were required thereby forcing communication scientists to look for new possibilities. Communication Scientists all over the world were in an incessant search for a wideband and low-loss medium of data communication which could be used at high data rates with the least amount of lost possibly. This constant search, for such a medium, led to the development of optical fiber communication. Let us have a quick glimpse into the history of communication. [3-6].

II. AIMS AND SCOPE OF THE JOURNAL

The journal covers research into the design, characterization, and production of structures scales. The electromagnetic energy traveled, along with the lengths of these cables and was confined in between the two metallic layers. These cables had a loss figure of about 20db/km.[7] When operating frequencies increased further the coaxial cables proved to be inadequate and loss, thereby giving rise to the need of another medium called waveguides. These are basically hollow structures which guide the electromagnetic energy from one point to of about 20db/km. When operating frequencies increased further the coaxial cables proved to be inadequate and loss, thereby giving rise to the need of another medium called waveguides. These are basically hollow structures which guide the electromagnetic energy from one point to another through them. But as the operating frequency further increased to few hundreds of gigahertz these waveguides too proved to be inadequate as there was no supporting electronic circuitry available that could operate at such high frequencies. [8]



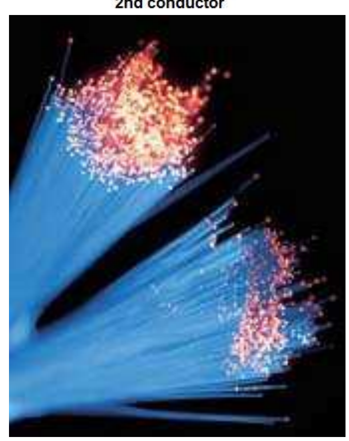


Figure 1: Conduction Band

Motivation – OPTICAL COMFINDMENT

On the very first look, both the questions seem trivial. This is because we already have a lot of sources of light in our day to day life, for e.g. incandescent bulbs, gas bulbs, LEDs, fluorescent lamps, etc. Then why worry about sources? Similarly, the second question also has a very obvious answer. Fibers are also used for illumination and are wrapped in bundles so that they may opt for a variety of other applications, including sensors and fiber.[9] lasers. They are used as light guides in medical and other applications where bright light needs to be shone on a target without a clear line-of-sight path. Many microscopes use fiber-optic light sources to provide intensely[10]

