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Design and Implementation of an Optical Measuring Interference System for Noise Signals in Optical Fiber Based on Neural Networks

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Abstract: This research proposes improvements to the Mach-Zehnder interference system (MZDIS) that will enable it to assess the noise-to-optical-fiber ratio with a high accuracy of 0.4 dB obtained from an optical signal of 5 to 40 dB. The optical system of the proposed interference system has been modified to improve accuracy at a modulation frequency of 10 GHz, in addition to 3 dB optical couplers (OC), which make up the proposed setup. Two branches receive the signal from the initial connection, one of which contains a phase controller and a light backlight. The free spectral range (distance spectroscopy between two neighboring transmission peaks) is controlled by optical delay. The phase controller synthesizes the optical signal's phase. In the first route, for the technique of Optical signal to noise ratio (OSNR) monitoring, which is based on the cancellation of a certain frequency component of the spectrum of the ovdm signal after optical detection by adding polarization scattering on the signal to allow noise to strike inside this component, has been successfully implemented in the optical Orthogonal Frequency Division collection system with direct detection. This noise's individual and general amplitudes were measured using a narrow beam pass filter. To ascertain the value of Osner. The color dispersion did not affect the measurement accuracy, which was less than 1db and had a satisfactory measurement range of [5-40dB]. In addition, it is not required to send manual tones or decode design modifications, which reduces costs.

Keywords: Mach-Zehnder interference system (MZDIS); Optical couplers (OC); Optical signal to noise ratio (OSNR).

1. Introduction

Spontaneous amplification emission (ASE) noise is the predominant mode of noise in optical networks in which optical amplifiers are used to compensate for transmission loss. This noise is described by the ratio of the optical signal to the Usner noise. The Usner parameter is one of the important parameters for estimating the quality of an optical signal, due to which a fiber-optic link can be designed to operate at a certain PIR bit error rate. In addition, Osner identifies the factors of network performance degradation [1].

Technologies for measuring the optical signal-to-noise ratio in optical networks are divided into two groups. Outside the sphere, and inside the sphere. In off-field measurement techniques noise is measured the linearity

of the wavelengths between the optical channels in the optical network, and therefore they are linearly distorted the interpolation is within the wavelength of the desired channel as shown in Figure 1 while in measurement techniques inside the field the noise is measured inside the beam field of the optical channel [2]. Off-field monitoring techniques can accurately estimate the OSNR in a conventional point-to-point transmission system (Where the noise spectrum is fairly regular), But in modern returnable networks dynamically shaping. In which light signals are added and deleted as in (WDM systems). Each signal can traverse different paths and pass through a different number of optical amplifiers [3].
In addition, the noise spectrum in these networks may not be regularly due to the photo filtration that occurs various network elements, such as the reconfigurable optical transmission complex. As a result Noise levels may vary from Channel to channel. Thus, the can be measured the accumulators in these networks are exactly [4]. Over the past years, many researchers have tried to develop a technique capable of observing the real value (OSNR).

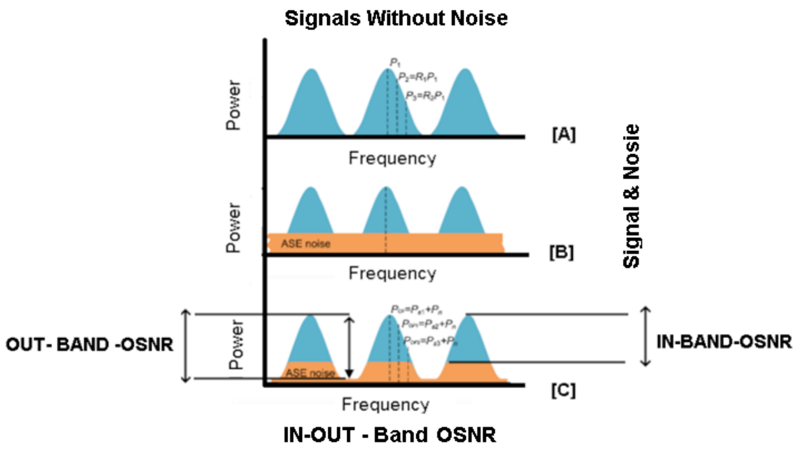

Figure 1. Out-of-band and In-band OSNR measurement.

Even in a dynamic networking environment. For this purpose, it is necessary to distinguish and reveal the components of the small noise are hidden behind the big light signal. For example, such differentiation can be achieved (Detection of Noise within the range). During the use of various optical properties of the optical signal and noise. For example For example, an optical signal can be characterized as polarized, correlated, while a noise signal is non-polarized, non - Interconnected. Similarly, after the photo electronic conversion process, the signal compounds، Noise and properties Different in Electric field, this is what can be exploited in OSNR monitoring within the field [5].
Monitoring the ratio of optical signal to noise outside the field, Light spectrum analysis in this technique, the noise spectrum is assumed to be (ASE) almost regularly. Thus as long as it is not used a narrow optical filtering element in the optical network [6]. The levels of light signals and ASE noise can be easily estimated from measured optical spectrum.in Figure 2 OSNR measurement Based on the light spectrum.

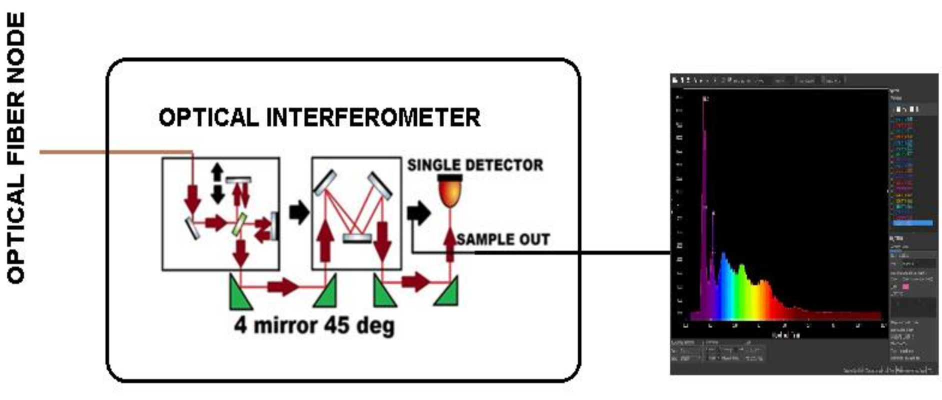

Figure 2. OSNR measurement Based on the light spectrum.

Techniques for monitoring the ratio of optical signal to noise within the field, the technique of adding the indicative tone, This method is based on adding a subcarrier or tone pilot to the data signal at the terminal P Too narrow, say, a few mega-transmitter. The indicative tone does not carry any information, and has a spectral line width line, with a higher intensity than neighboring harmonics, is transmitted outside the field of the basic optical signal baseband via Optical fiber. The indicative tone is exposed to the same influencing factors as the signal of the primary beam. Can extract the tone from any node in the network via a simple electronic circuit to monitor various optical parameters such as Optical channel capacity, wavelength, mutual interference, OSNR ratio, chromatic dispersion, pattern dispersion Polarization. Figure 3 shows the principle of operation of this technique, in which a light signal is sent from node A to node C, Pass through B. A small sine vehicle is added to the light signal at node A and the tone will be output at the node. Lead B of Through a photo detector and used to monitor optical performance [7].

