Optiwave
DESIGN SOFTWARE

Optiwave Software Packages Enable Defence Photonic simulations of Devices and system Level

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Outline

- Optiwave overview
- Software product line
- Optiwave software capabilities
- Q&A

Optiwave
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General Information

- Optiwave established in 1994
- Located in Ottawa, Ontario, Canada
- Optiwave develops innovative software tools that offer design, simulation, and optimization capabilities for components, links, systems and networks
- Optiwave's software offers users a distinct competitive advantage through
  - shortening product time introduction to the market
  - improving product quality
  - enhancing productivity and cost-effectiveness

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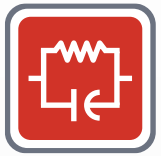
Product Line

System-Level

OptiSystem
Optical Communication System Amplifier Design Suite



OptiSPICE
Opto-Electronic Circuit Design Software

Component-Level

OptiBPM
Waveguide Optics Design Software

OptiFDTD
Finite-Difference Time-Domain Design Software

OptiMode
Waveguide and Modal Analysis Software

OptiFiber
Optical Fiber Design Software

OptiGrating
Integrated Fiber Optical Gratings Design Software

OptiOmega
Photonics Device and Circuit Design Software Package

NEW

Instrumentation-Level

OptiInstrument
Instruments Communication and Control Tool

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Company Overview

31	7,000+	300,000+
Years in Business	Paid Accounts	Evaluation Downloads

80+	15,000+	12,000+
Countries	Paid Users	Citations

Optiwave's software has been licensed to industry-leading corporations, universities, research and governmental institutions

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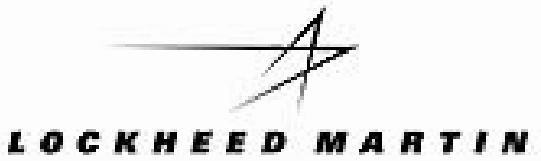
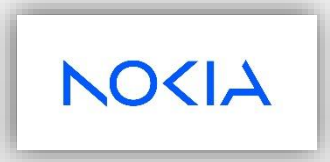
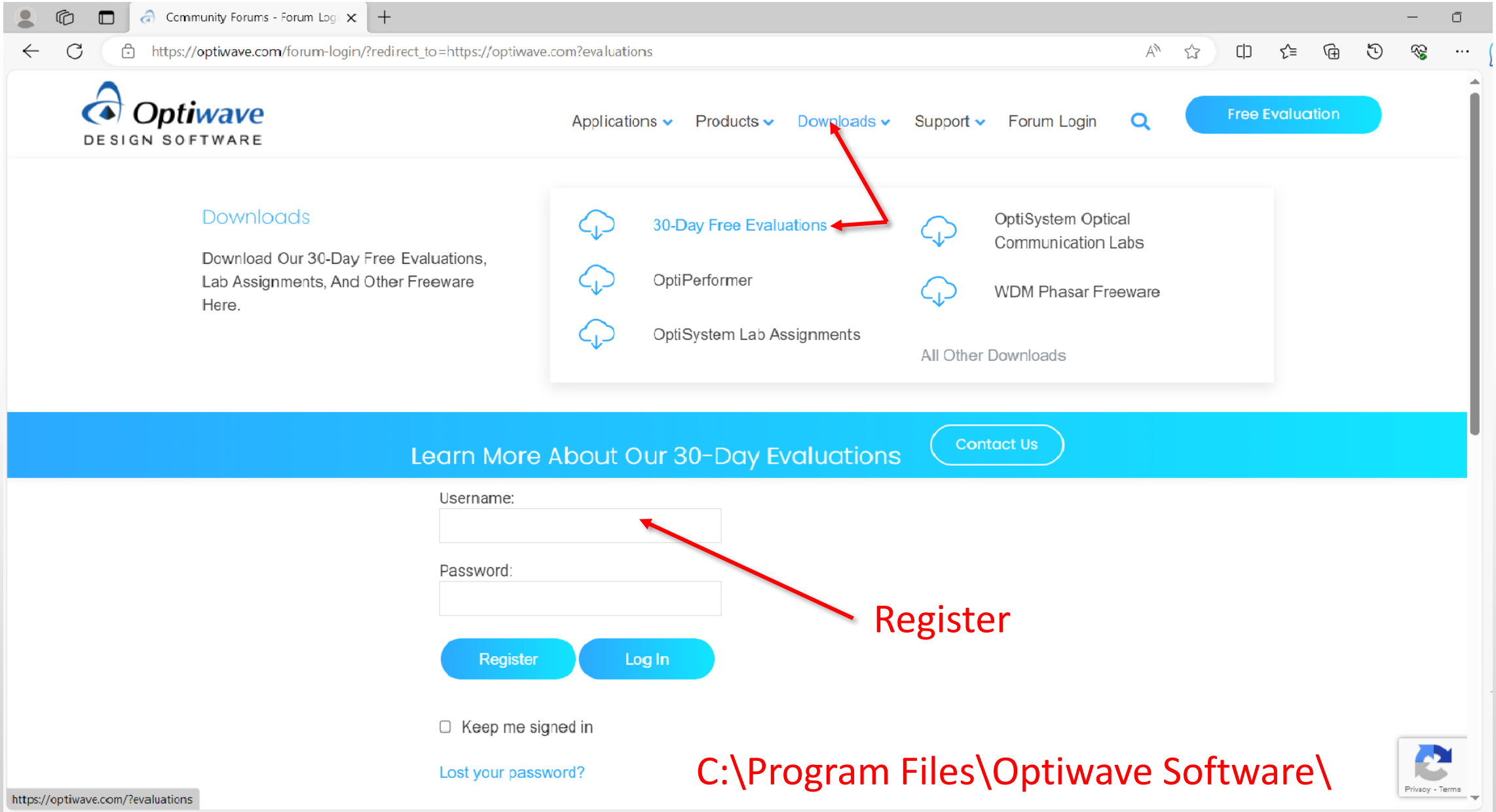
Optiwave Key Customers





Optiwave Software Download



Reference Material

Knowledge Base

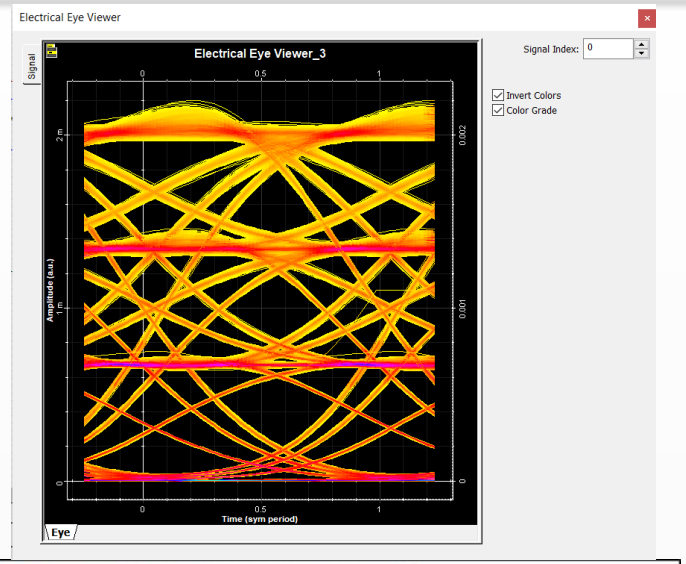
- www.Optiwave.com
- Types of articles
  - Fundamental theory
  - General structures without paper confirmation
  - Paper reproductions
- Growing number of articles

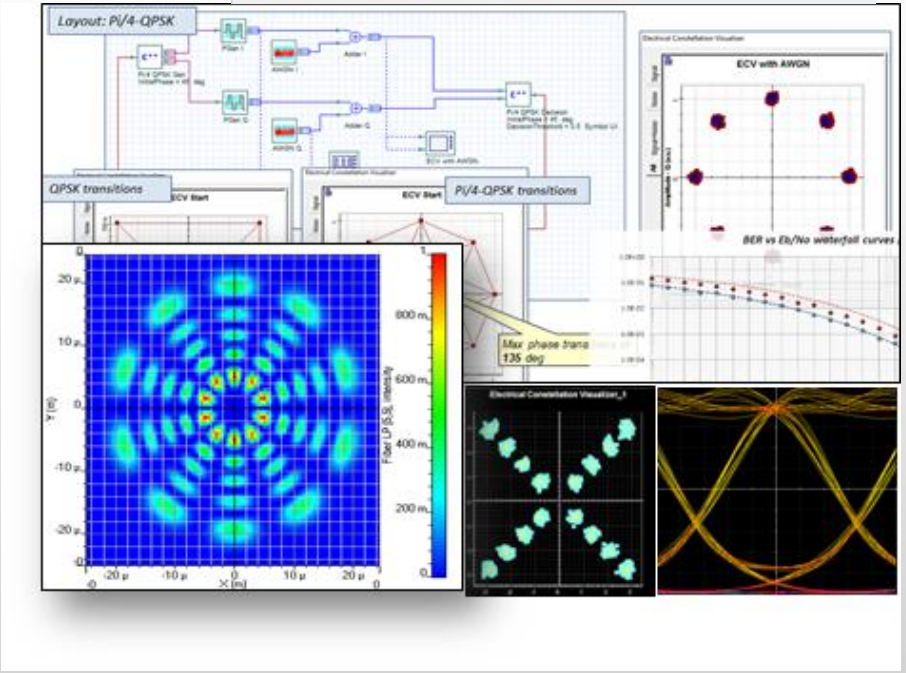
YouTube

- OptiwaveHD - https://www.youtube.com/@OPTIWAVEHD
- Playlists for each product
- Recording of wide range of applications and tutorials