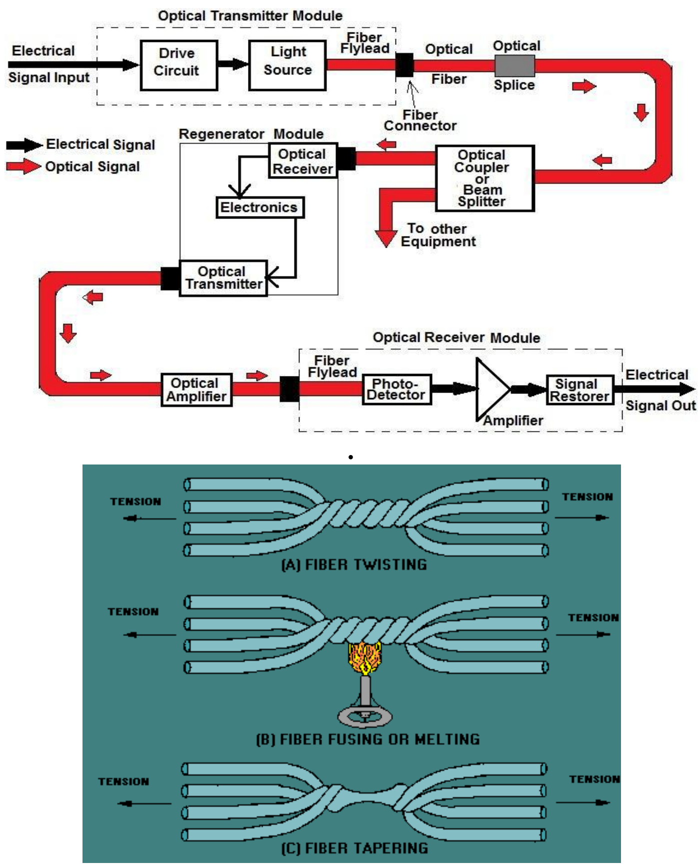


Figure 2: Optical Communication Link through light source

III. WHY OPTICAL FIBRE

Fibers having attenuations greater than 1 dB/km are rarely used in communication networks. Nevertheless, the attenuation of badly matched fibers may exceed 1 dB/km per connector or splice if they are badly handled during installation stages. A good coupling efficiency requires precise positioning of the fibers to center the cores. The simplest way to avoid connector losses is by splicing the two ends of the fibers permanently, either by gluing of by fusing at high temperatures. Losses in gaps can be viewed as a type of Fresnel loss because existing air space introduces two media interfaces and their associated Fresnel reflection losses. In this case, there are two major losses to be considered. The first loss takes place on the inner surface of the transmitting fiber, and the second loss occurs due to reflections from the surface of the second fiber. One way of eliminating these losses is by introducing a coupler that matches the optical impedances of the two materials.[11-13]

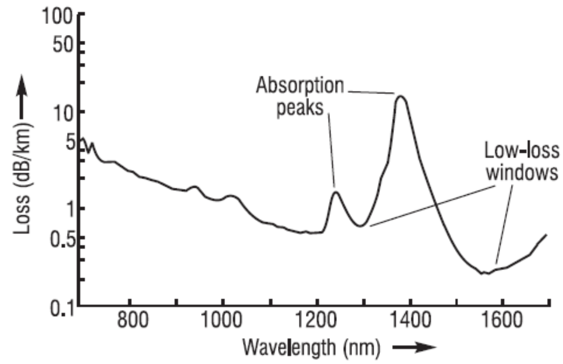


Figure 3: Absorption with Low- Loss Peak

Scattering Losses of an optical fiber

Despite the careful manufacturing techniques, most fibers are inhomogeneous that have disordered, amorphous structures. Therefore, high-order modes suffer more losses, thus causing modal dispersions. The modal dispersion is one of the primary cause of rising time degradation for increasing fiber wavelengths. In addition, propagation time varies with an index of refraction Power losses due to scattering are caused by such imperfections in the core material and irregularities between the junction and cladding as shown in Figure 2 . In homogeneities can be either structural or compositional in nature. In structural in homogeneities, the basic molecular structure has random components, whereas, in compositional inhomogeneity, the chemical composition of the material varies. The net effect from either inhomogeneity is a fluctuation in the refractive index. [14]As a rule of thumb, if the scale of these fluctuations is on the order of l/10 or less, each irregularity acts as a scattering center. This is a form of Rayleigh scattering and is characterized by an effective absorption coefficient that is proportional to . Rayleigh scattering can be caused by the existence of tiny dielectric inconsistencies in the glass.[15] Because these perturbations are small with respect to the waves being propagated, light striking a Rayleigh imperfection scatters in all directions. Scattering losses are less at longer wavelengths, where the majority of the transmission losses are due to absorption from impurities such as ions. Rayleigh scattering losses are not localized, and they follow a distribution law throughout the fiber.[18] However, they can be minimized by having low thermodynamic density fluctuations. A small part of the scattered light may scatter backward, propagating in the opposite direction. This backscattering has important characteristics and may be used for measuring fiber properties. Usually, the in homogeneities in the glass are smaller than the wavelength l of the light. The scattering losses in glass fibers approximately follow the Raleigh scattering law; that is, they are very high for small wavelengths and decrease with increasing wavelength.[19] In general, optical losses in the glass cause the optical power in fiber to fall off exponentially with the length L of the fiber.

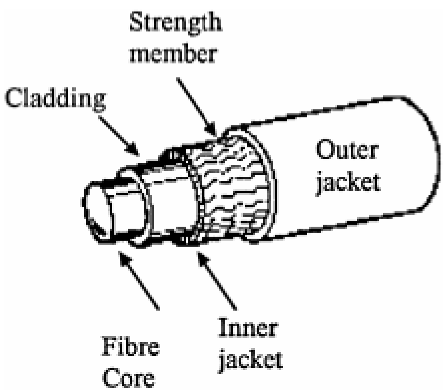


Figure 4: Extrinsic Fiber Losses

IV. APPLICATIONS OF FIBER-OPTICS

- Mie Scattering
- Rayleigh Scattering

Mie Scattering

Non-perfect cylindrical structure of the fiber and imperfections like irregularities in the core-cladding interface, diameter fluctuations, strains, and bubbles may create linear scattering which is termed as Mie scattering