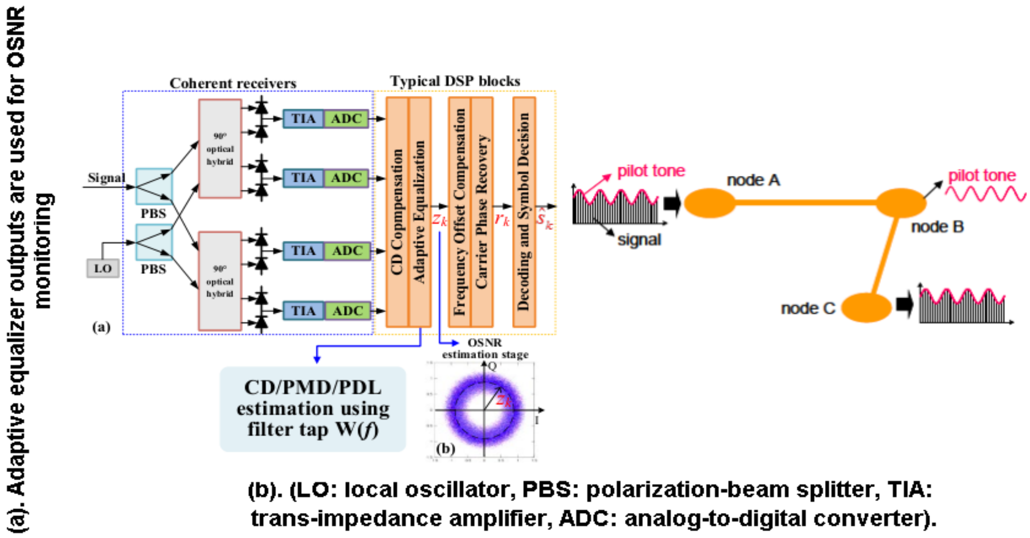

Figure 3. Tone - based optical performance monitoring technology.

The average amplitude of the indicative tone is proportional to the average optical amplitude of the channel. On the other hand, the discrete will also show to the electron the experimental tone present in the optical spectrum of the WDM channels in the L-spectrum as shown in Figure 4. For this the value of the OSNR can be guessed simply by measuring the ratio of the carrier to Noise (CNR) from the electronic spectrum using the following relation [8].

$$\mathrm{OSNR} = \sqrt{\frac{\mathrm{BESA_{ESA}}}{\Delta v}\frac{\mathrm{CNR}}{m^2}} \tag{1}$$

Where CNR: carrier-to-noise ratio for the indicative tone, m: modulation depth for the tone, BESA: resolution of the frequency beam width for the electronic spectral analyzer, Δv: the width of the optical beam.

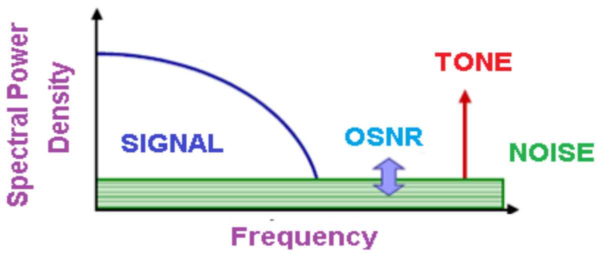

Figure 4. OSNR monitoring using the indicative tone.

This technique is characterized by simplicity and low cost, but in return requires the introduction of modifications to a device the interference of the pilot tone with the data signal causes a prolonged deterioration in the quality of the signal, so the P, but at the same time it should be so large that it is easily distinguishable from the given signal measurement accuracy of OSNR is also low [9].
Optical delay Interferometer technology, this technique takes advantage of the optical signal correlation property to a large extent, and the DE coherence of the ASE noise signal. Figure 5 shows the elements that make up the monitoring module, namely, a tunable filter, the choice of the channel to be monitored, and the interferometer by delay Mach Zehnder (MZDI) interferometer delay Zehnder-Mach, and a measure of capacity. Mzdi consists of From Two 3 dB links coupler. The first Link serves to distribute the signal into two branches, in one of the branches there is a light backlight، and a phase controller. Optical delay is used to control the free spectral range (Distance Spectroscopy between two adjacent transmission peaks). As for the phase controller, it synthesizes the phase of the signal in the first path, so that the two paths are combined constructively or destructively at the exit (MZDI) [10].

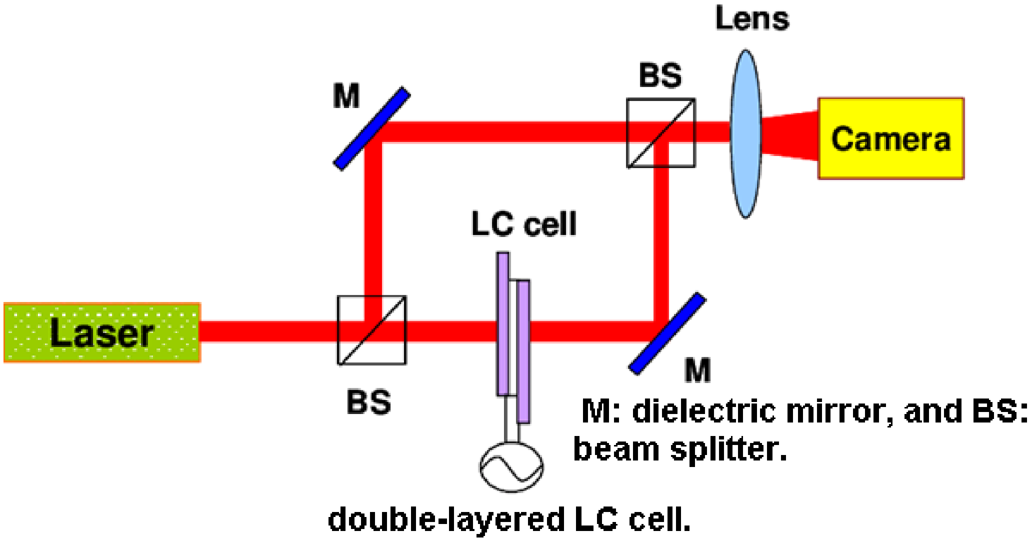

Figure 5. General block diagram of Mach Zehnder (MZDI).

For a light delay equal to one bit time, the maximum power resulting from constructive interference can be calculated، and the small potential resulting from the destructive interference of the following 4 Relations [11].

$$P_{max} = \frac{1}{2}P_{noise} + \frac{3}{4}P_{sig} + \frac{1}{2}P_{sig}\sqrt{\frac{1}{ER} - \frac{1}{ER^2}} \tag{2}$$

$$P_{min} = \frac{1}{2}P_{noise} + \frac{1}{4}P_{sig} - \frac{1}{2}P_{sig}\sqrt{\frac{1}{ER} - \frac{1}{ER^2}} \tag{3}$$

$$r = \frac{P_{const}}{P_{dest}} = \left(\frac{3}{4}P_{sig} + \frac{1}{2}P_{sig}\right) / \left(\frac{1}{4}P_{sig} + \frac{1}{2}P_{sig}\right) \tag{4}$$

$$OSNR = \frac{B_n}{B_r}\left[\frac{1+2\sqrt{\frac{1}{ER}-\frac{1}{ER^2}}}{r-1} - \frac{1-2\sqrt{\frac{1}{ER}-\frac{1}{ER^2}}}{2}\right]^{-1} \tag{5}$$

Where $P_{sig:}$ Noise-equivalent beam width NEB, Precision package display = nearly 0.1mm, There is a developer proposal for the technique using an interferometer (MZDI) with a delay = 1/4 bit, Where was obtained from one of the output ports is on constructive interference, and from the other port on destructive interference as shown in the Figure 6 $P_{dest} . P_{const}$ They are two potentials measured at constructive and destructive interference ports, respectively. The principle of operation of this technique.

