



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

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www.optiwave.com

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

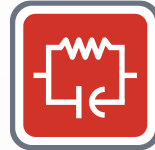
- Optiwave established in 1994
- Located in Ottawa, Ontario, Canada
- Optiwave develops innovative software tools that offer design, simulation, and optimization capabilities for components, links, systems and networks
- Optiwave's software offers users a distinct competitive advantage through
 - shortening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

Product Line

System-Level



OptiSystem
Optical Communication System
Amplifier Design Suite



OptiSPICE
Opto-Electronic Circuit Design
Software

Component-Level



OptiBPM
Waveguide Optics Design Software



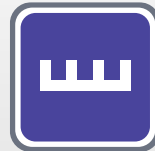
OptiFDTD
Finite-Difference Time-Domain
Design Software



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

Company Overview

31

Years in Business

7,000+

Paid Accounts

300,000+

Evaluation Downloads

80+

Countries

15,000+

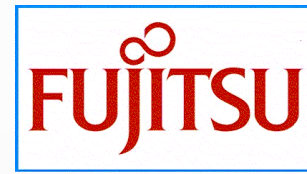
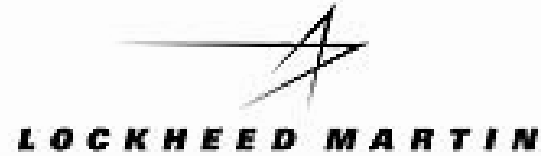
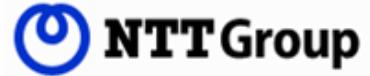
Paid Users

