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Modeling of Optical Fiber at Different Wave Length using ANOVA-Test

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Abstract:
The optical communication systems have many losses. These losses cannot be remove but reduces so that at the different wave length we calculate the losses and check which wave length is more efficient. This paper deals with the comparison of wave length 1310nm with wave length 1550nm using anova analysis.

Introduction

Optical fiber can be used as a medium for telecommunication and computer networking because it is flexible and can be bundled as cables. It is especially advantageous for long-distance communications, because light propagates through the fiber with little attenuation compared to electrical cables. This allows long distances to be spanned with few repeaters. Additionally, the per-channel light signals propagating in the fiber have been modulated at rates as high.the block diagram show the optical communication system.

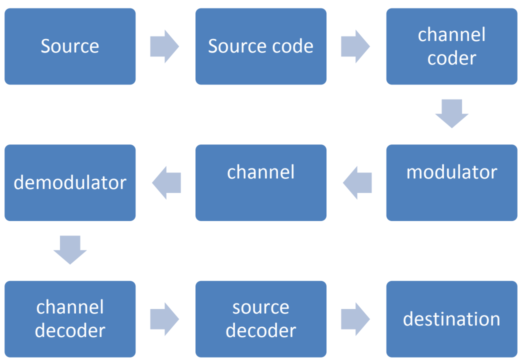


Fig.a block diagram of optical communication system.

The basic blocks of fiber optic communication systems are transmitter, optical fiber cable and receiver. The main function of transmitter to converts electrical signal into light source using LEDs and laser diodes. The optical fiber provides the connection between a transmitter and a receiver. At the receiver end uses photo detector to convert optical information signal back into an electrical signal.

Losses: The attenuation of an optical fiber measures the amount of light lost between input and output. Total attenuation is the sum of all losses. Optical losses of a fiber are usually expressed in decibels per kilometer (dB/km). The expression is called the fiber's attenuation coefficient α and the expression is

$$\alpha = - -\frac{10}{z[km]}\log\left(\frac{P(z)}{P(0)}\right)$$

An **optical fiber connector** terminates and enables quicker connection and disconnection than splicing. The connectors mechanically couple and align the cores of fibers so light can pass. Better connectors lose very little light due to reflection or misalignment of the fibers. Optical fibers may be connected to each other by connectors or by *splicing*, which are, joining two fibers together to form a continuous optical waveguide.

Table 1: losses of fiber

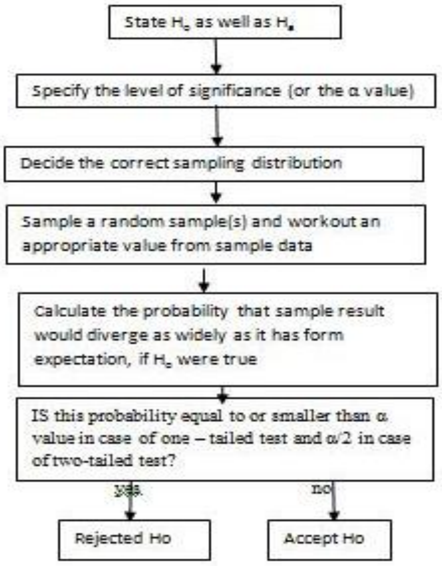
Fiber type	Single mode at wave length 1310nm	Single mode at wave length 1550nmnm
fiber attenuation/km*	0.4dB	0.3 dB
fiber attenuation/km#	0.35 dB	0.22 dB
Connector loss	0.75 dB	0.75 dB
Splice loss	0.1 dB	0.1 dB

*These values are per TIA/EIA and other industry specifications and are the value used by transition networks in all link loss calculations.

#these values are one example of the performance that can be obtained with a new fiber installation [1-9].