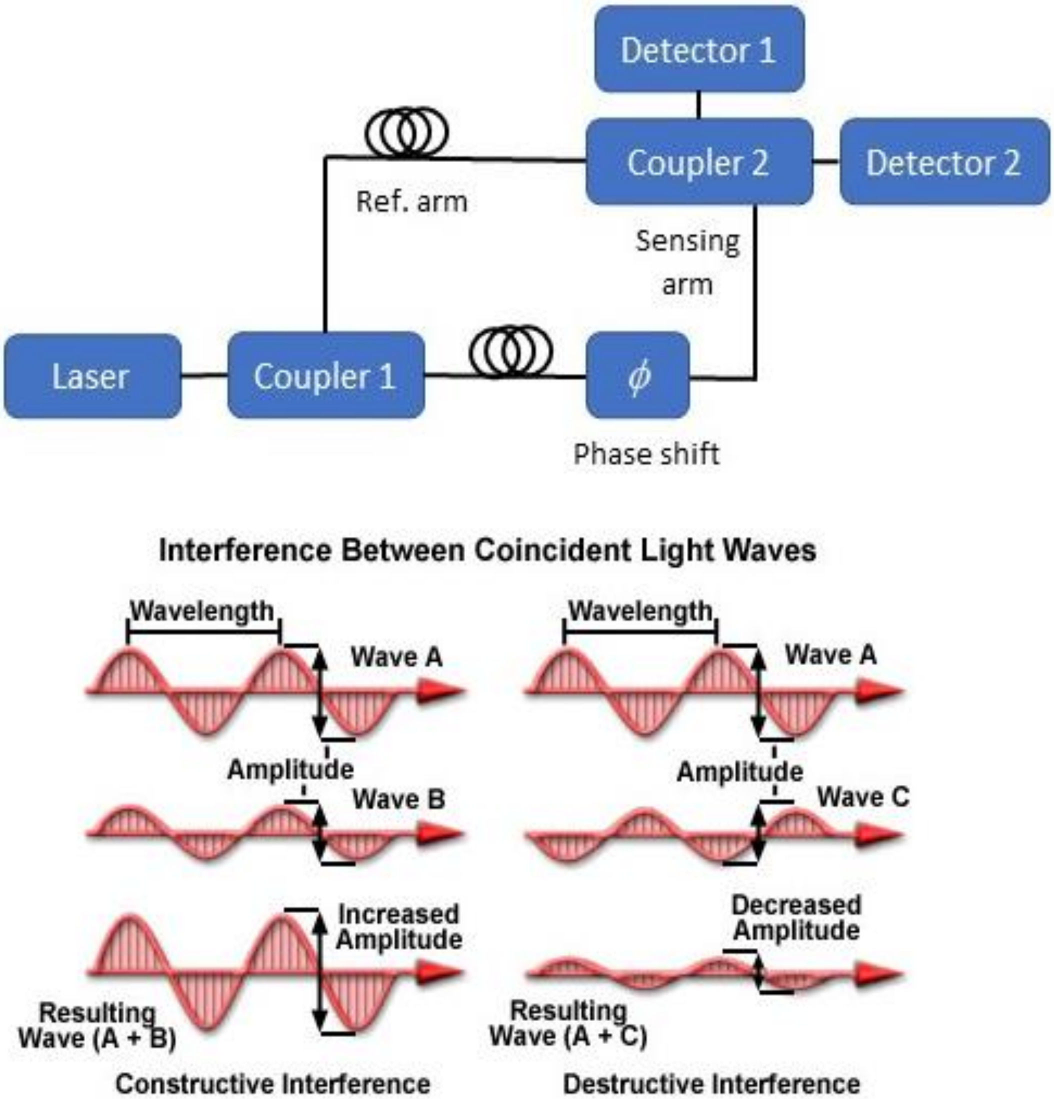

Figure 6. Mach –zehnder optical device with constructive & destructive in optical fiber network.

Monitoring the ratio of light signal to noise using neural networks, Artificial neural networks ANNs is an information processing system based on mathematical models of Certain performance features in a way that simulates biological neural networks (nervous system), by means of massive processing Distributed in parallel and made up of simple processing units, these units are nothing but computational elements called neurons Cells ,Neurons ,Nodes, which have a neurological property as they store practical knowledge And the information to make it available to the user by adjusting the weights. Neural networks are used in a lot of Fields and applications include Signal Processing Signal Processing, Control, and shape recognition .Speech Recognition speech recognition pattern recognition [12].

Artificial neural networks contain an artificial neuron cell called a neuron. These are arranged Neurons are the entire artificial neural network in the system. Can In a series of layers that form with that The layer contains only a few modules or millions of modules and it depends on how the neural networks are prompted It is difficult to learn the patterns hidden in the data set. In general, an artificial neural network has a layer the input layer input and the output layer output as well as the hidden layers layer hidden. Receive a layer Input data from the outside world that the neural network needs to analyze or recognize.

Then pass these Data via one or several hidden layers that convert inputs into data of value for the output layer. Finally, the output layer provides an output of the form of the response of the artificial neural network to the input data provided [13]. In Figure 7 the structure of the neural network.

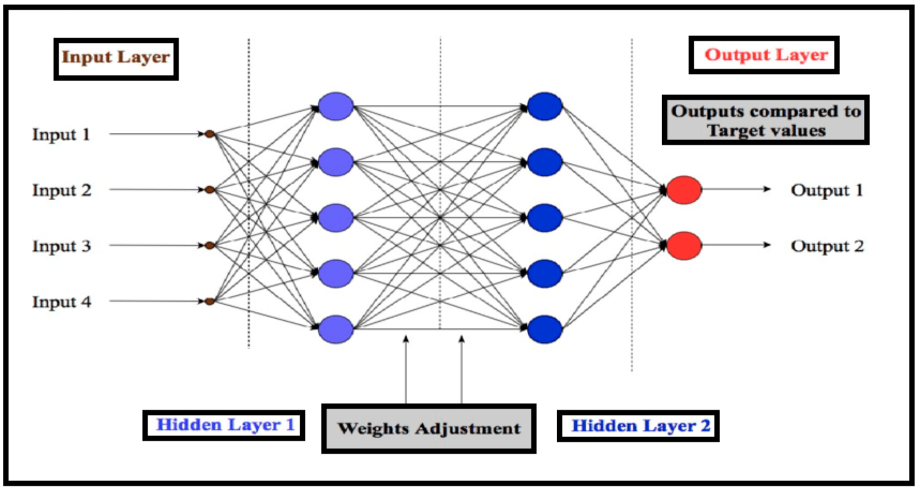

Figure 7. The main structure of the neural network.

The main components of the neural network are the neuronal free, weight, bias, and threshold and activation sequence function activation. An empty neuron cell, ganglion, or sensory organ (areWhich are sometimes called Elements ofProcessing in the neural network). These nerve cells are connected to each other by means of weighted links .links weighted. The resulting values of these weights represent the information with which the network will begin to solve the problem. Contains these neuronal cells are controlled by states that are related to the nerve cells located in the NF Activation [14].

The activation function is one of the important elements of the neural network. The output of the neural network model depends on its accuracy and computational efficiency on the activation function.

The activation function in a neural network is a mathematical equation that controls the output of Z on The neural network; it determines which neuron should be activated. In addition, the activation function works.Normalization of neuronal cell output. The activation dependent types are the binary degree function step binary, linear dependent, and dependent Non-linear. In most complex data processing applications, a nonlinear activation follower. There are two types of machine learning based on ANN, one is called supervised learning and the other is called unsupervised learning. Supervised learning is like learning by instruction where many Examples (training group) for training ANN. The training set takes the input characteristics of the system and the output data which was done by another method such as experimental measurement or human measurement to obtain a map Predefined functional between inputs and outputs. During the training process, the performance of the neural network model is checked and monitored by the error or performance. This function compares the expected output of a For ANN and the real output. ANN keeps training by repeating until the error value drops to the desired value. After completing the training, the neural network is tested Using new data to determine the response and quality of the artificial neural network. In a non-learning style under supervision, the network is optimized based on the nature of the inputs and the relationship between inputs and outputs) outputs Unknown the idea is that a similar type of information most often leads to certain types of output. It explains .Figure 8 schemes of supervised and unsupervised learning techniques [15].

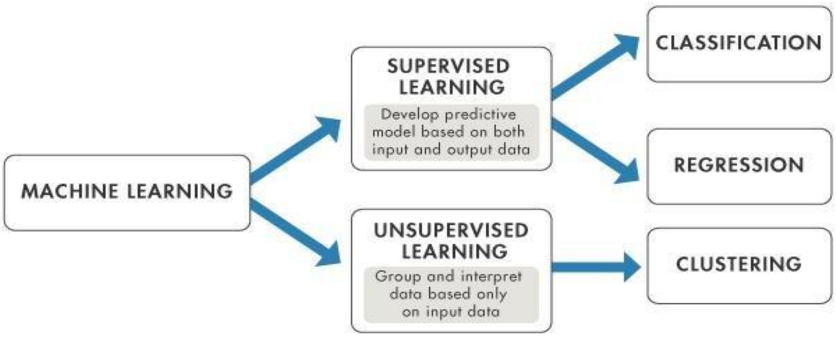

Figure 8. Schemes of supervised and unsupervised learning techniques.