OptiSystem Software

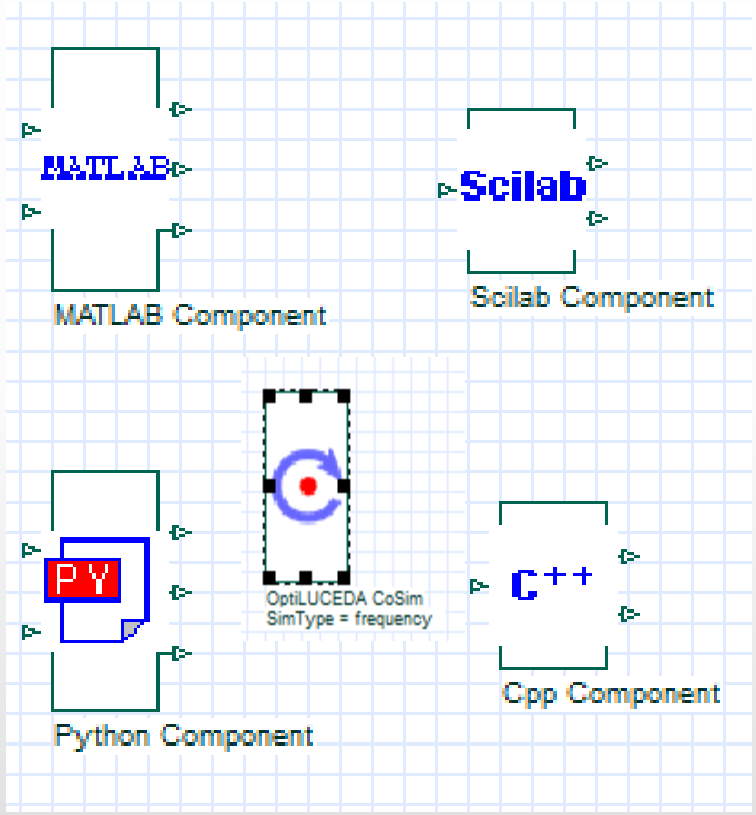
- OptiSystem has over 625 components and visualizers (optical, electrical, Binary, and M-ary)
- OptiSystem Example Library has over 1000 examples demonstrating the different applications

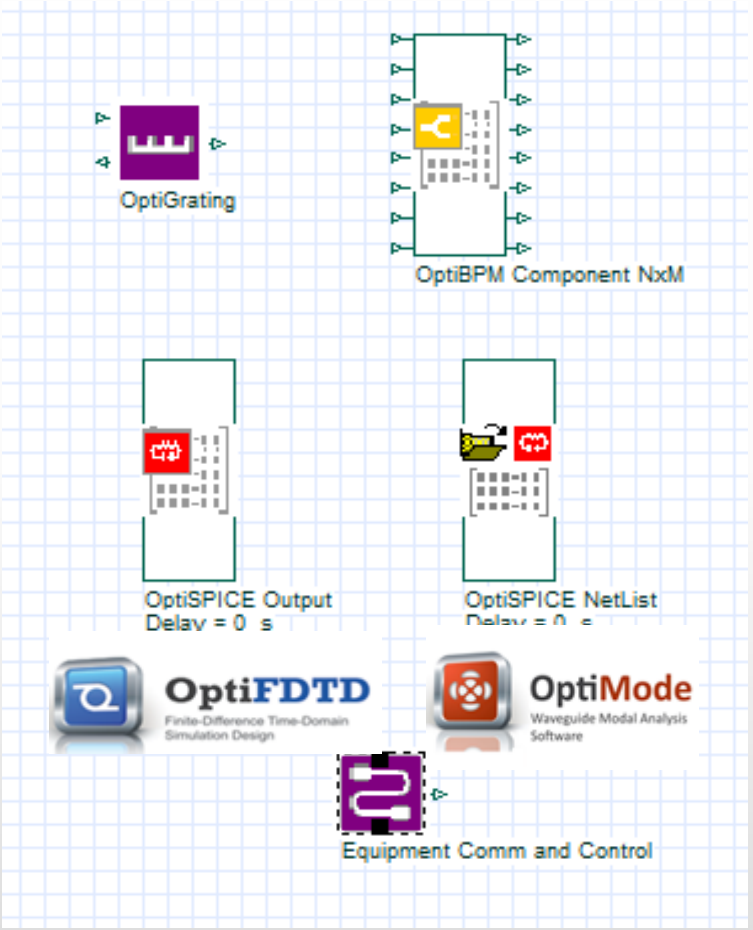




OptiSystem Software Interworking

- OptiSystem works with other Optiwave's software packages (OptiGrating, OptiBPM, OptiSPICE, OptiFDTD OptiInstrument, and OptiMode)
- OptiSystem supports External Software packages (Matlab, Python, C++, and Scilab), IPKISS (Luceda)
- OptiSystem can call external software or can be called by the external software





OptiSystem Tools

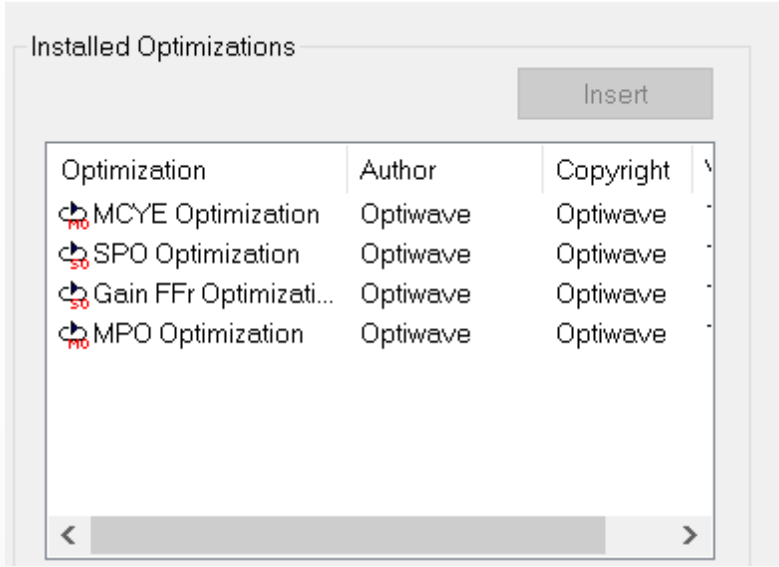
Optimizations

Single parameter optimization (SPO)

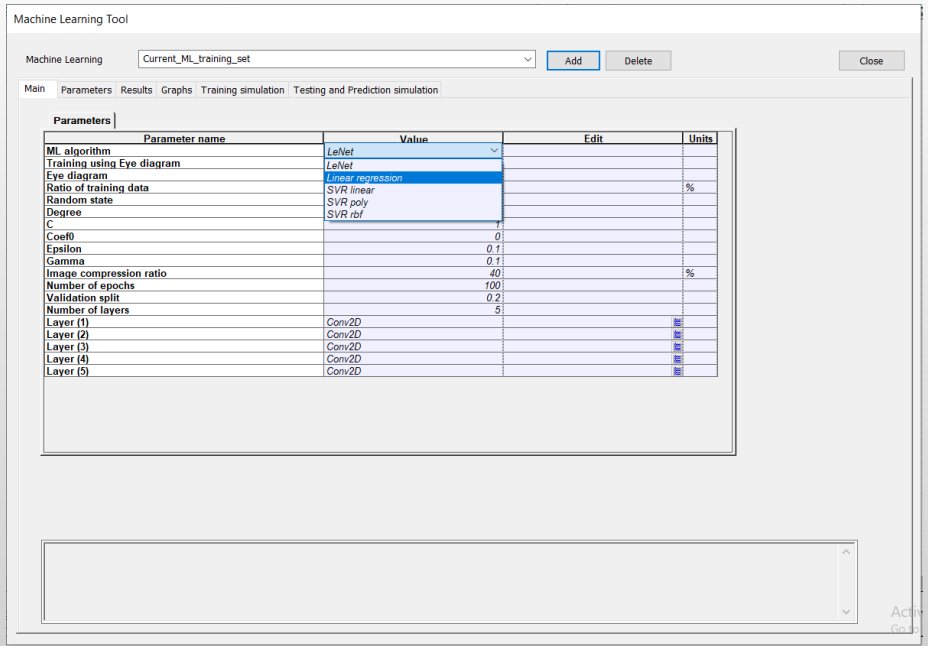
Multi-parameter optimization (MPO)