12,000+

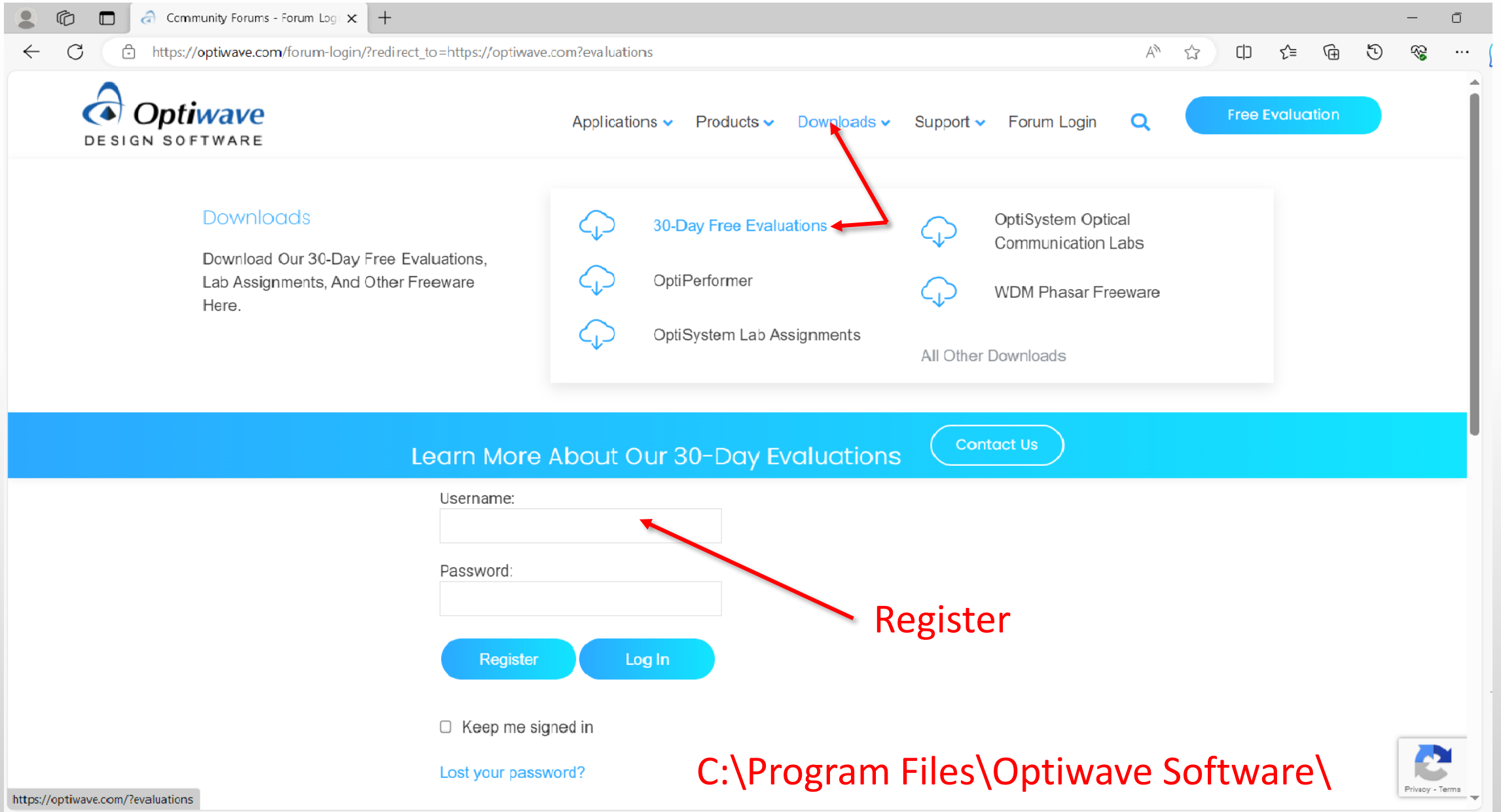
Citations

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

Optiwave Key Customers



Optiwave Software Download



The screenshot shows the Optiwave website's 'Downloads' page. The navigation bar includes 'Applications', 'Products', 'Downloads', 'Support', and 'Forum Login', along with a search icon and a 'Free Evaluation' button. The main content area features a 'Downloads' section with the text: 'Download Our 30-Day Free Evaluations, Lab Assignments, And Other Freeware Here.' Below this, a list of download options is displayed, including '30-Day Free Evaluations', 'OptiSystem Optical Communication Labs', 'OptiPerformer', 'OptiSystem Lab Assignments', and 'WDM Phasar Freeware'. A red arrow points from the 'Downloads' menu item to the '30-Day Free Evaluations' link. Below the download list is a blue banner with the text 'Learn More About Our 30-Day Evaluations' and a 'Contact Us' button. At the bottom, there is a registration form with fields for 'Username:' and 'Password:', and buttons for 'Register' and 'Log In'. A red arrow points from the 'Register' button to the 'Register' text. Below the registration form, there is a checkbox for 'Keep me signed in' and a link for 'Lost your password?'. The footer contains the URL 'https://optiwave.com/?evaluations' and a 'Privacy - Terms' link.

Community Forums - Forum Log x +
https://optiwave.com/forum-login/?redirect_to=https://optiwave.com?evaluations

Optiwave
DESIGN SOFTWARE

Applications ▾ Products ▾ Downloads ▾ Support ▾ Forum Login 🔍 Free Evaluation

Downloads

Download Our 30-Day Free Evaluations, Lab Assignments, And Other Freeware Here.

- 30-Day Free Evaluations
- OptiSystem Optical Communication Labs
- OptiPerformer
- OptiSystem Lab Assignments
- WDM Phasar Freeware

All Other Downloads

Learn More About Our 30-Day Evaluations Contact Us

Username:

Password:

Register Log In

Keep me signed in

[Lost your password?](#)

Register

C:\Program Files\Optiwave Software\
Privacy - Terms

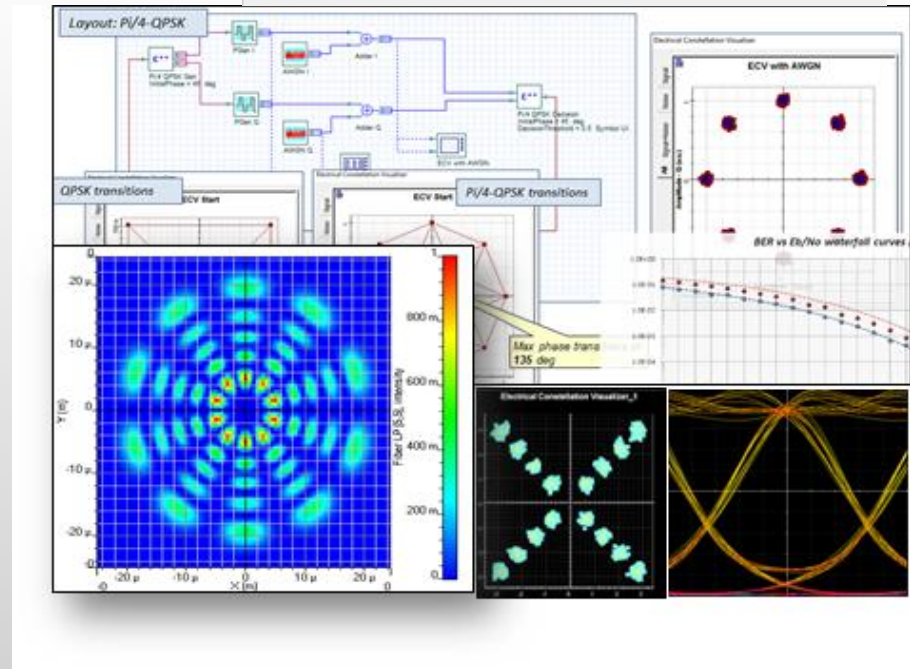
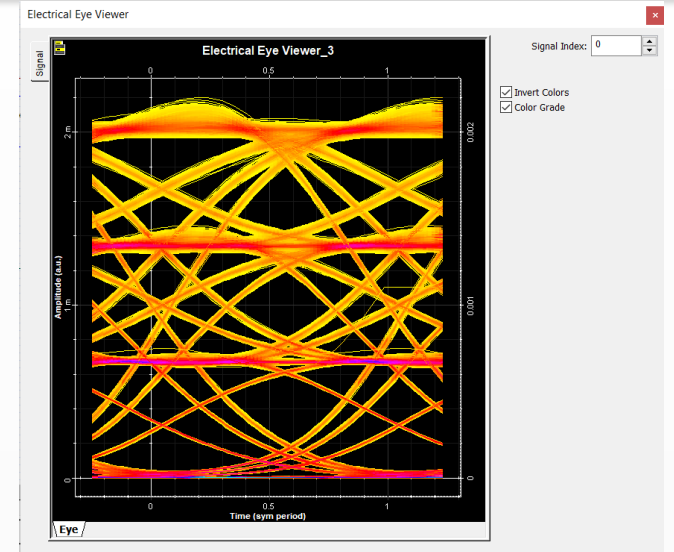
Knowledge Base