There are many different algorithms used to train an artificial neural network, including backpropagation, quasi-Newton, conjugate gradient, Kohonen training, Delta-bar algorithm using Delta and Levenberg-Marquart. Marquart advises Levenberg, since it provides the possibility of not processing information. Parallel processing parallel processing: another advantage of artificial neural networks is their ability allows it to perform several calculations simultaneously, which allows it to process large amounts of data quickly and efficiently. Generalizability-artificial neural networks can generalize from the examples I have seen during Practice and apply what you have learned to new data. This means that she can make accurate predictions even on Data that you have never seen before [16]. In this research paper, present the second part of the methodology for the design and implementation of the proposed interference measurement, and the simulation work in the lab of the neural network library to complete the process of monitoring the signal for the original signal, the third part of the results, & the fourth part of the conclusion.

2. Methodology of a Proposed Optical System Design, and Analysis by Neural Network:

The research methodology is divided into two parts. The first section is to design and implement the proposed optical system, analyze the optical signal path relative to the pattern and convert the pattern at the optical splitter, and the second section is to analyze the signal and noise results using neural network technology.

3.1 Design and Implementation of The Proposed Optical System:

In this section present the part about the design and actual implementation of the proposed optical system capable of completing the process of monitoring and analyzing data using a neural network. The Mach –Zehnder device is the most system components provide monitoring (OSNR) in optical fiber the classical diagram shown in Figure.9. The front surfaces of the photonic interference in the proposed optical system act on, the back surface of the two segments formed for this device. As segments of the optical beam, and operate As plane mirrors, these elements can be individually adjusted separately ,and the separation of the two Rays have determinants .The thickness of these two slices .The distance between the radials in the Mach and Zander scale is large.in Figure 10 show the proposed optical interference system based on (Mach – Zehnder interferometer).

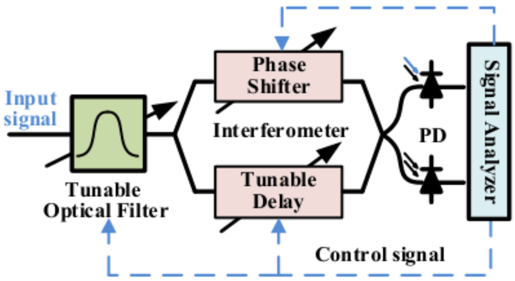

Figure 9. Classical design of Mach-Zhender in optical fiber network.

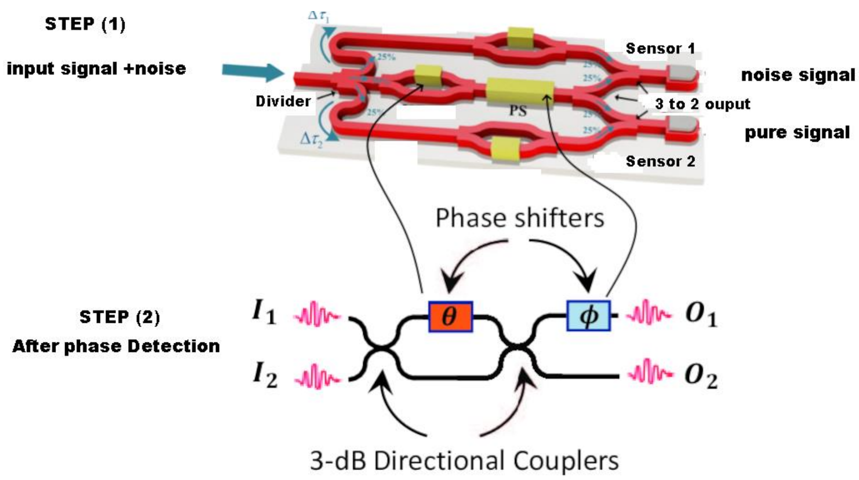

Figure 10. The proposed optical interference system based on (Mach – Zehnder interferometer).

The previous figure of the proposed optical system shows the path of Rays in the makhozinder scale - A parallel beam of monofilament rays is divided by the wavelength at the path plane of the optical fiber At the initial stage of the semi-reflecting surface glass slide at the half-reflective surface Parallel surface-into two beams that unite after their reflection, passing after the division and entering the phase detector, to become the result after passing through the proposed system, the optical signal (noise) exits track No. 1 and the original signal from track No. 2. In Figure 11 the mode converter in a proposed optical paths after phase shitter. Figure 12 the light intensity of optical signal in paths.

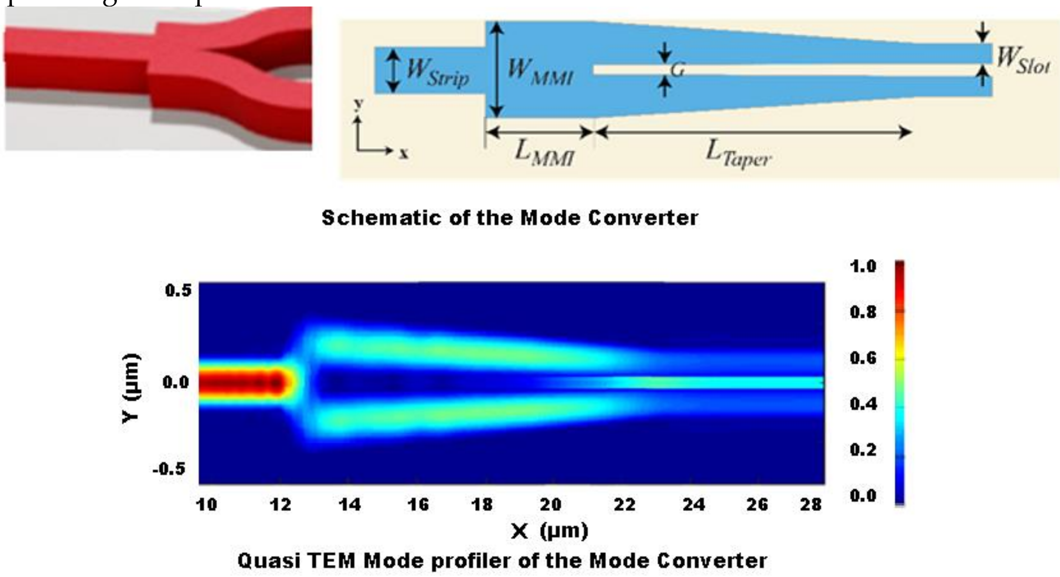

Figure 11. Mode converter in proposed optical paths after phase shitter.

In the previous figure, the pattern transformation of the rays passing through the path was described, resulting from the phase shifter and the path divider, this simulation was done by a computer program to analyze the variables on the path of the light wave and make sure of the pattern transformation after the division.

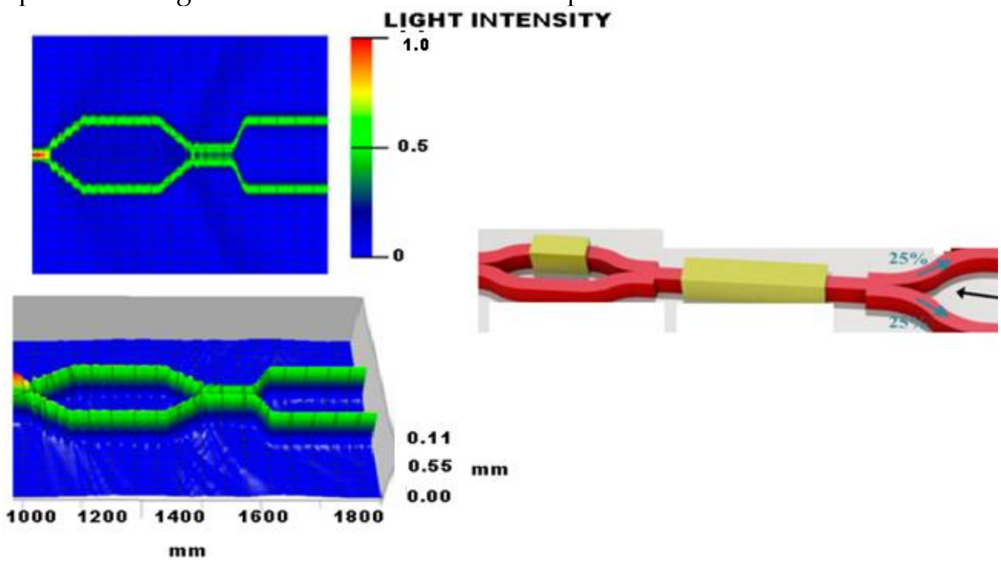

Figure 12. The simulation results by BPM SOFTWARE to check the optical intensity of light signal.