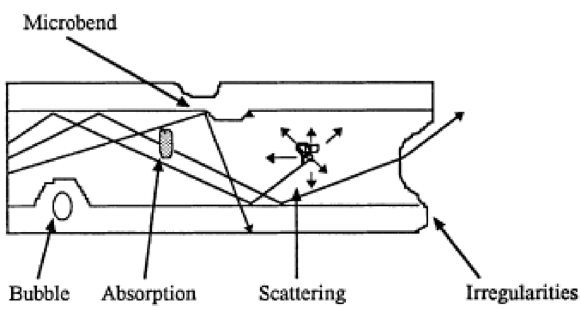


Figure 5: Microband of Fiber Optics

Rayleigh Scattering

The dominant reason behind Rayleigh scattering is refractive index fluctuations due to density and compositional variation in the core. It is the major intrinsic loss mechanism in the low impedance window. Rayleigh scattering can be reduced to a large extent by using longest possible wavelength.[20]

V. SYNTHESIS OF OPTICAL- FIBER

This Chapter is devoted to the description of the optical cable installation methods. Each type of optical fiber cable has a specific strain limit, and special care and arrangements may be needed to ensure successful installation without exceeding it. Some of the most difficult situations for the installation of optical fiber cables are in underground ducts. The condition and geometry of duct routes are of great importance. Damage caused by overloading during installation may not be immediately apparent but can lead to failure later in its service life. Also, aspects related to bending during the installation may require special consideration. Consideration should also be given to factors of time and disturbance. Installation equipment may be required to run for long periods of time and the time of day, noise levels, and traffic disruption should be taken into account.[22]

There are many types of cable installation (underground duct, trenchless, mini-trench, aerial, submarine, etc.) are described. Clause 2 deals with additional safety precautions when installing optical cables. In a top-down approach -a large piece of material is cut down to small pieces through different means such as lithography and electrophoresis. In order to obtain a reliable end-to-end network, all different network nodes shall be evaluated using the same methods and metrics.[23]

A network node should be able to fulfill its optical functionalities, including the ability to be reconfigured, in all conditions of the environment, in which the node will reside

Figure 6: SR7265 DSP Lock-In Amplifier

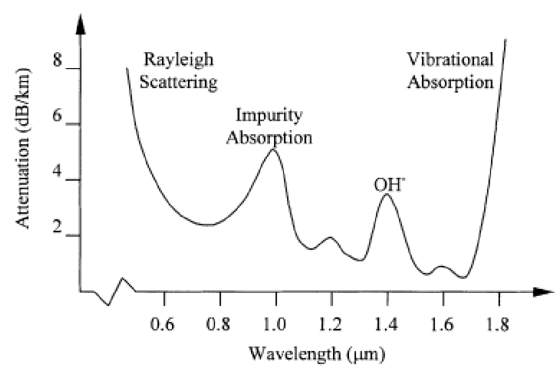


Figure 7: Fiber reconfiguration with Scattering

VI. CONCLUSION

The choice of an appropriate emergency restoration method for a damaged optical fiber cable, as well as its permanent repair, depends on the extent of the damage and particularly on the distribution of fiber breaks. The restoration procedures presented below are based on the premise that optical fiber cable systems carry large traffic cross sections and warrant a substantial. Thus, a basic understanding of the mechanics of cable behavior, with regard to the mechanical tension applied to the cable, in damage situations is important in developing and applying these methods. Especially at high optical power levels scattering causes disproportionate attenuation, due to non-linear behavior. Because of this nonlinear scattering, the optical power from one mode is transferred in either the forward or backward direction to the same, or other modes, at different frequencies [24]

Pump laser at 980 nm or 1480 nm excites erbium doped fiber.

- Erbium fluoresces at 1550 nm, providing stimulated emission gain to the communication signals. The doped fiber thus acts much like a laser but without the end mirrors (single pass).
- Spontaneous emission of the erbium is a noise source, so the amplification comes at the expense of reduced SNR.

VII. Acknowledgment

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References

[1] Report by Allen Consulting Group Pty Ltd for the Australian Govt. Dept. of Broadband, Communications and the Digital Economy, "Quantifying the Possible Economic Gains of Getting More Australian Households online," http://www.dbcde.gov.au/__data/assets/pdf_file/0004/135508/Quantifying_the_possible_economic_gains_of_getting_more_Australian_households_online.pdf, Nov. 2010.