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

YouTube

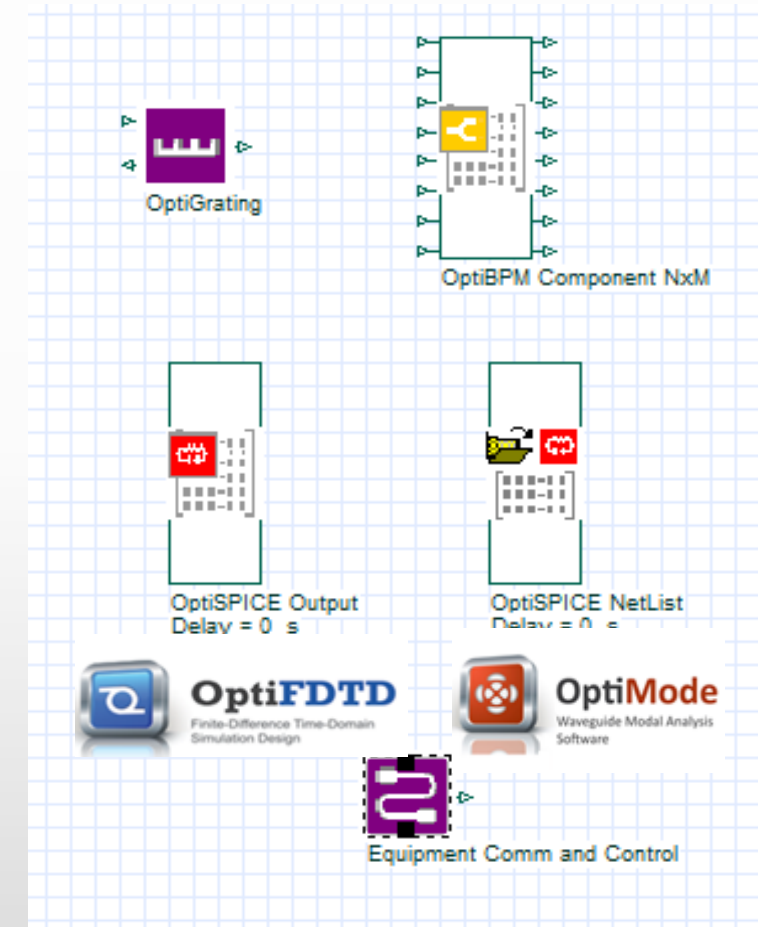
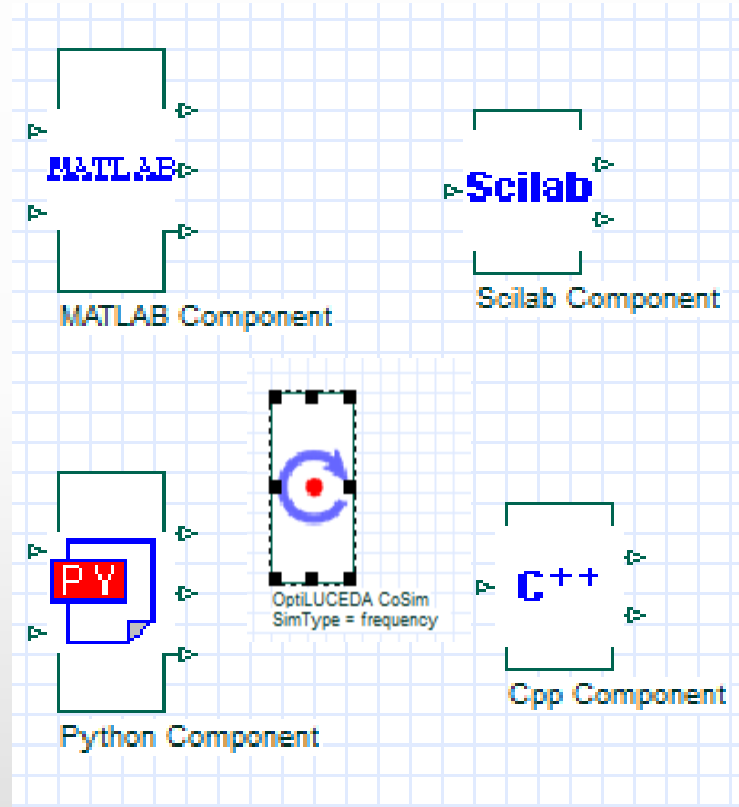
- **OptiwaveHD** - <https://www.youtube.com/@OPTIWAVEHD>
- Playlists for each product
- Recording of wide range of applications and tutorials