In Figure 13 the implementation of optical proposed system. As the implementation of the proposed system by the method of optical paths adopted aamir transparent carrier polymers , which allows us to implement an optical panel of an appropriate size , and one of the advantages of this material is to completely isolate the optical paths from the surrounding medium, the design is signed in that process and the computer came aamir CNC machine for drilling in polymers to connect to the light-permeable layer without payment upon receipt scratches , and that process uses laser drilling tools (to sign the optical path with high accuracy), and there is also a zoom circuit operating with a system (Trans - Impedance Amplifier) to zoom according to the value of the input so that the measuring device can make the required calibration accurately.

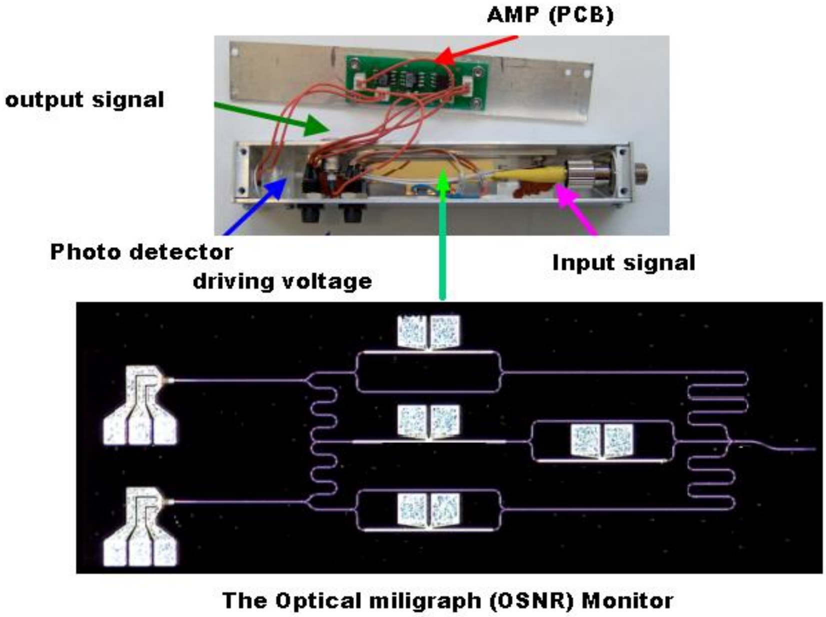

Figure 13. The implementation of optical proposed system.

3.2 Building a Neural Network to Monitor The Noise Signal:

The neural network, in this research was built using the MATLAB as a software environment, where the introduction of Data, network training and extraction of the final network with its weights and provide special libraries of artificial intelligence. The construction of the neural network can be summarized as follows: 1-data collection for training. 2-selection of the topology of the neural network and its characteristics. 3-training the network on the data, validating the results. Data collection for training The data for neural network training was compiled similar to that obtained through the design of a phase modulator Previously, using the optical simulation program vpi photonics as shown in Figure 14, 15 where Network input data on the values of the shorter distance between the photovoltaic cell and the polarization of the signal (xi), (yi) II) and the country of the statistical distribution scheme shown in Figure 16 while the signal-to-noise ratio value is the target.

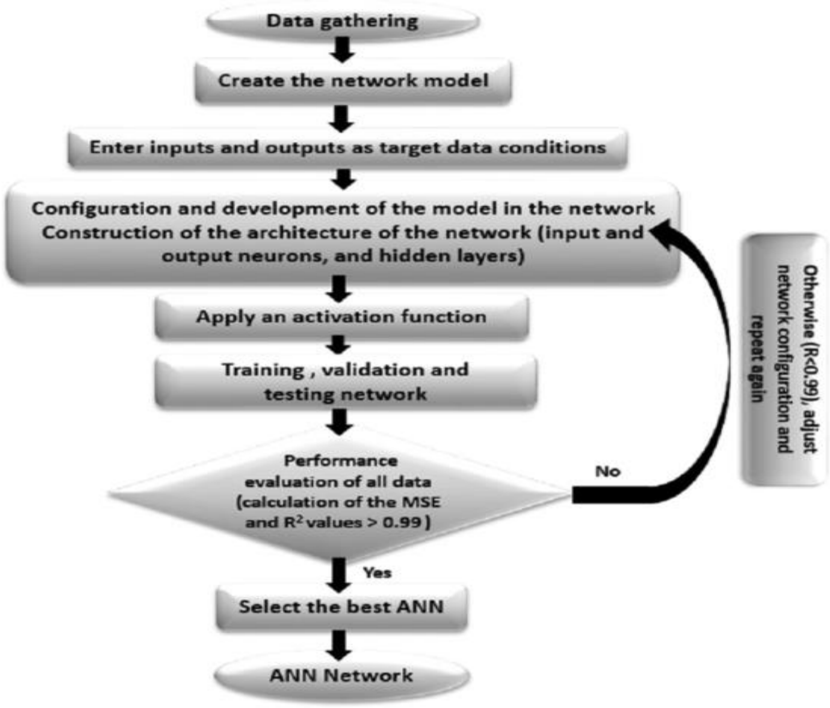

Figure 14. The flow chart of operating aproposed (ANN).

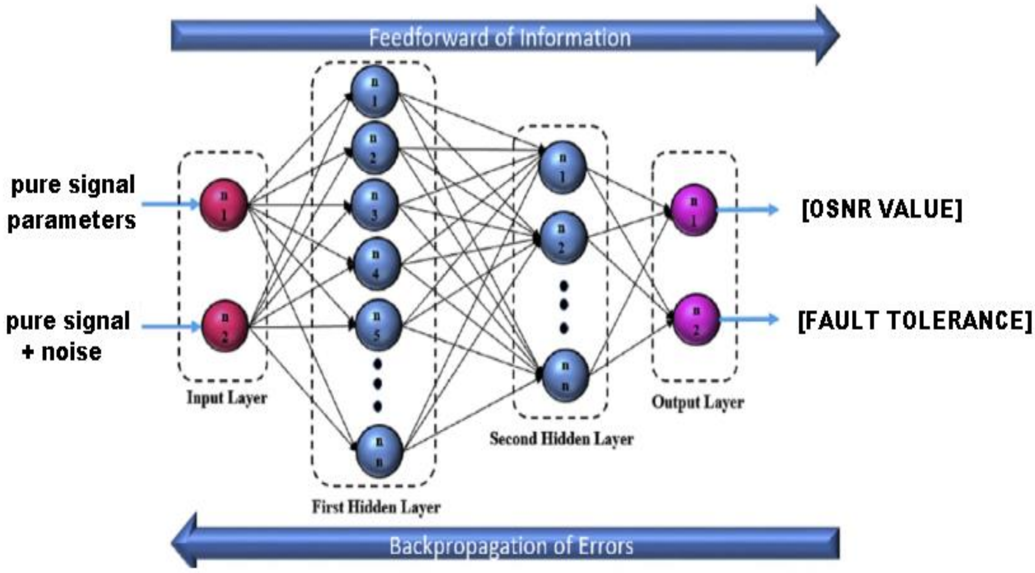

Figure 15. The ANN model using feedpropgation error to find (OSNR value & fault tolerance).

