

**DETERMINATION OF AEROSOL SCATTERING ATTENUATION ON
TERRESTRIAL FREE-SPACE OPTICAL COMMUNICATION IN
SELECTED LOCATIONS IN NIGERIA**

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20PCE02314**

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COMMUNICATION IN SELECTED LOCATIONS IN NIGERIA**

BY

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**A DISSERTATION SUBMITTED TO THE SCHOOL OF
POSTGRADUATE STUDIES IN PARTIAL FULFILMENT OF THE
REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE (M.Sc)
INDUSTRIAL PHYSICS (ATMOSPHERIC AND COMMUNICATION
PHYSICS) IN THE PHYSICS DEPARTMENT, COVENANT
UNIVERSITY, OTA, OGUN STATE, NIGERIA**

MARCH, 2023

ACCEPTANCE

This is to attest that this research work is accepted in partial fulfillment of the requirements for the award of the degree of Master of Science (M.Sc) in Industrial Physics (Atmospheric and Communication Physics) in the Department of Physics, College of Science and Technology, Covenant University, Ota, Nigeria.

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Prof. Akan B. Williams
(Dean, School of Postgraduate Studies)

Signature and Date

DECLARATION

I, AYO-AKANBI, OLAOLUWA ADEDAPO (MATRIC NO: 20PCE02314) declare that this research was carried out by me under the supervision of Dr. Olusayo A. Akinwunmi of the Department of Physics, College of Science and Technology, Covenant University, Ota, Nigeria. I attest that this dissertation has not been presented wholly or partially for the award of any degree elsewhere. All sources of data and scholarly information used in this dissertation are duly acknowledged.

AYO-AKANBI, OLAOLUWA ADEDAPO

Signature and Date

CERTIFICATION

We certify that this project titled “**DETERMINATION OF AEROSOL SCATTERING ATTENUATION ON TERRESTRIAL FREE-SPACE OPTICAL COMMUNICATION IN SELECTED LOCATIONS IN NIGERIA**” is an original research work carried out by **AYO-AKANBI, OLAOLUWA ADEDAPO (20PCE02314)** in the Department of Physics, College of Science and Technology, Covenant University, Ota, Nigeria under the supervision of **DR. SAYO A. AKINWUMI**. We have examined and found this work acceptable as part of the requirements for the award of the degree of Master of Science in Industrial Physics (Atmospheric and Communication Physics).

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(Dean, School of Postgraduate Studies)

Signature and Date

DEDICATION

This research is dedicated to God. I am grateful to Him for his assistance throughout this program.

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ABSTRACT

Free-Space Optics (FSO) is a new technology that allows the transmission of data through the propagation of light in free space. However, it is limited by various atmospheric parameters such as aerosol, temperature and humidity which has significant impact on its design, and attenuates the propagated signals which affects the performance and may lead to unavailability network for wireless communication. The impacts of these atmospheric parameters (visibility, temperature, and relative humidity) on the performance of terrestrial free space optical communication are investigated in this study using the Kim and Ijaz model. The study also looks into the seasonal influence on free space optical communication performance in response to high bandwidth communication demand in selected locations across Nigeria's six geopolitical zones, including Enugu, Lagos, Port Harcourt, Abuja, Kano, and Maiduguri. This study makes use of re-analysed data from the Visual Crossing (VC) archives spanning twenty-one (21) years (2000-2021). The visibility, temperature, and relative humidity of selected locations across Nigeria's six geopolitical zones were collected to determine the aerosol scattering attenuation on terrestrial free space optical communication for the FSO system design. The results show that attenuation values are higher (about 2.87 and 1.84 dBkm⁻¹ for 850 and 1550 nm respectively in Kano) in the late dry season (DJF) and lower (about 0.88 and 0.41 dBkm⁻¹ for 850 and 1550 nm respectively in Maiduguri) in the late wet season (JJA). During the study period, average visibility shows a decreasing trend during the dry season and an increasing trend during the wet season at all location. Furthermore, as the value of temperature increases, the value of relative humidity decreases. The wavelength of 1550 nm corresponding to a frequency of 193 THz, has the lowest aerosol scattering attenuation in all of the selected locations both in the dry and wet seasons. The findings of this study can be used to determine the suitable location where communication engineers can instal free space optical communication link for optimal performance.

Keywords: Optical wireless communication, Attenuation, Weather condition, Scintillation, Aerosol scattering, Meteorological data.