Monte-Carlo Yield Estimation (MCYE)

Gain flattening filter optimization

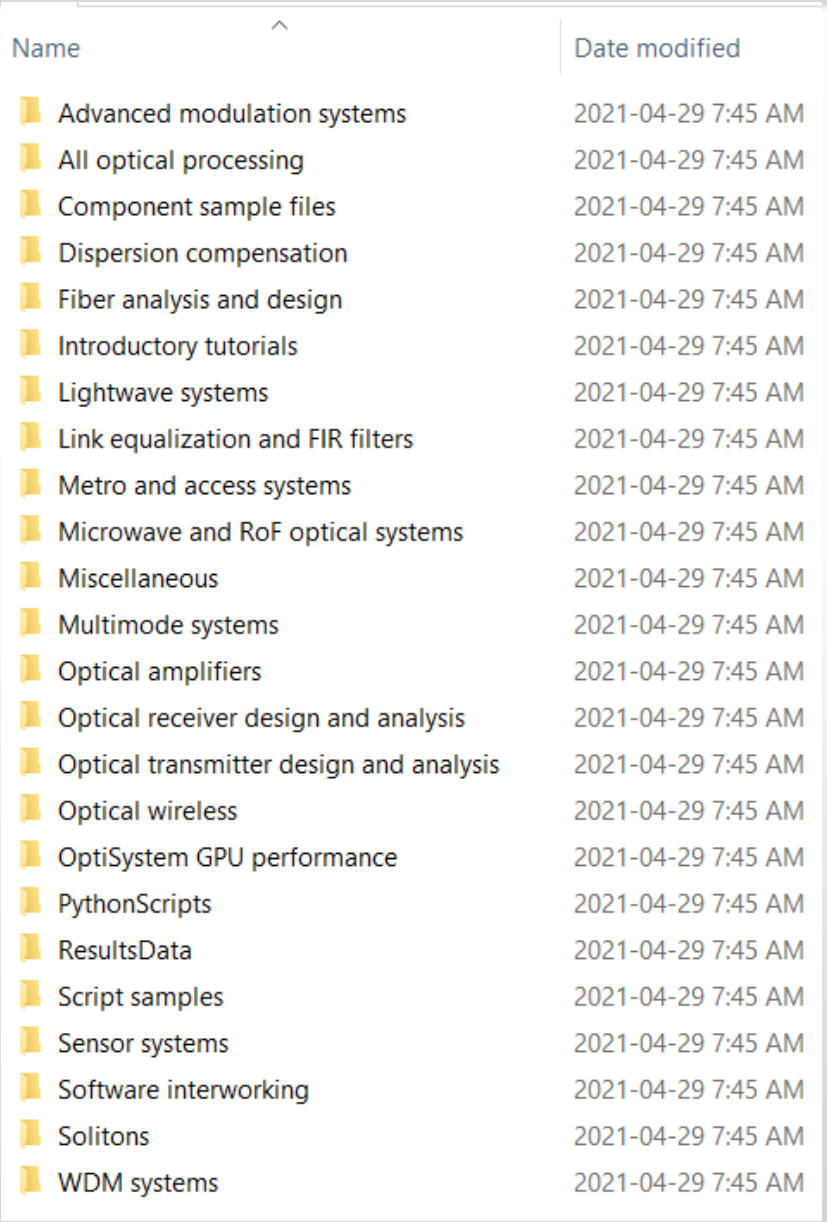


Machine Learning Tool (New Features)



OptiSystem Software Applications

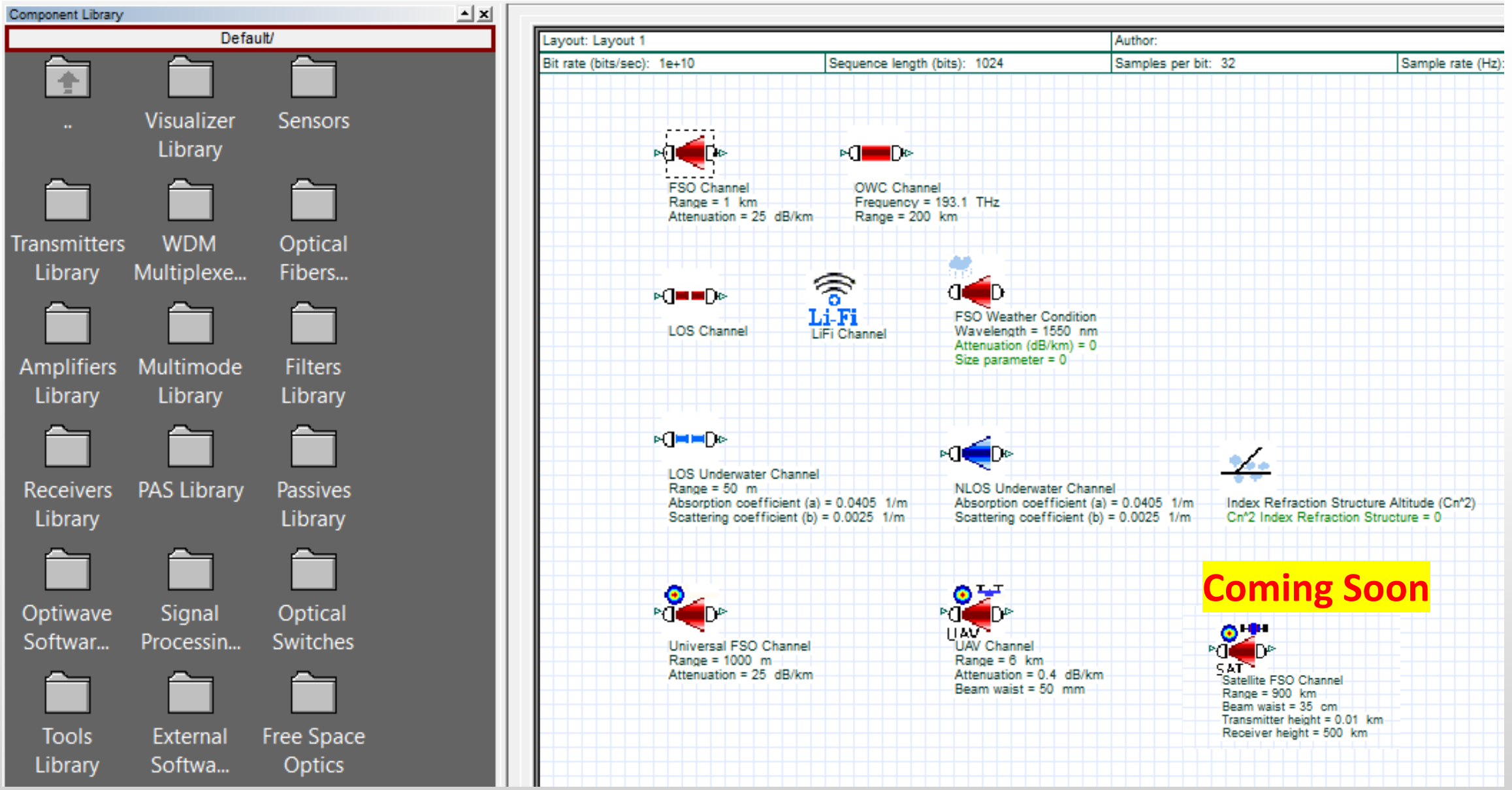
- **Optical Fiber Lasers (pulsed, CW)**
- **Optical Amplifiers – Optimization**
- **Microwave Photonics**
- **Sensors**
  - OTDR, Phi-OTDR
  - FBG, TFBG
  - PCF for Biosensing
  - LiDAR Signal Processing
- **Optical Wireless Communication**
  - LiFi
  - VLC
  - FSO and Satellite communication
  - Underwater communication
  - Unmanned Aerial Vehicle (UVA)
  - High altitude platforms (HAPS)
- **Spatial Division Multiplexing**
  - Few Modes MMF
  - SM and MM MCF
- **Quantum Key Distribution**
- **Digital Image processing**
- **PIC System Characterization**
- **Machine Learning**
- **Advanced Modulation**
  - mQAM, PAMx, mPSK, PAS
- **New Radio front-haul**