The model prepared in the VPI photonics simulation program for testing the proposed monitoring module consists of : 1 - OOK-NRZ optical transmission module: the OOK-NRZ signal is generated by modulating the laser upstream signal , NRZ-encoded random digital bits with an 10 Gb/sec using the (MZI) MACH-ZEHNDER, 2- OSNR ratio adjustment unit, simulating both color dispersion, polarization dispersion, Composed of fiber offer Chromatic dispersion, and from the PMD emulator polarization pattern dispersion simulator. The purpose of adding this aim of adding these elements is to study their impact the performance of the Monitoring Unit. Finally, an amplified spontaneous emission noise signal ASE was added to the optical signal using the element (Set OSNR) through which the OSNR value is set and subsequently required to be measured in a unit Surveillance. The proposed OSNR monitoring module consists of an optical filter that allows determining the width of the optical signal beam B, and selecting the desired signal in the event that combined signals are applied by dividing the wavelength WDM. This is followed by a polarity controller and a polarity divider to obtain the two optical signal compounds. Both compounds are transferred from the light field to the electric field using a PD photo detector. The resulting signals from the two branches are simultaneously sampled and sent to a program written in the Matlab language, through which a parametric statistical distribution diagram is drawn and a value is deduced OSNR .Figure 16 design of the proposed OSNR Monitoring Unit using the VPI photonics program.

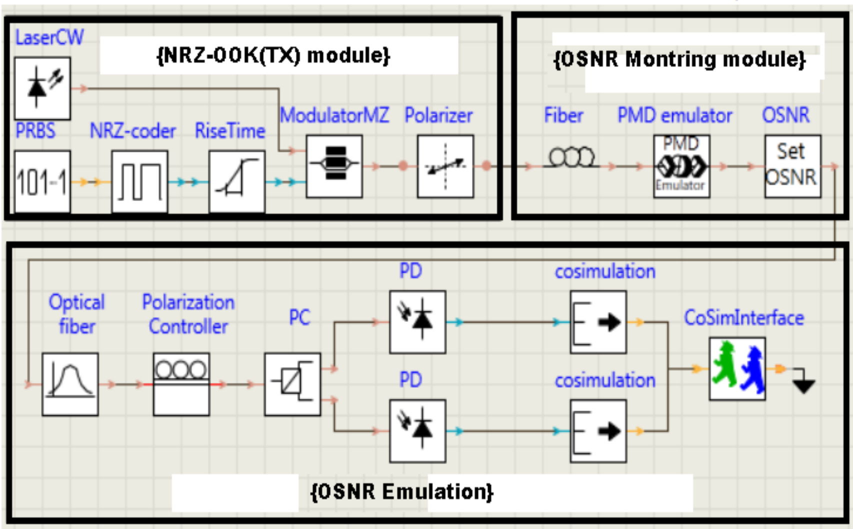

Figure 16. Design of the proposed OSNR Monitoring by (VPI).

Basic simulation model parameters: Bit rate transmission (10 Gbps), Bit modulation pattern (NRZ-OOK), the average capacity of the laser source1 mW, Laser source frequency (193.1 THz (λ = 1.55μm), The intensity of the noise potential of the laser source (2.3×10^{-15}W/Hz), Color fiber dispersion coefficient (17 ps/ (nm.km), Polarization dispersion coefficient (0.1 0.1 ps/km$^{\frac{1}{2}}$),& Fiber damping (0.2 dB/km).
Selection of neural network topology and characteristics the "nnstart" or "nntool" functions are used in the Matlab program to create an ANN model. The neural network the synthetic proposed in this research is a multilayer ANN network with back-feeding and propagation Rear feed forward back propagation, which consists of three layers two hidden layers and an output layer. The inputs in this design are the values of the shortest distance between the pair of samples of the signal polarization and the diameter, as the output of the ANN model is the actual OSNR value. The number of neurons in each layer is mostly variable and is therefore determined by experience, trial and error. Many experiments are carried out until the best design is reached. The final design consists of a first hidden layer consisting of 5 neurons, and a second hidden layer also consisting of neurons, and the output layer contains one neuron, the activation follower is sigmoid which is suitable when the goal is to produce a continuous output. Which is the Levenberg-Marquardt Back Propagation continuous output training algorithm the fastest way to solve non-linear problems)? The construction of the artificial neural network is illustrated in the Figure 17.

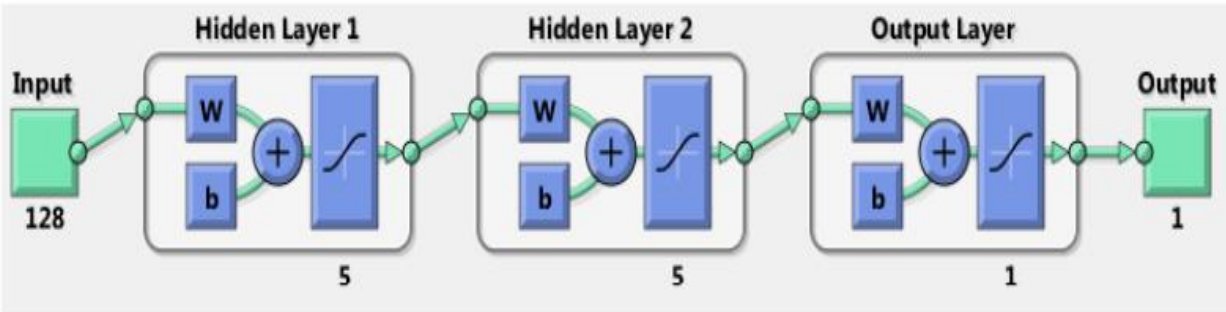

Figure 17. Aproposed Artificial neural network model in MATLAB.

The Table 1 summarizes the parameters of the proposed neural network, and training performance of the proposed neural network to evaluate the performance of the proposed ANN model, the Mean Squared Error (MSE) was calculated Error. This represents the average square difference between the outputs and the specified goals. The MSE is given according to the following relationship [17]:

$$\mathrm{MSE} = \frac{\sum_{i=1}^{n} (Y_i - \hat{Y}_i)^2}{n} \quad (6)$$

Where n= the number of observation data, the target value is the original value) - $\hat{Y}_i$ the expected value.

Table 1. Parameters of the proposed neural network.

N of income items	128
N of output elements	1
N of neurons in the hidden layers	5
Continue activation	Sigmoid
Training algorithm	Levenberg-Marquardt Back Propagation
Data segmentation	70% training and 15 validation And 15% experimental testing
N training courses	100

3. Results

The actual experiment of the proposed system inside the laboratory, according to the real conditions in which the system is operated in optical networks , where the proposed system, polarization sampling and color dispersion were also taken, which gives accuracy in making the decision of the neural network . In Figure 18 An explanatory form for the experiment of the proposed optical system in order to ensure its efficiency and work on modes internists to the profiler form show in Figure 19.