- OptiSystem 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



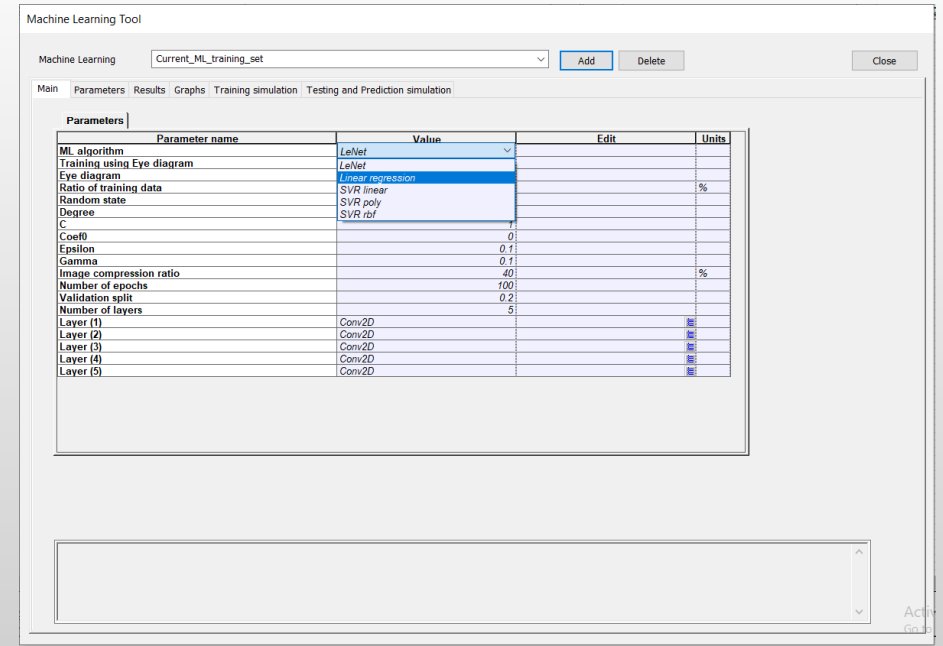
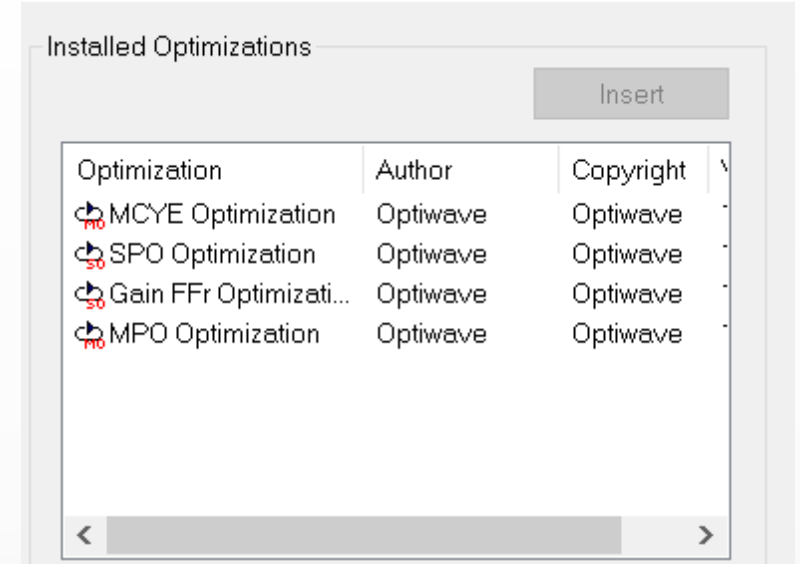
Optimizations