Name	Date modified
Advanced modulation systems	2021-04-29 7:45 AM
All optical processing	2021-04-29 7:45 AM
Component sample files	2021-04-29 7:45 AM
Dispersion compensation	2021-04-29 7:45 AM
Fiber analysis and design	2021-04-29 7:45 AM
Introductory tutorials	2021-04-29 7:45 AM
Lightwave systems	2021-04-29 7:45 AM
Link equalization and FIR filters	2021-04-29 7:45 AM
Metro and access systems	2021-04-29 7:45 AM
Microwave and RoF optical systems	2021-04-29 7:45 AM
Miscellaneous	2021-04-29 7:45 AM
Multimode systems	2021-04-29 7:45 AM
Optical amplifiers	2021-04-29 7:45 AM
Optical receiver design and analysis	2021-04-29 7:45 AM
Optical transmitter design and analysis	2021-04-29 7:45 AM
Optical wireless	2021-04-29 7:45 AM
OptiSystem GPU performance	2021-04-29 7:45 AM
PythonScripts	2021-04-29 7:45 AM
ResultsData	2021-04-29 7:45 AM
Script samples	2021-04-29 7:45 AM
Sensor systems	2021-04-29 7:45 AM
Software interworking	2021-04-29 7:45 AM
Solitons	2021-04-29 7:45 AM
WDM systems	2021-04-29 7:45 AM

Free space Optic Channels

OptiSystem Free-Space Components



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Features of FSO & UAV Component

- Spatial input beam
- Plane and spherical beam wavefronts
- Weather conditions
- Temporal and spatial scintillation
- Loading external scintillation phase masks
- Beam propagation evolution
- Receiver capture loss
- Beam wandering
- UAV dynamics

Light Gaussian Beam

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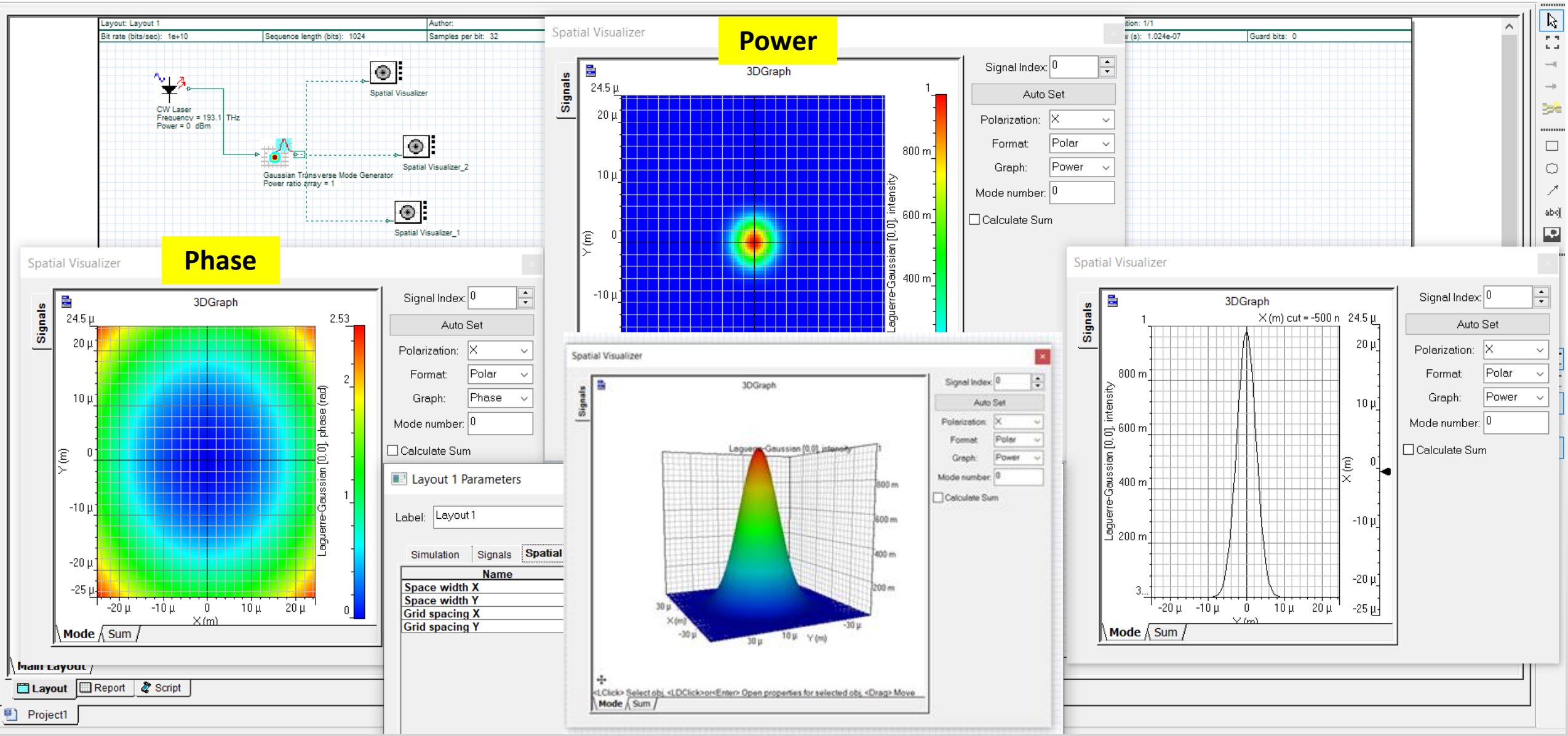
Gaussian Transverse Mode Generator



Scintillation (Weather Turbulence)

Turbulence Effects

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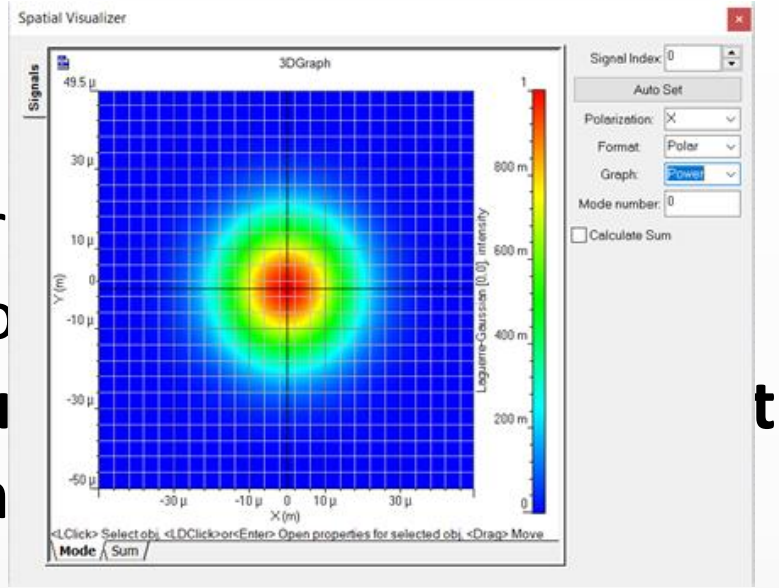

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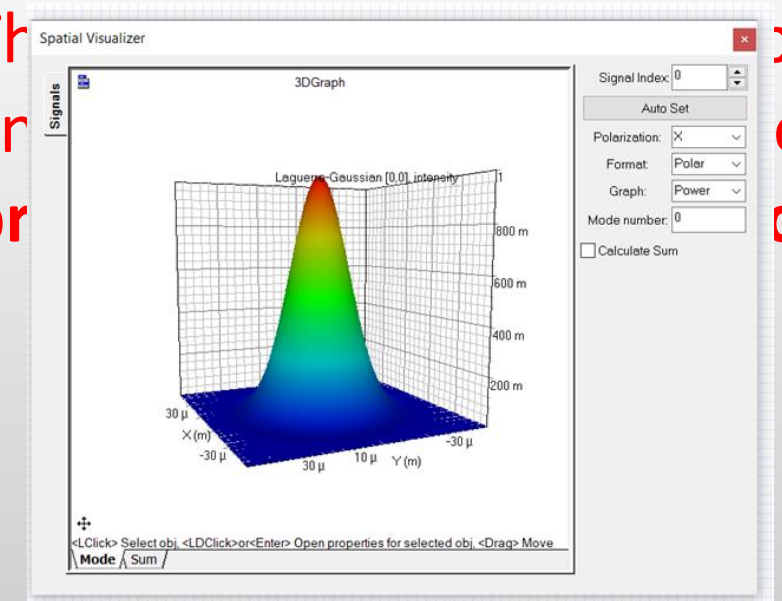