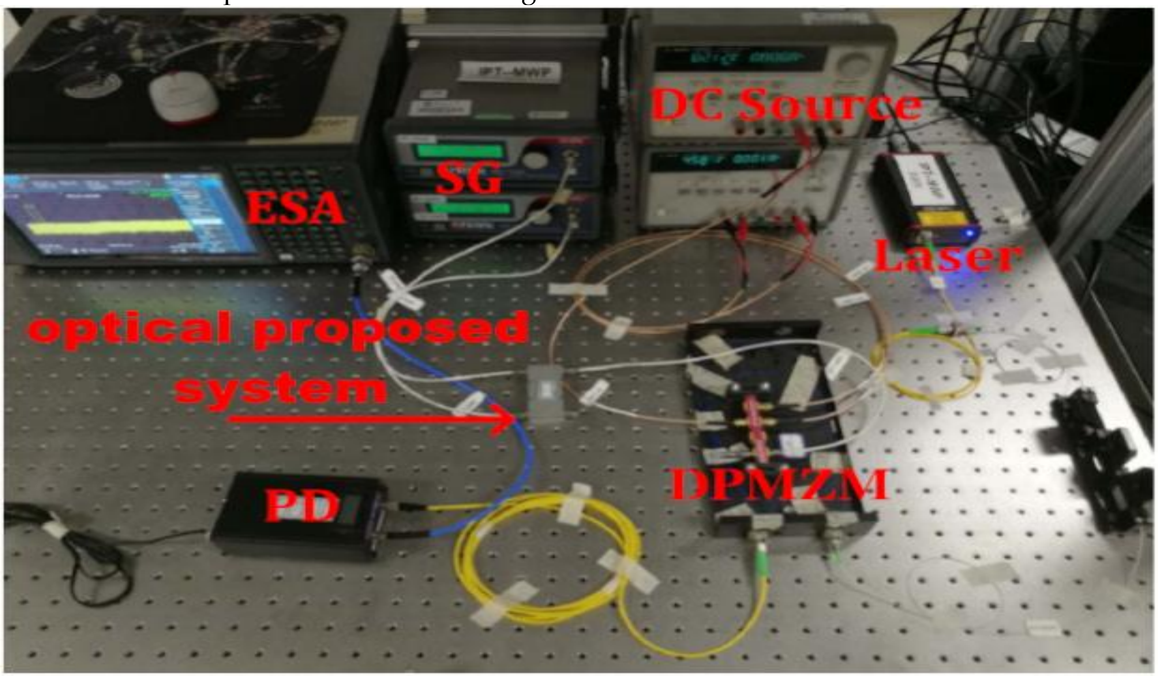

Figure 18. The expermintal setup of test optical proposed system.

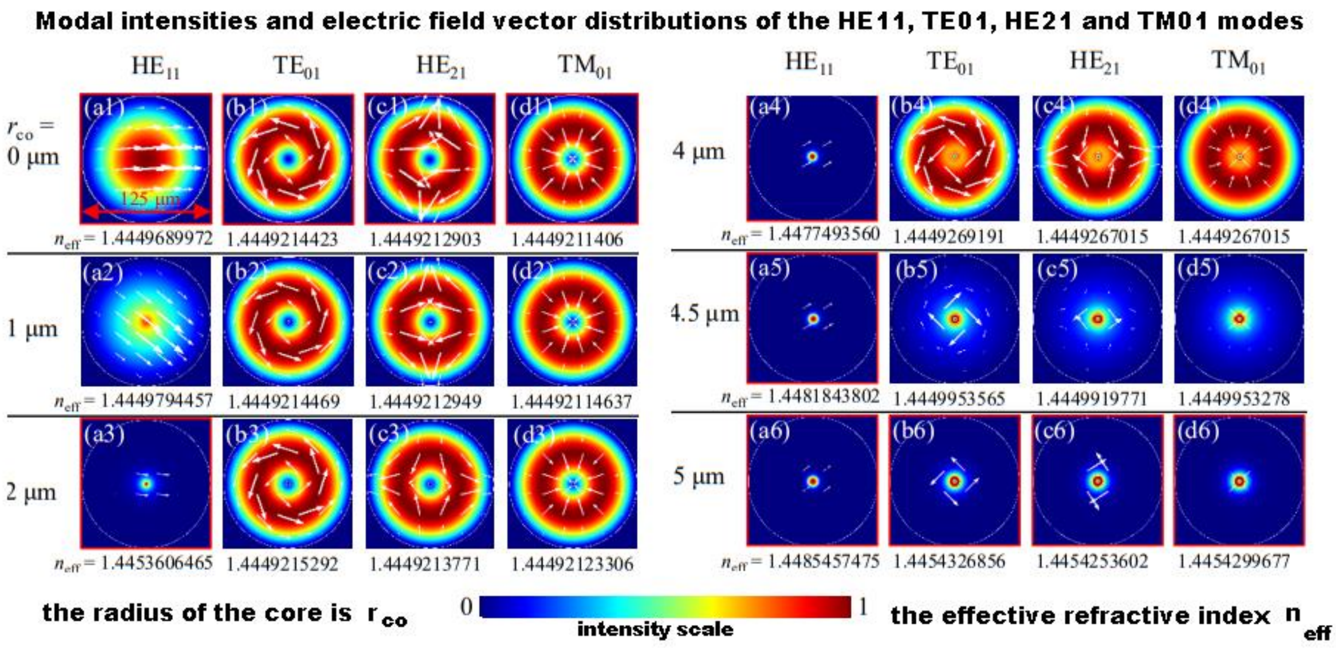

Figure 19. Samples of data set by optical proposed system in expermental setup.

In Figure 20 the optical spectrum analyzer's output at 10, 50, and 70 MHz, respectively, for adding 20 dB to the Tim cell is displayed in Figure 8. Figure 8 displays the observed RF energy in the photo detector, which was -101.5, -110.9, and -122.2 DB. At the same frequencies, the noise floor was found to be around -130 dB Tim cells with an internal electric field of 29.8 v/m generated 28.5, 19.1, and 7.8 dB at each frequency. Consequently, using the formula $E_{min} = 29.8 \text{ X } 10^{snr/20}$v/m, the lowest measurable electric fields at those three frequencies are -1.12, -3.3, and -12.13 v/m, as appropriate.

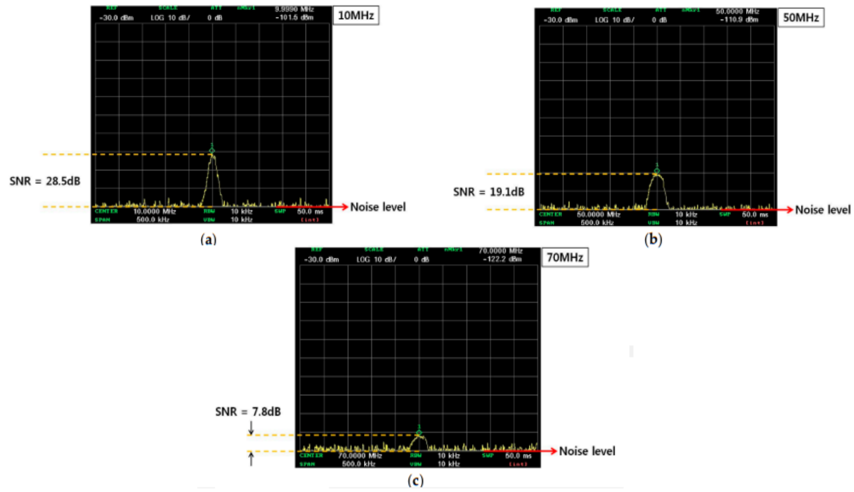

Figure 20. Measure SNR samples by optical spectrometer in aproposed expermental setup.

In Figure 21 the results of (ANN) proposed system to relationship of the amplitude of the measured noise with the OSNR for different values of the signal amplitude Psig. The VPI photonics optical simulation program sends the values of total power P_{total} and noise power N_{beat} to a program written in MATLAB that solves anonymous Psig. The OSNR ratio survey was actually carried out within the domain [15-40] by the Set OSNR element and each time the OSNR value was calculated by the proposed monitoring unit, and Figure 23. Was reached, which shows the relationship between the value measured according to the procedure of the proposed measurement unit provided by the MATLAB program, and the actual value of the OSNR ratio set by the Set element OSNR. It was concluded that the control unit can operate within the range [15-40]. In the field below 15, the error becomes significant. We note that the errors in the measurement within the first domain are less than dB 1 which is a good figure in comparison with other methods.

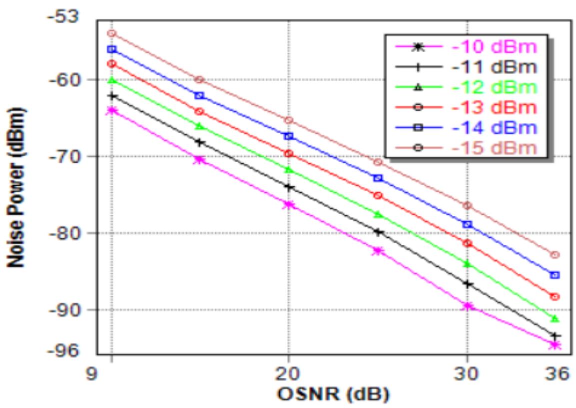

Figure 21. The measured noise represents the beating noise, because it is considered the dominant noise within the specified OSNR domain, and as is clear, its ability to N_{beat} is inversely proportional to OSNR.