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

Component Library

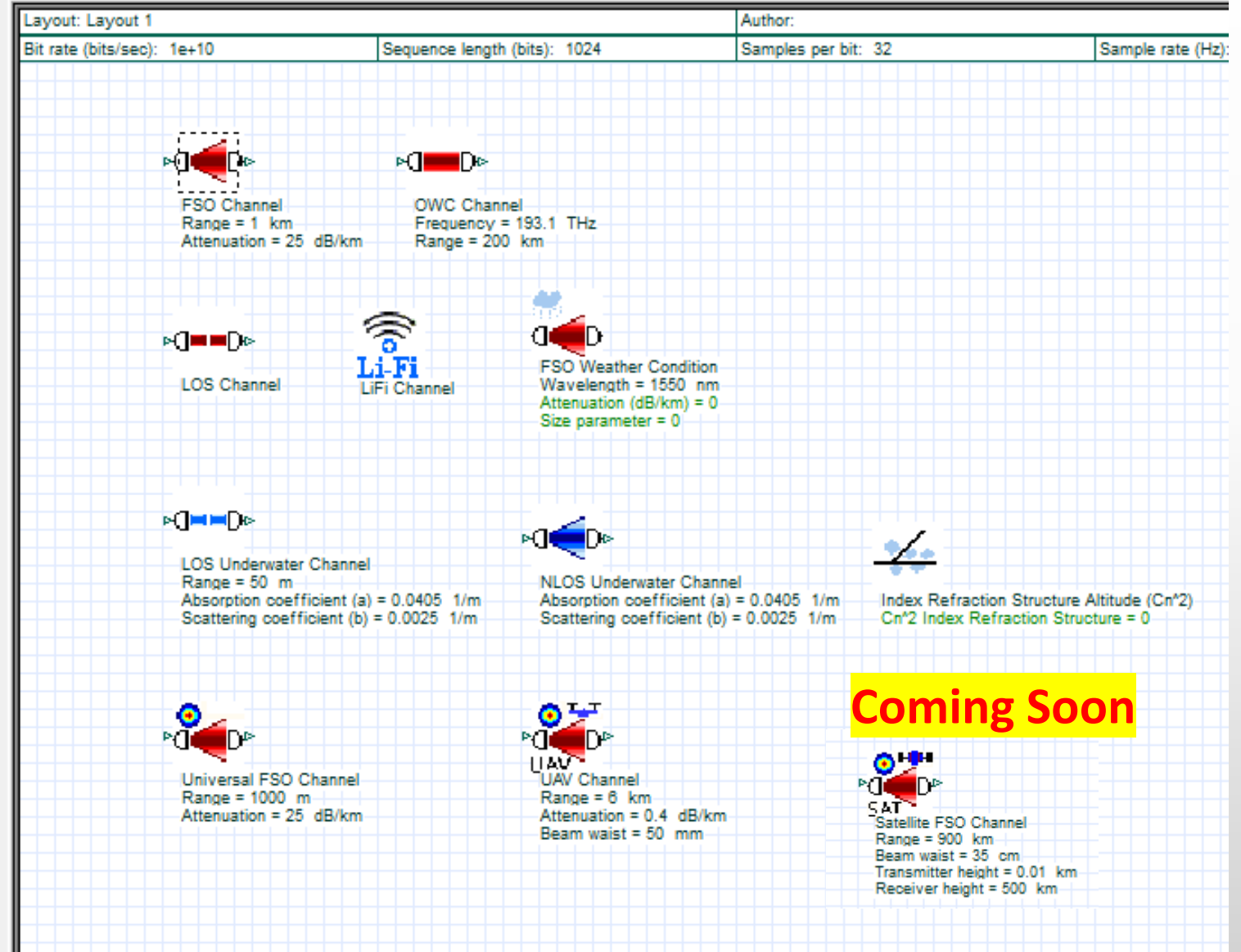
Default/

- Visualizer Library
- Sensors
- Transmitters Library
- WDM Multiplexe...
- Optical Fibers...
- Amplifiers Library
- Multimode Library
- Filters Library
- Receivers Library
- PAS Library
- Passives Library
- Optiwave Softwar...
- Signal Processin...
- Optical Switches
- Tools Library
- External Softwa...
- Free Space Optics

Layout: Layout 1

Author:

Bit rate (bits/sec): 1e+10 Sequence length (bits): 1024 Samples per bit: 32 Sample rate (Hz):



FSO Channel
Range = 1 km
Attenuation = 25 dB/km

OWC Channel
Frequency = 193.1 THz
Range = 200 km

LOS Channel

Li-Fi Channel

FSO Weather Condition
Wavelength = 1550 nm
Attenuation (dB/km) = 0
Size parameter = 0

LOS Underwater Channel
Range = 50 m
Absorption coefficient (a) = 0.0405 1/m
Scattering coefficient (b) = 0.0025 1/m

NLOS Underwater Channel
Absorption coefficient (a) = 0.0405 1/m
Scattering coefficient (b) = 0.0025 1/m

Index Refraction Structure Altitude (Cn²)
Cn² Index Refraction Structure = 0

Universal FSO Channel
Range = 1000 m
Attenuation = 25 dB/km

UAV Channel
Range = 6 km
Attenuation = 0.4 dB/km
Beam waist = 50 mm

SAT
Satellite FSO Channel
Range = 900 km
Beam waist = 35 cm
Transmitter height = 0.01 km
Receiver height = 500 km

Coming Soon

- 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

Gaussian Transverse Mode Generator

The screenshot displays the Optiwave software interface for a Gaussian Transverse Mode Generator. The main layout shows a CW Laser (Frequency = 193.1 THz, Power = 0 dBm) connected to a Gaussian Transverse Mode Generator (Power ratio array = 1). The layout parameters are: Bit rate (bits/sec): 1e+10, Sequence length (bits): 1024, Samples per bit: 32.

Three Spatial Visualizer windows are shown:

- Top Spatial Visualizer (Power):** Displays a 2D heatmap of intensity. The Y-axis ranges from -10 μ m to 24.5 μ m. The X-axis ranges from -25 μ m to 25 μ m. The intensity scale ranges from 0 to 1. The plot shows a central Gaussian-like spot.
- Bottom Left Spatial Visualizer (Phase):** Displays a 2D heatmap of phase. The Y-axis ranges from -25 μ m to 24.5 μ m. The X-axis ranges from -25 μ m to 25 μ m. The phase scale ranges from 0 to 2.53. The plot shows a central Gaussian-like spot.
- Bottom Center Spatial Visualizer (3D Graph):** Displays a 3D surface plot of intensity. The X-axis ranges from -30 μ m to 30 μ m, the Y-axis from -30 μ m to 30 μ m, and the Z-axis (intensity) from 0 to 1. The plot shows a central Gaussian-like peak.

Each Spatial Visualizer window includes a control panel with the following settings:

- Signal Index: 0
- Auto Set
- Polarization: X
- Format: Polar
- Graph: Power (or Phase for the bottom left window)
- Mode number: 0
- Calculate Sum

The bottom left window also includes a table for Layout 1 Parameters:

Name
Space width X
Space width Y
Grid spacing X
Grid spacing Y

The bottom left window also includes a table for Simulation Signals:

Name
Space width X
Space width Y
Grid spacing X
Grid spacing Y

The bottom left window also includes a table for Simulation Signals:

Name
Space width X
Space width Y
Grid spacing X
Grid spacing Y

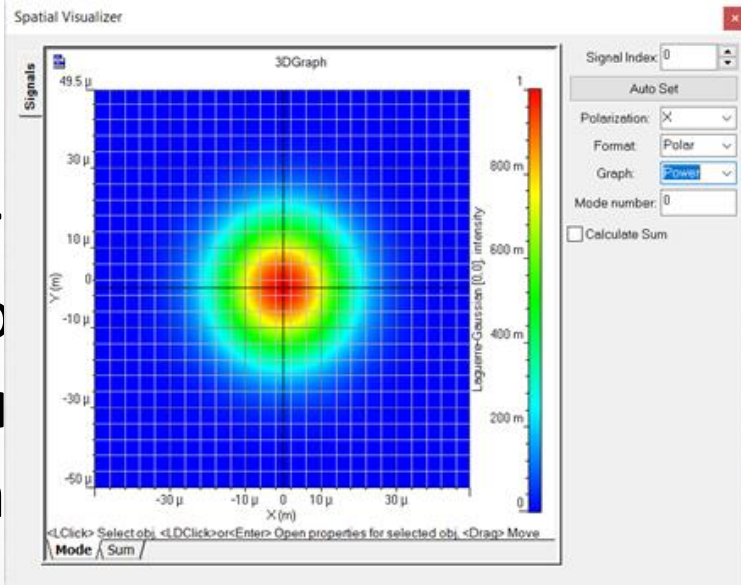
The bottom left window also includes a table for Simulation Signals:

