CALIFORNIA STATE SCIENCE FAIR
2014 PROJECT SUMMARY

Name(s)

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Project Number

34511

Project Title

Catching Wave(length)s: The Effect of Electromagnetic Fields on Fiber Optic WDM Signal Quality

Abstract

Objectives/Goals

Modern fiber optic companies use wavelength-division multiplexers (WDM's) to send multiple streams of information at the same time on a single device This technique maximizes efficiency. However, several variables such as electromagnetic fields could play a role in the performance of these systems. The goal of this project is to discover how the ways that EM fields affect light apply to WDM system performance. As WDM systems grow more popular, this interaction becomes more and more critical to understand.

Methods/Materials

This experiment was solely performed using the network simulation program OMNet++. Two programming languages, C++ and NED, were utilized to describe 4 different WDM systems inside the simulation (32 channel, 16 channel, 8 channel, and 4 channel). The simulation was run several times with millions of signals sent across 4 trials to acheive a consistent BER (bit-error rate). Then, the same simulation was performed with the WDM systems, except with a C++ code designed to simulate an EM field. Between each trial, the channel spacing (amount of "distance" between signals) was changed.

Results

The results showed that WDM modules that were exposed to EM influence increased in number or errors as compared to the control group. For example, System B, with 16 channels, had a BER rate of .0000003 when not exposed to EM, but had a rate of .0000005 when exposed. Overall, all the systems showed small decreases in signal quality. However, the systems that had less "channels", or streams of information being transmitted at once showed the least change when exposed to EM. Despite this, systems with a larger amount of channels such as system A, with 32 channels, showed a greater decrease in efficiency when exposed to EM interference.

Conclusions/Discussion

In conclusion, WDM systems that have been exposed to EM influence show a general decrease in effeciency. However, these results should partially be accredited to the channel spacing of the WDM systems, which was shown to increase BER in control systems as well. A trend that was discovered was the amount of channels multiplexed tended to correlate with the amount of BER increased of decreased. These results may become more relevant in the future due to design parameters focusing more on greater channels and lower channel spacing.

Summary Statement

How do the effects of electromagnetic fields on light affect fiber optic network quality?

Help Received

Mother helped with board.