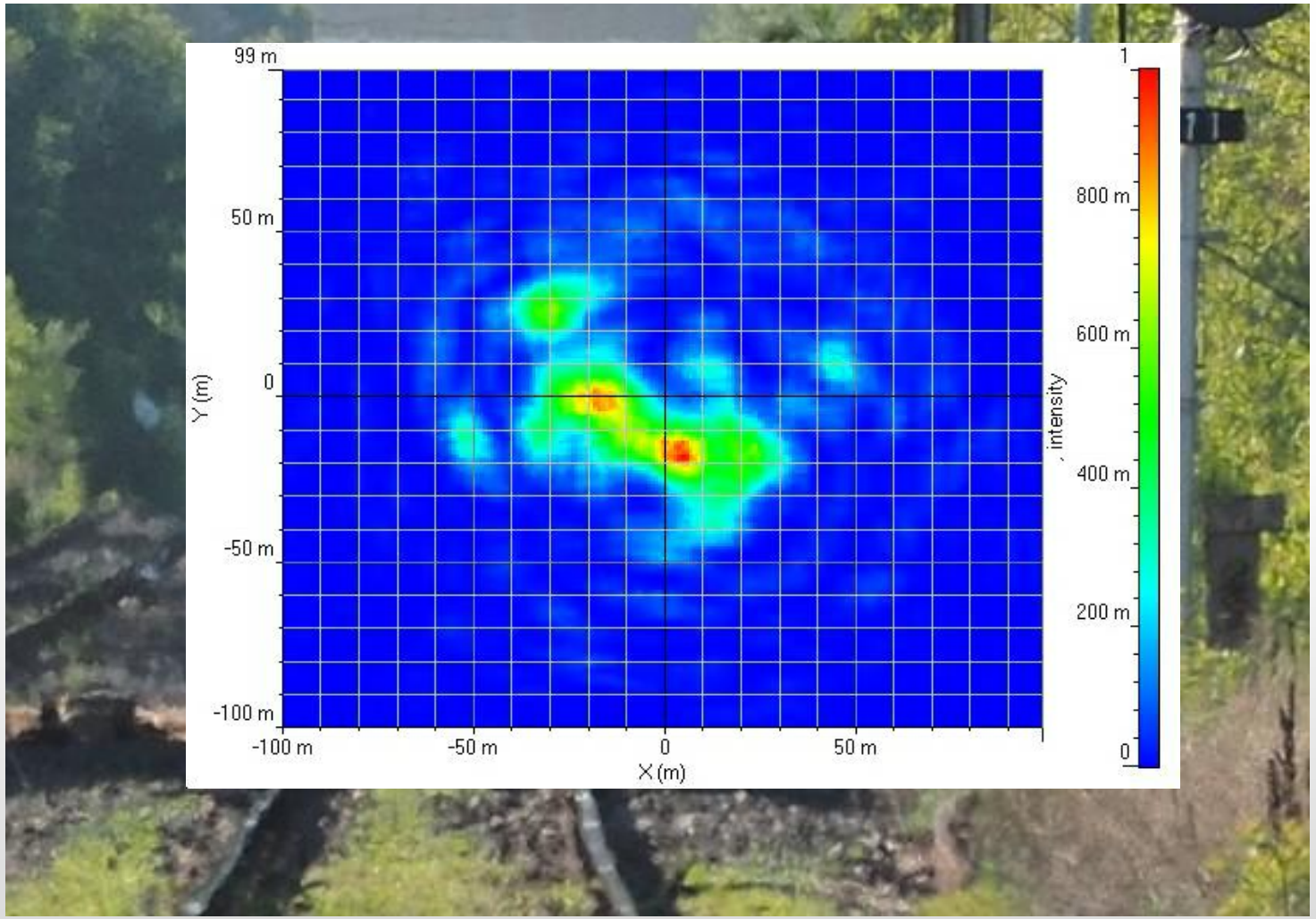

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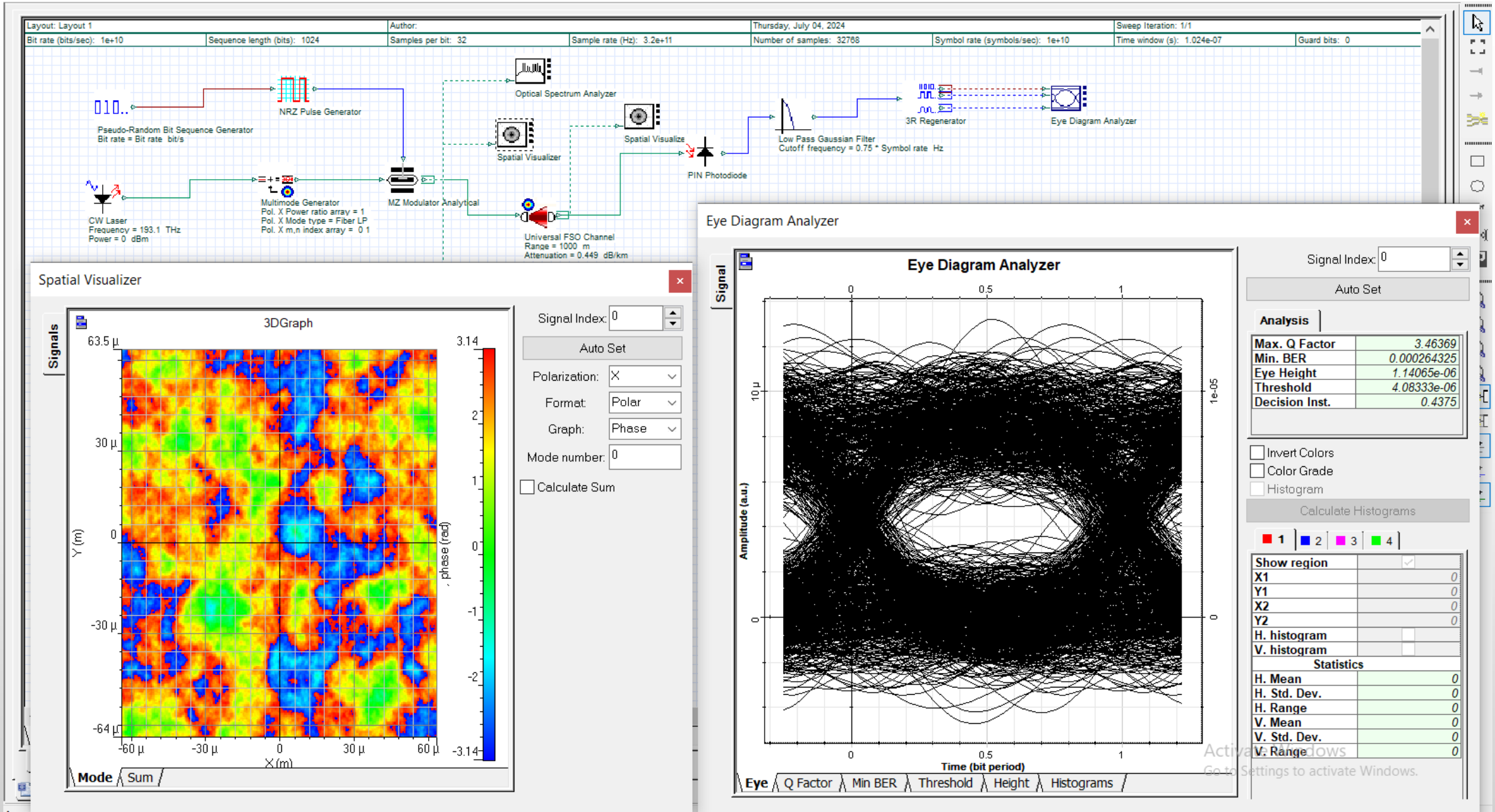
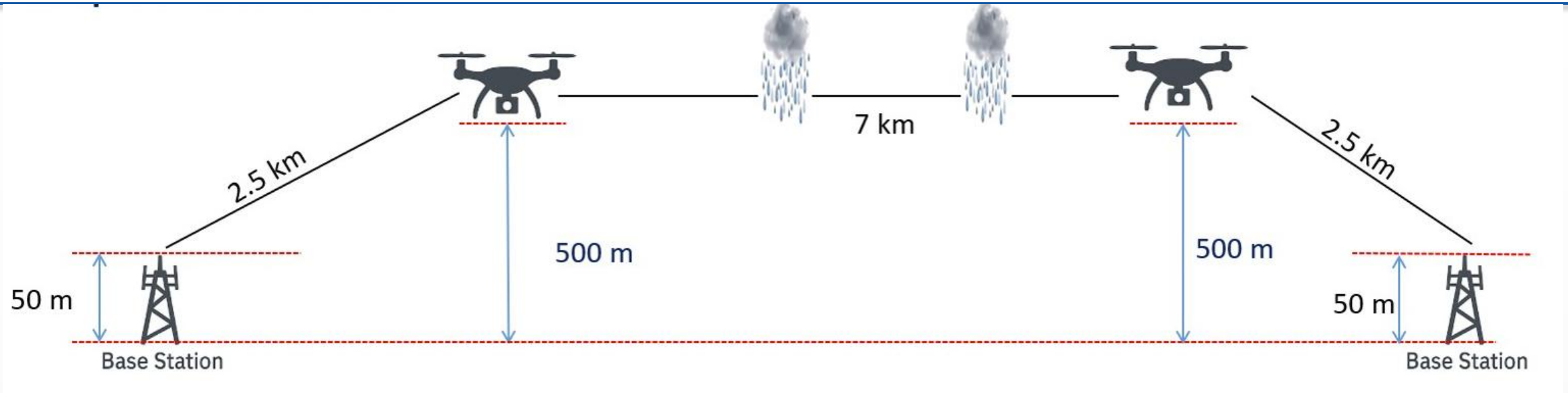
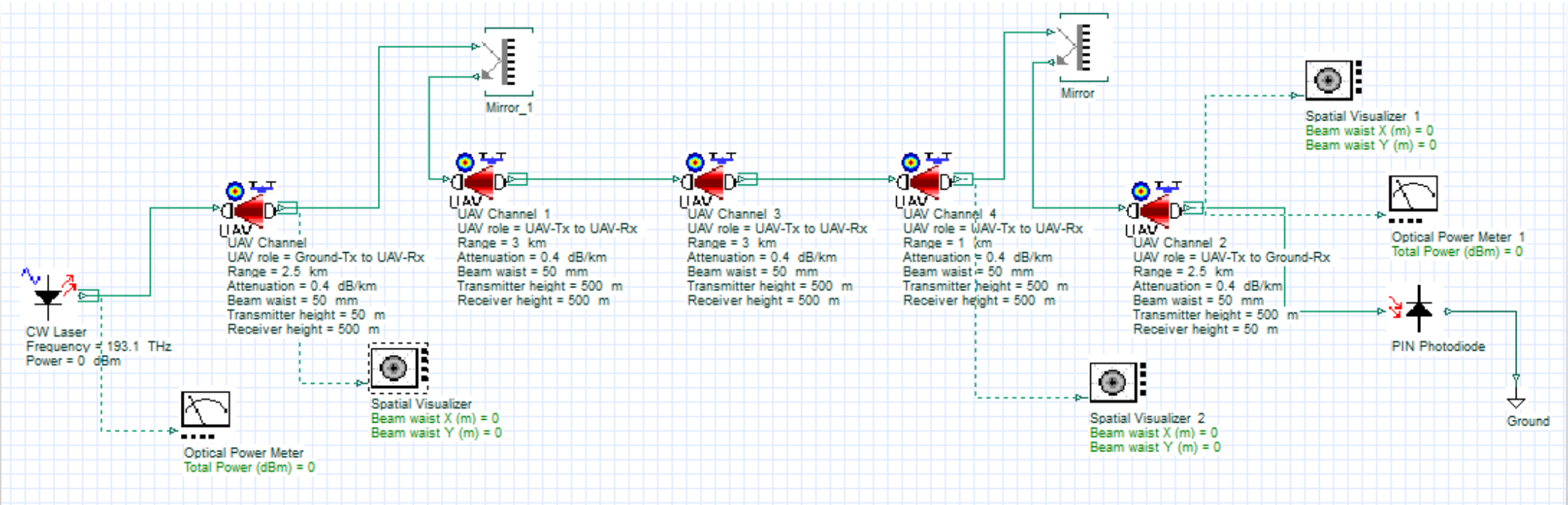
Spatial Scintillation