Name
Space width X
Space width Y
Grid spacing X
Grid spacing Y

Scintillation (Weather Turbulence)

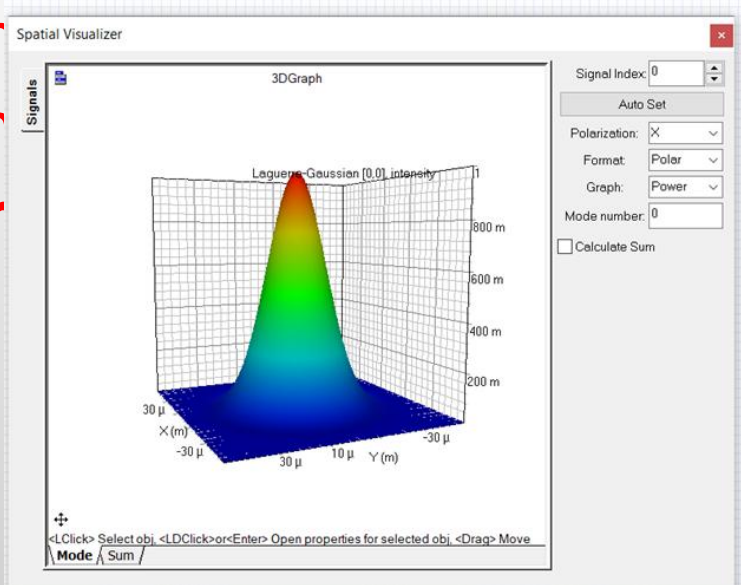
Turbulence Effects

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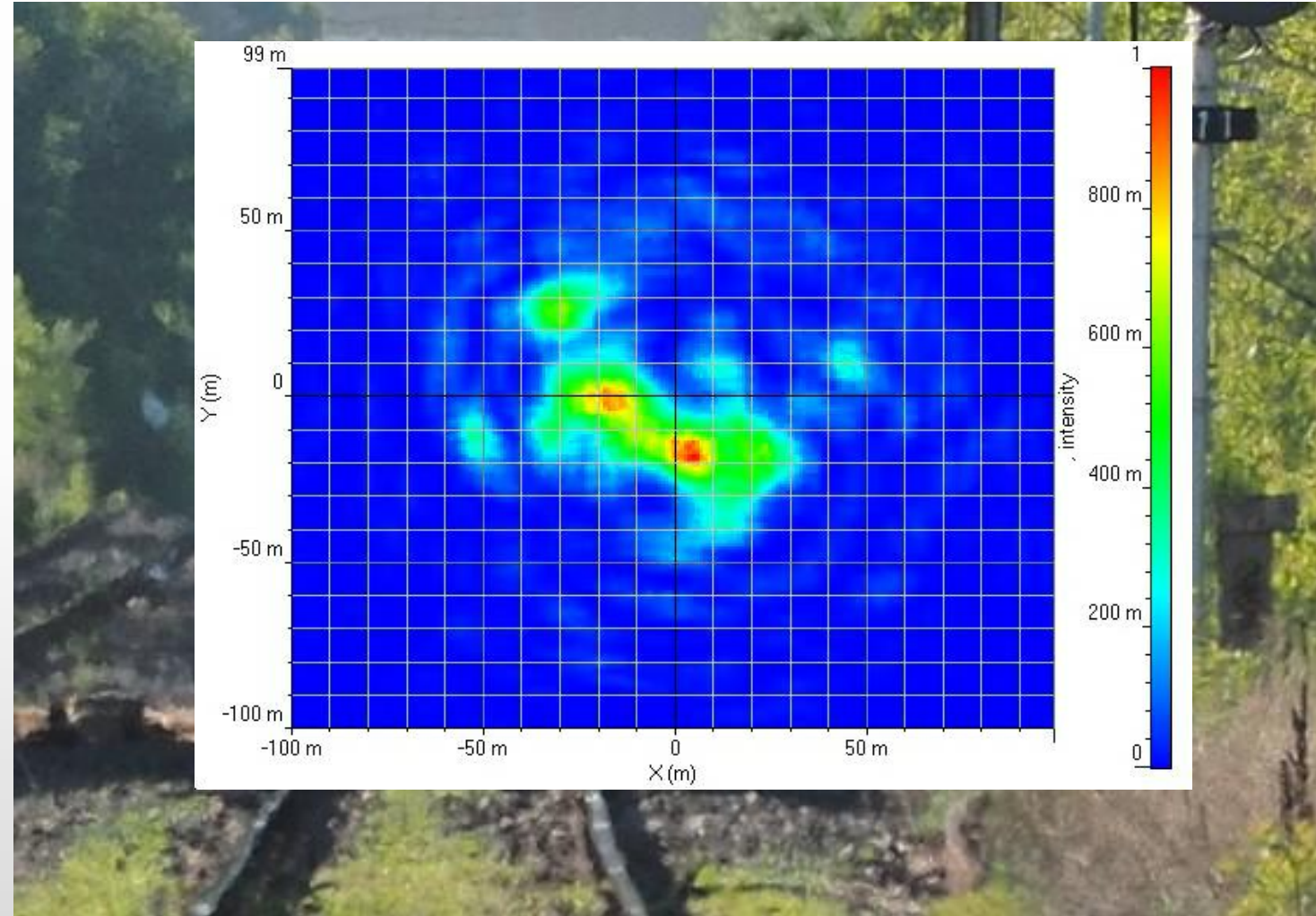