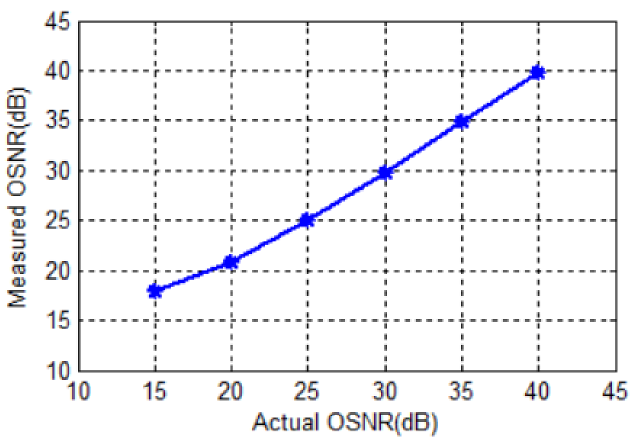

Figure 22. OSNR value measured by the proposed unit of measurement against its actual values.

In this Figure 22 the OSNR value measured by the proposed unit of measurement against its actual values. The results obtained in this paragraph are with the assumption that there is no color dispersion, the dispersion of a polarization pattern, and since the two mentioned types of dispersion can affect the results, the effect of each on the performance of the measurement technique. Was carried out for the differential Group delay from 0 to 15 and for four actual values of the OSNR ratio It is [20, 25, 30, 35 dB]. Each time the OSNR value is calculated by the proposed monitoring unit, and the figure.23.

It was reached, which shows the relationship between the value measured according to the procedure of the proposed measurement unit and provided by the MATLAB program with the value of the differential Group delay DGD. As can be seen from the figure, measured, value is almost unaffected by the dispersion of the polarization pattern, because the proposed technique does not rely on measuring the capacitance at a specific frequency vehicle as in the first technique, but measures the least capacitive of the frequency vehicles OFDM signal, which will then represent a signal Just the noise. Surveillance. Although the modified technique will solve the problem of the polarization dispersion effect, it will increase the complexity and cost of the unit.

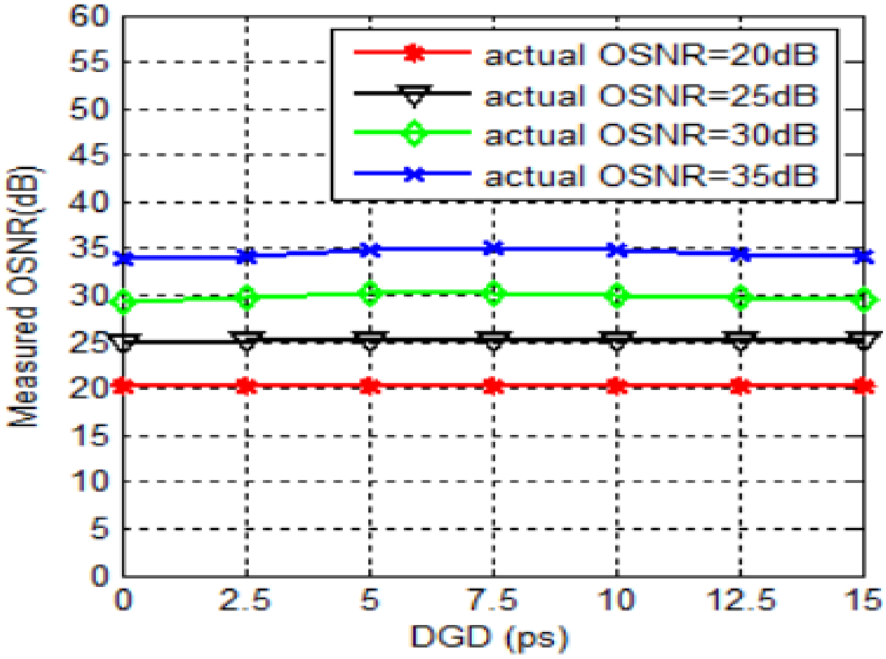

Figure 23. The effect of polarization pattern dispersion on the measured OSNR value after adjustment.

Over the past years, many OSNR monitoring methods have been proposed, which have been classified into two groups: out-of-band and in-band.in out-of-band measurement techniques, ASE noise are measured at wavelengths located between optical channels. While in the field monitoring techniques, the ASE noise is measured within the field of the optical signal by investing the optical properties characteristic of both the optical signal and the noise. In-field OSNR measurement can be applied in a conventional point-to-point transmission system, but this method is not suitable for modern dynamically reconfigurable networks, so we use in-field measurement techniques that provide more accurate measurement results.

One of the most important parameters to monitor for Optical Networks is the optical signal-to-noise ratio OSNR It is an indicator of signal quality directly in the optical layer, because OSNR is associated with the ber bitrate of the transmitted optical signal, in addition, OSNR is transparent to both the bitrate and the modulation pattern used for the optical signal, which makes it suitable for working with it in dynamic optical networks.

Also, any small change in the optical network can significantly affect OSNR, so when using OSNR monitors, factors affecting the performance of the network can be isolated, and therefore its maintainability faster and more effectively.in Table 2 COMPARISON BETWEEN THE OSNR techniques and the OSNR monitoring technique proposed in this research for the ddo-ofdm system.

TABLE .2. Provides a comparison between the OSNR techniques and the OSNR monitoring technique proposed in this research for the ddo-ofdm system.

Technical parameters	Measurement area	Accuracy	Polarization dispersion effect	The effect of color dispersion	Advantages	Disadvantages
Spectrum analysis in OPC [18,19]	15-35 dB	Depend on the measured sub-carrier the errors are larger (10%)	Affected	It is affected in the case of transmission with two side beams	__________ __________ __________	A spectral analyzer with resolution requires great accuracy. Significant measurement errors within the in-band
Guess the channel Photovoltaic processing by means of The received signal [20,21]	6-18 dB [20] and 7-28dB [21]	±1 dB [20] 0.8 dB[21]	_________ _________	Not affected	Fast response time	Values cannot be measured High for OSNR. Require a receiver For OFDM processing The received signal (Complexity and high cost) require manual tripods
Neighbor algorithm Nearest [22,23]	15-25 dB	0.7 dB	___________	___________	The possibility of determining the modulation pattern, immunity to rotation of the modulation scheme, consumption of less computational resources than a network ANN	Requires decoding adjustment Requires .OFDM Massive data processing The receiver.
Proposed technique	15-40 dB	<1dB	Affected But when Addendum Won'T FFT Affected	It is not affected whether the transmission is made with one or two side packages	There is no need to send guide signals, or decode OFDM modification Cost reduction And complexity) Independent of the pattern Modification of pregnant Subgenus	The addition of a polarizing controller is required to adjust the addition of DGD between the two polarization compounds

4. Conclusions

The proposed system succeeded in the OSNR monitoring technology in an optical Orthogonal Frequency Division collection system with direct detection, this technology is based on the cancellation of a certain frequency component of the OVDM signal spectrum after optical detection by adding polarization scattering on the signal to let the noise hit inside this component. Using a narrow beam pass filter, the amplitude of this noise was measured, as well as the total amplitude was measured. So the Osner value can be determined. A good measurement field of [5-40dB] and a measurement accuracy of less than (1 dB) was reached, and it was not affected by color dispersion. And there is no need to send manual tones or decode OFDM adjustment, thereby reducing the cost and complexity of the monitoring module. But they are affected by the dispersion of the polarization pattern and require polarized microcontroller tuning. The problem of the measurement result being affected by polarization scattering was eliminated by analyzing the full spectrum of the OVDM signal using an optical proposed system and neural network [Levenberg-Marquardt Back Propagation]. A neural network was built and trained to analyze the longitudinal statistical distribution scheme in the presence of polarization pattern dispersion. And was Results have been obtained showing that the OSNR measurement process is not affected by polarization dispersion.

Declaration of Competing Interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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