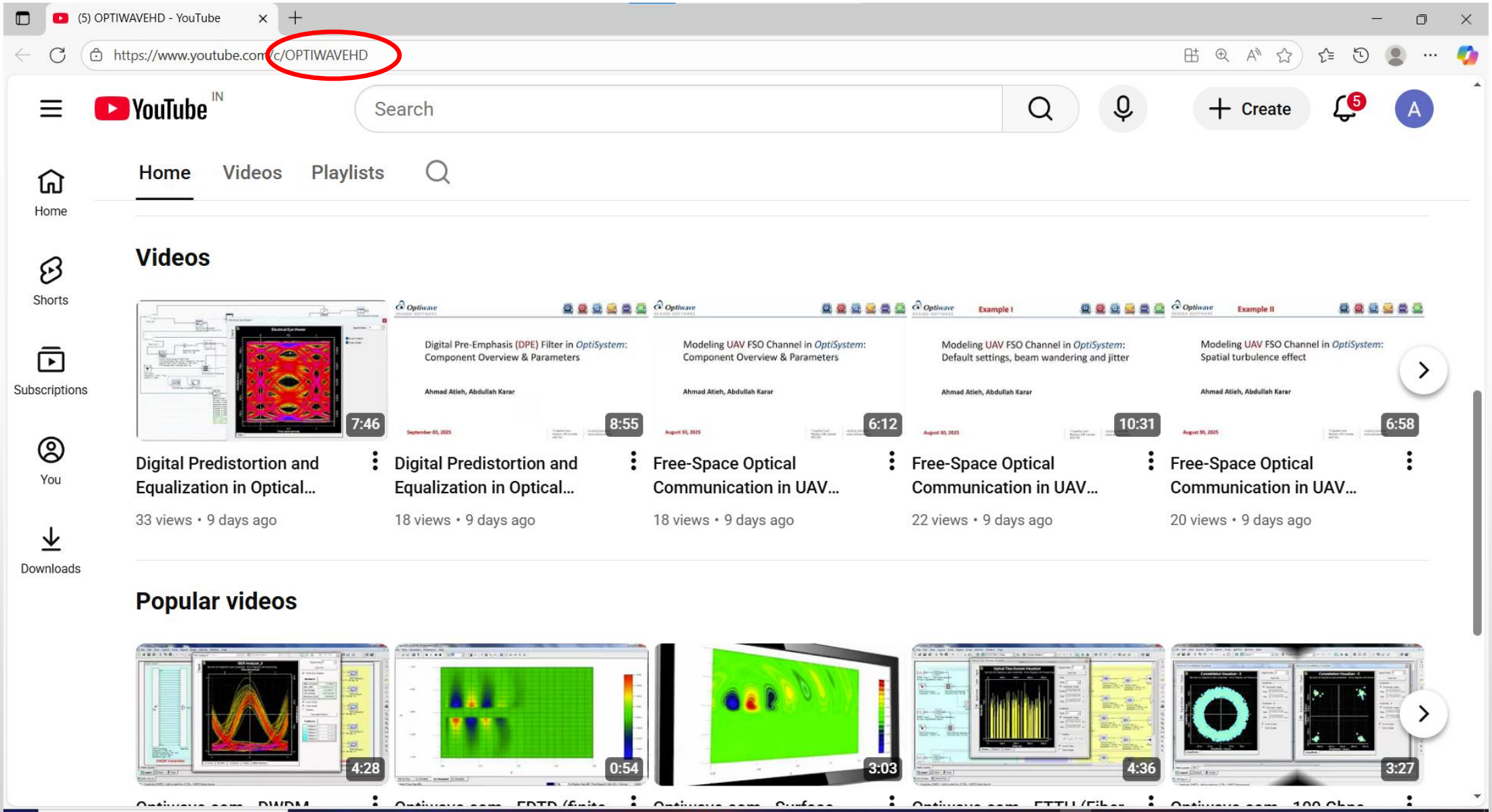


UAV Component Application

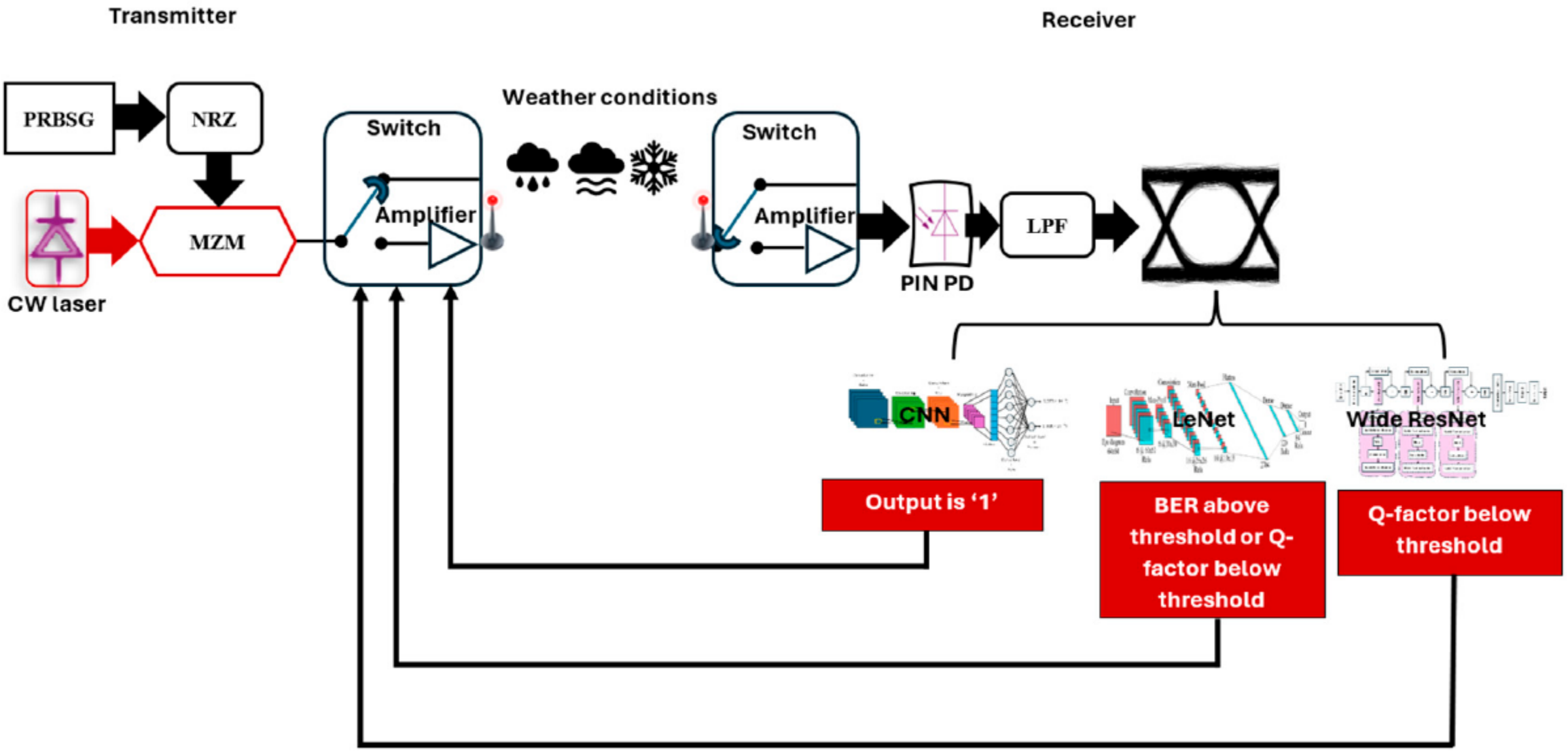




UAV Component Videos – OptiwaveHD (YouTube)



Machine Learning FSO System



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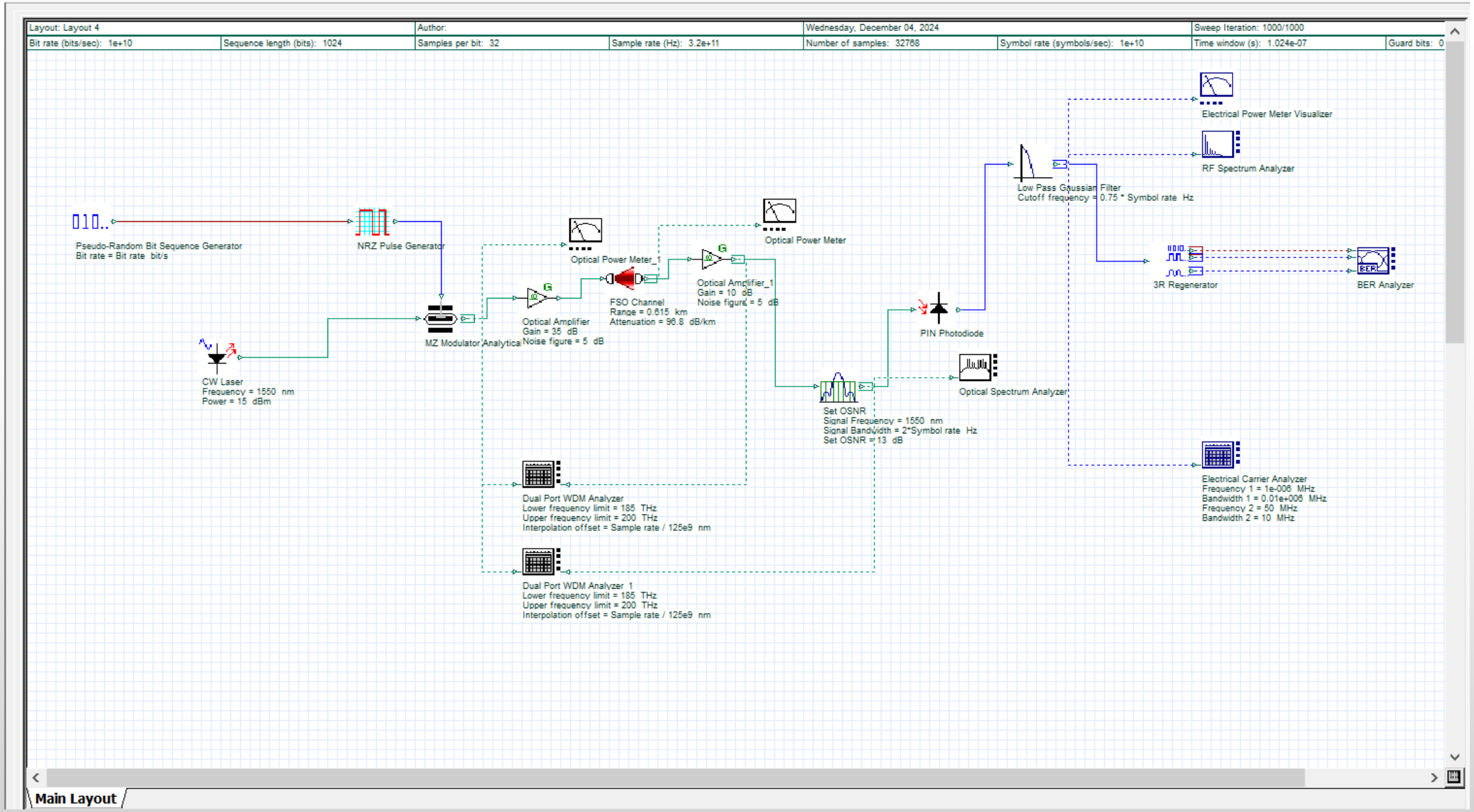
FSO Communication System



Machine Learning FSO System

photonics

MDPI

Article

Real-Time Signal Quality Assessment and Power Adaptation of FSO Links Operating Under All-Weather Conditions Using Deep Learning Exploiting Eye Diagrams

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[2] Optiwave Systems Inc., Ottawa, ON K2E 8A7, Canada
* Correspondence: ahmad.atieh@optiwave.com

Abstract

This paper proposes an intelligent power adaptation framework for Free-Space Optics (FSO) communication systems operating under different weather conditions exploiting a deep learning (DL) analysis of received eye diagram images. The system incorporates two Convolutional Neural Network (CNN) architectures, LeNet and Wide Residual Network (Wide ResNet) algorithms to perform regression tasks that predict received signal quality metrics such as the Quality Factor (Q-factor) and Bit Error Rate (BER) from the received eye diagram. These models are evaluated using Mean Squared Error (MSE) and the coefficient of determination (R^2 score) to assess prediction accuracy. Additionally, a custom CNN-based classifier is trained to determine whether the BER reading from the eye diagram exceeds a critical threshold of 10^{-4}; this classifier achieves an overall accuracy of 99%, correctly detecting 194/195 "acceptable" and 4/5 "unacceptable" instances. Based on the predicted signal quality, the framework activates a dual-amplifier configuration comprising a pre-channel amplifier with a maximum gain of 25 dB and a post-channel amplifier with a maximum gain of 10 dB. The total gain of the amplifiers is adjusted to support the operation of the FSO system under all-weather conditions. The FSO system uses a 15 dBm laser source at 1550 nm. The DL models are tested on both internal and external datasets to validate their generalization capability. The results show that the regression models achieve strong predictive performance, and the classifier reliably detects degraded signal conditions, enabling the real-time gain control of the amplifiers to achieve the quality of transmission. The proposed solution supports robust FSO communication under challenging atmospheric conditions including dry snow, making it suitable for deployment in regions like Northern Europe, Canada, and Northern Japan.