[2] CSIRO ICT Centre, "Enabling a revolution in healthcare through e-health innovation," http://www.csiro.au/science/healthcare-revolutionthrough-ehealth-innovation.html.

[3] Australian Govt. Dept. of Broadband, Communications and the Digital Economy, "National Digital Economy Strategy," http://www.nbn.gov.au/the-vision/digitaleconomystrategy, 2011.

[4] In-Line Gas Sensor Based on a Photonic Bandgap Fiber With Laser-Drilled Lateral Microchannels Hartmut Lehmann; Hartmut Bartelt; Reinhardt Willsch; Rodrigo Amezcua-Correa; Jonathan C. Knight IEEE Sensors Journal, 2011

[5] A Fading-Discrimination Method for Distributed Vibration Sensor Using Coherent Detection of $varphi $ -OTDR Fufei Pang; Meeting He; Huanhuan Liu; Xuanwei Mei; Jiang Tao; Tongzhi Zhang; Xiaobei Zhang; Na Chen; Tingyun Wang IEEE Photonics Technology Letters, 2016

[6] New Bismuth-doped fiber laser operating at 1625–1775 nm E. M. Dianov; S. V. Firstov; S. V. Alyshev; K. E. Riumkin; S. V. Shubin; V. F. Khopin; A. N. Guryanov; O. I. Medvedkov; M. A. Melkumov 2014 The European Conference on Optical Communication (ECOC).

[7] When to use 3D Die-Stacked Memory for Bandwidth-Constrained Big Data Workloadsason Lowe-Power Mark D. Hill David A. WoodUniversity of Wisconsin–Madisonpowerjg,markhill,david@cs.wisc.edu

[8] Influence of facet reflection on the performance of Vertical-Cavity Semiconductor Optical Amplifiers," Tikrit Journal for Pure science, vol. 8, No. 2. 2002. Abstract

[9] Theoretical investigation of spectral linewidth properties of double fused 1.3 um MQW-VCA in reflection and transition modes," Tikrit Journal for Pure Science, vol. 8, No. 2. 2002. Abstract

[10] Vertical cavity amplifiers and its cavity length dependence the saturation power and quantum efficiency," Tikrit Journal of Pure Science, vol. 9, No. 2. 2003. Abstract

[11] Conductometric studies of 1:1 monosubstituted salicylic/acid in aqueous solution at 25o C," Science Journal of Chemical, Libya. 2004

[12] C. E. Shannon, Proc. IRE 37, 10 (1949).

[13] K. Fukuchi, T. Kasamatsu, M. Morie, R. Ohira, T. Ito, K. Sekiya, D. Ogasahara, and T. Ono, Paper PD24, Proc. Optical Fiber Commun. Conf., Optical Society of America, Washington, DC, 2001.

[14] P. P. Mitra and J. B. Stark, Nature 411, 1027 (2001).

[15] A. Mecozzi, IEEE Photon. Technol. Lett. 13, 1029 (2001).

[16] J. Tang, J. Lightwave Technol. 19, 1104 (2001).

[17] J. Tang, J. Lightwave Technol. 19, 1110 (2001).

[18] J. B. Stark, P. P. Mitra, and A. Sengupta Opt. Fiber Technol. 7, 275 (2001).

[19] E. E. Narimanov and P. P. Mitra, J. Lightwave Technol. 20, 530 (2002).

[20] 9- Constraint base Student Modeling (CBSM) in ICAIT," Iraqi Journal of Physics, Vol. 6. 2005. Abstract

[21] Fuzzy Logic Approach to Recognition of Isolated Arabic Characters." International Journal of Computer Theory and Engineering (IJCTE), Vol. 2, No. 1. 2010. Abstract

[22] Effects of pump recycling technique on stimulated Brillouin scattering threshold: A theoretical model," Optics. Express, Vol. 18, No. 21, pp. 22339-22347 Impact factor: 3.88. 2010. Abstract

[23] Brillouin Linewidth Characterization in Single-Mode Large Effective Area Fiber through the Co-Pumped Technique," International Journal of Electronics, Computer, and Communications Technologies (IJECCT), Vol. 1(1), pp. 16-20. 2010. tract

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