Anova Analysis: analysis of variance is extremely useful technique concerning researches in the fields of economics, biology, education, psychology, sociology, business/ industry and in researches of several other disciplines. Anova Analysis is consider an appropriate Analysis for judging the significance of a sample mean or for judging the significance of difference between the means of two samples in case of losses of optical wave length at 1310nm and losses of optical wave length at 1550nm (in which case we use variance of the sample as an estimate of the population variance). Losses of optical wave length at 1310nm and losses of optical wave length at 1550nm optical both sample are related, we use paired Anova Analysis for judging the significance of the mean of difference between the related sample. It can also be used for judging the significance of the coefficients of simple and partial correlations. The relevant test hypothesis, one-way anova, is calculated from the sample data and then compared with its probable value based on specified level of significance for concerning degree of freedom for accepting or rejecting the null hypothesis. We design our hypothesis such that we support the null or reject the null hypothesis. Then we decide the statistics technique to use.

FLOW DAIGRAM FOR HYPOTHESIS TESTING



Basic concept concerning testing of hypotheses:

1. Alternative hypothesis is usually the one which one wishes to prove and the null hypothesis is the one which one wishes to disprove. Thus, a null hypothesis represents the hypothesis we are trying to reject, and alternative hypothesis represent all other possibilities.

2. If the rejection of a certain hypothesis when it is actually true involves great risk, it is taken as null hypothesis because then the probability of rejecting it when it is true is α (the level of significance) which is chosen very small.

3. Null hypothesis should always be specific hypothesis i.e., it should not state about or approximately a certain value. In this case we state our hypothesis as under:

Null hypothesis Ho: Single mode at wave length 1550nm.

Alternative hypothesis Ha: Single mode at wave length 1310nm.

ANOVA Technique:

Under the one-way ANOVA, we consider only one factor and then observe that the reason for said factor to be important is that several possible types of samples can occur within that factor.

The various steps involved are as follows:

1. Take the total of the values of the individual loss of Single mode optical fiber.
2. Calculate the correction factor.
3. Find out the squares of the entire loss of Single mode optical fiber one by one and then find out its total. Subtract the correction factor from this value to obtain the sum of squares of deviations for the total variance.
4. Then calculate the sum of squares of deviations for variance between columns.
5. . Similarly, calculate the sum of squares of deviations for variance between rows.
6. Calculate degree of freedom for total variance, between columns, between rows and for the error.
7. ANOVA table can be set up as shown below in table II:

Table 2: ANOVA TABLE

Source of variation	SS	d.f
Between sample	$\sum r_j(\bar{x}_j - \bar{\bar{x}})^2$	c-1
Within sample	$\sum\sum(xij - \bar{x})^2$	N-c

Where r is the number of rows in the table, c is the number of columns, X is the grand mean, and ij X is the i th observation in the j th column. Where rj is the number of rows in the j th treatment and X j is the mean of the j th treatment[10-15].
The above F-ratio for treatment and blocks is used to judge whether the difference among different parameters is significant or just is a matter of chance. With the help of table 1 and table 2 we get table 3.

Table 3: Calculated Value of ANOVA Table

Source of variation	SS	d.f	MS	F-ratio	F-table
Between sample	0.006625	1	0.006625	0.087	8.813
Within sample	0.456675	6	0.0761125		
total	0.4633	7			

As the given table one-way design of experiment without repeated value , we shall about all the above stated steps while setting up the ANOVA table. ANOVA table can be set up for given table 1. The above table show that the calculate value of F is 0.087 which is less than the table value of 8.813 level with d.f (degrees of freedom) being 1 and 6 and hence could have arisen due to chance. This analysis support the – hypothesis .We may, therefore, conclude that the difference in wheat output due to varieties is significant.

Conclusion:

It has been found that calculated value of F ratio different than the tabulated value, so the difference between parameters is considered as significant and so we select null hypothesis. We are able to conclude that loss of Single mode optical fiber at wave length 1550nm is less than loss of Single mode optical fiber at wave length 1310nm.

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