Keywords: free-space optics; LeNet regression; wide ResNet regression; CNN classifier; eye diagrams; real-time signal quality prediction

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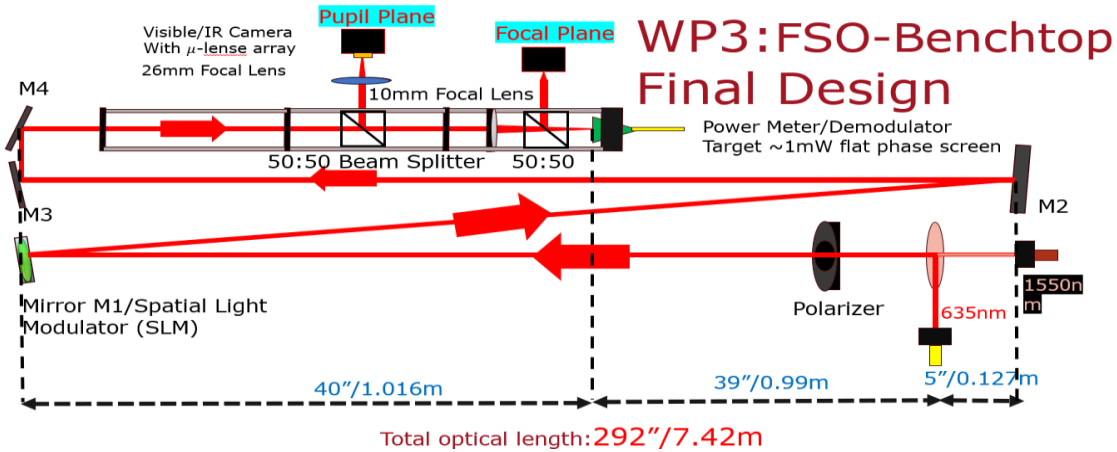
1. Introduction

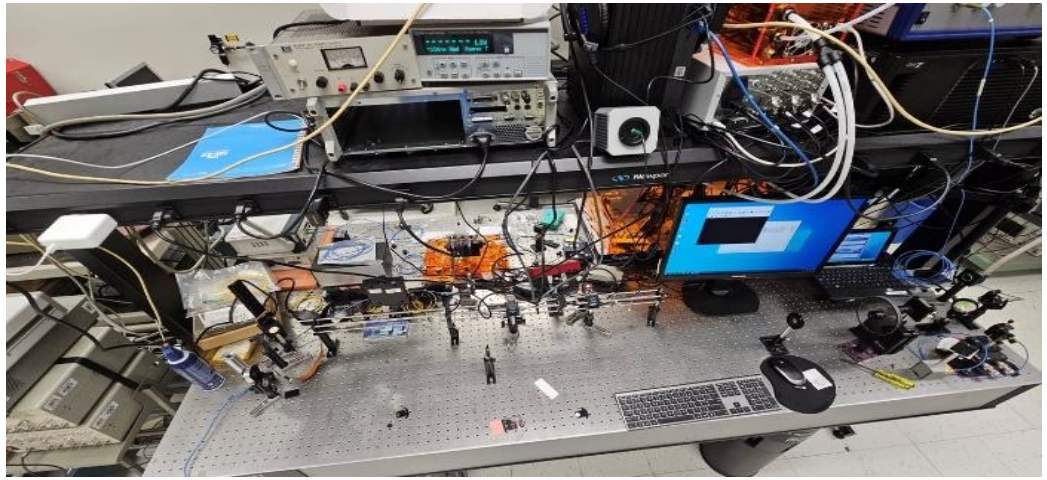
Over the past several decades, mobile communication systems have undergone a rapid evolution, with each generation emerging roughly every ten years since the introduction of first-generation (1G) networks in the 1980s. The allocated carrier frequency spectrum of 1G to fourth-generation (4G) technologies has primarily ranged from 700 MHz to 2.6 GHz [1]. However, the limited bandwidth within this range, coupled with the exponential increase in mobile device penetration and global data traffic, has resulted in persistent challenges

Adobe Acrobat Document

Accomplishments – Indoor FSO Demonstration

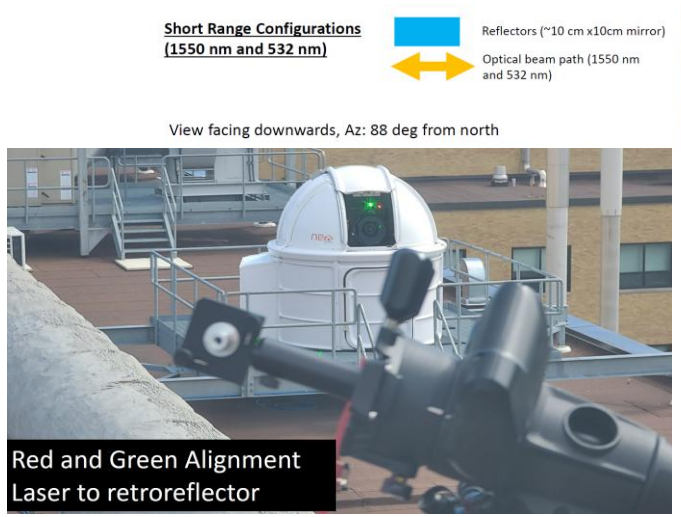
- Turbulence Implementation via Spatial Light Modulation (SLM).
- Integration of custom-built VIS/SWIR Shack-Hartmann wavefront sensor.
- Characterization of the applied C_n^2 via focal plane power measurements (scintillation effects).
- Integration between Photonics lab optical system characterization and OptiSystem software.

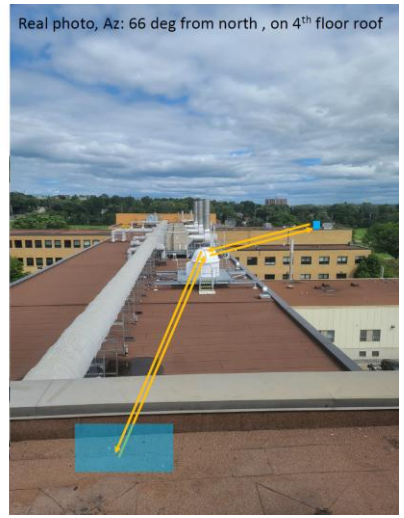


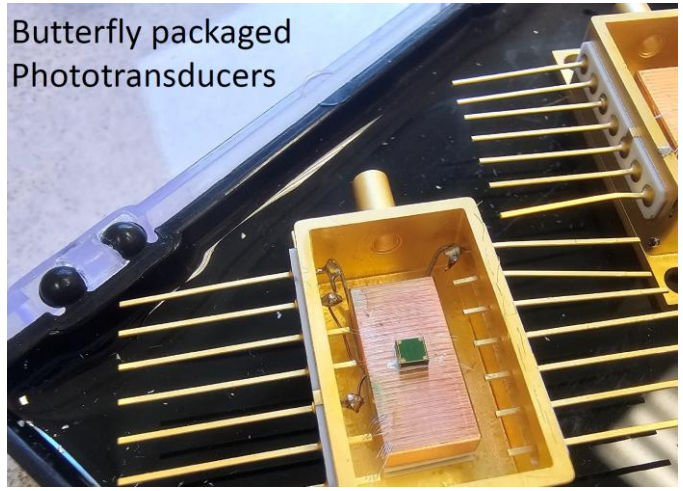


Accomplishments – Outdoor FSO Demonstration

- Rooftop (NRC) setup for outdoor characterization of signal transmission, with NRC weather station.
- Calibrations of the alignment laser using retro-reflector for different distances.
- Initial 60 m and 160 m links demonstrated at 1550 nm.
- Measurements at 4, 10, and 20+ Gbps data rates has been conducted.
- Power beaming with 10 W laser is planned.







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UAV Reflector Gimble

Thank You

Any Question

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