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Spatial Scintillation

Layout: Layout 1 | Author: | Thursday, July 04, 2024 | Sweep Iteration: 1/1
 Bit rate (bits/sec): 1e+10 | Sequence length (bits): 1024 | Samples per bit: 32 | Sample rate (Hz): 3.2e+11 | Number of samples: 32768 | Symbol rate (symbols/sec): 1e+10 | Time window (s): 1.024e-07 | Guard bits: 0

Spatial Visualizer

3DGraph

Y (m): -64 μm to 63.5 μm
 X (m): -60 μm to 60 μm
 - phase (rad): -3.14 to 3.14

Mode: Sum

Signal Index: 0
 Auto Set
 Polarization: X
 Format: Polar
 Graph: Phase
 Mode number: 0
 Calculate Sum

Eye Diagram Analyzer

Signal

Amplitude (a.u.): 0 to 10 μm
 Time (bit period): 0 to 1
 1e-05

Analysis

Max. Q Factor	3.46369
Min. BER	0.000264325
Eye Height	1.14065e-06
Threshold	4.08333e-06
Decision Inst.	0.4375

Invert Colors
 Color Grade
 Histogram

Calculate Histograms

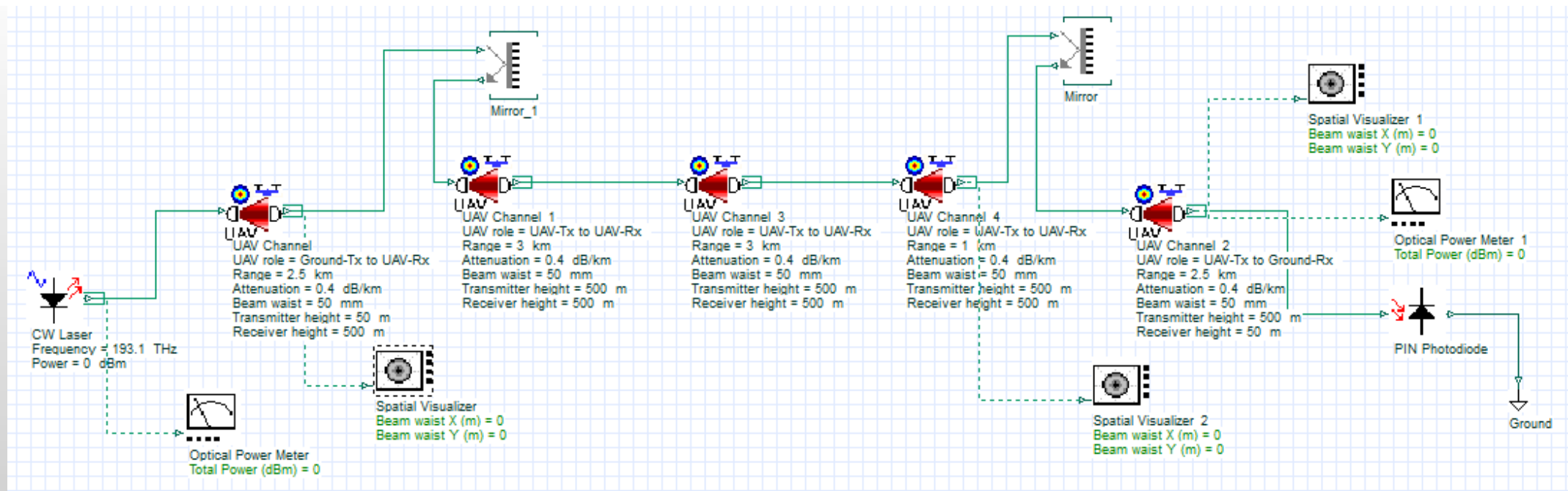
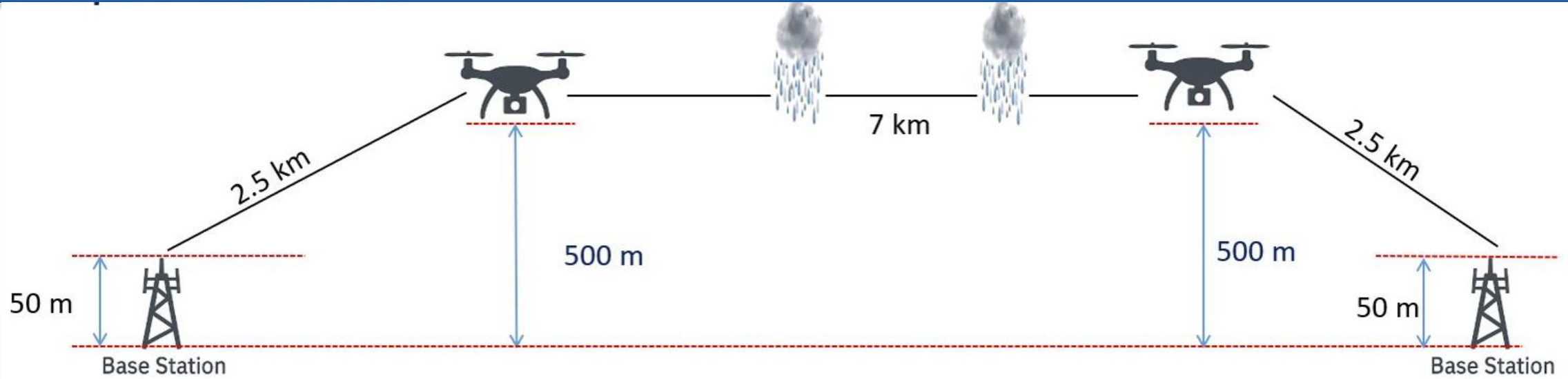
■ 1 ■ 2 ■ 3 ■ 4

Show region	
X1	0
Y1	0
X2	0
Y2	0
H. histogram	
H. Mean	0
H. Std. Dev.	0
H. Range	0
V. histogram	
V. Mean	0
V. Std. Dev.	0
V. Range	0

Eye | Q Factor | Min BER | Threshold | Height | Histograms

Active Windows
Go to Settings to activate Windows.

UAV Component Application

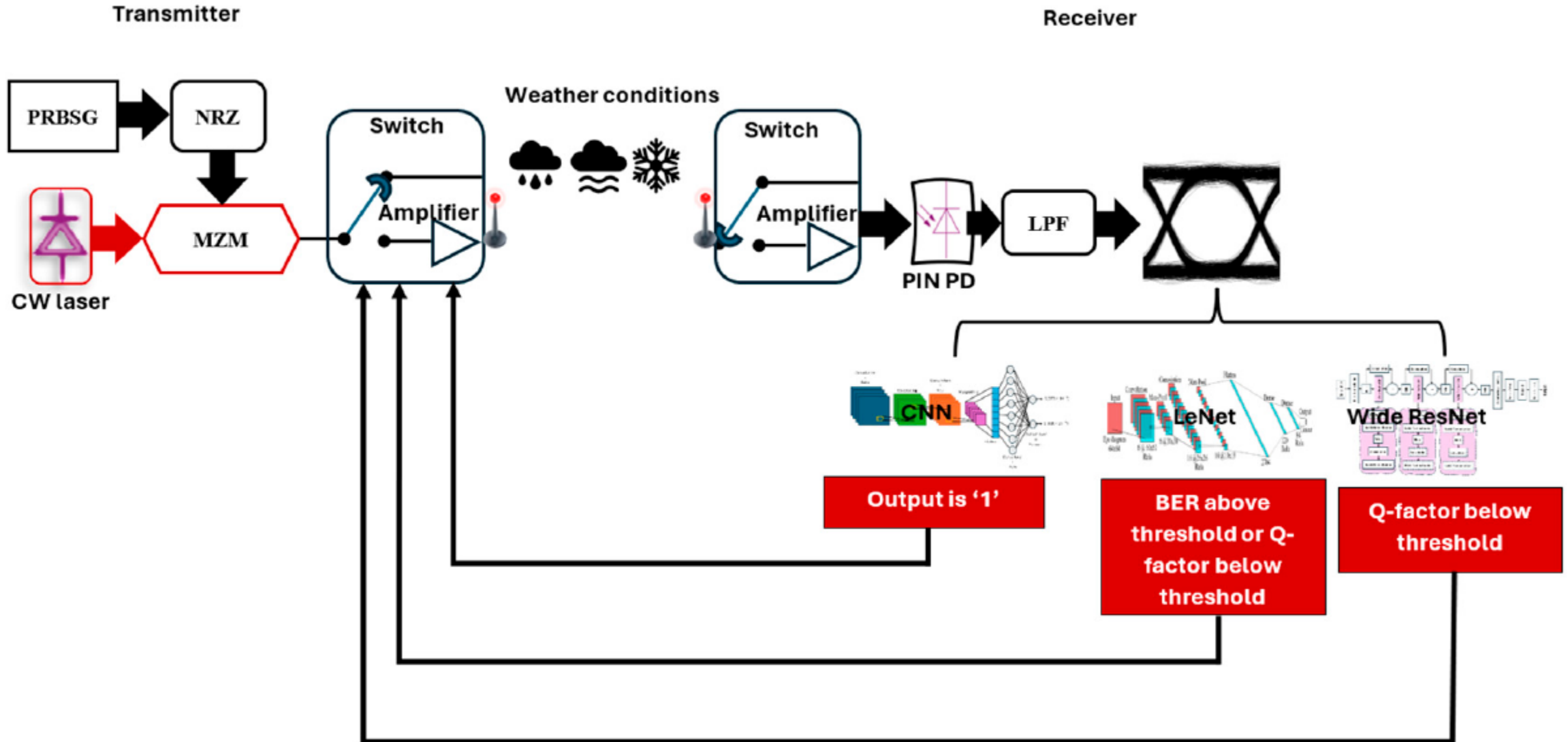


The screenshot shows a web browser window with the address bar containing 'https://www.youtube.com/c/OPTIWAVEHD'. The YouTube interface includes a search bar, navigation tabs for Home, Videos, and Playlists, and a sidebar with icons for Home, Shorts, Subscriptions, You, and Downloads. The main content area is titled 'Videos' and displays a grid of five video thumbnails. Each thumbnail shows a software interface with various plots and graphs. The video titles and durations are as follows:

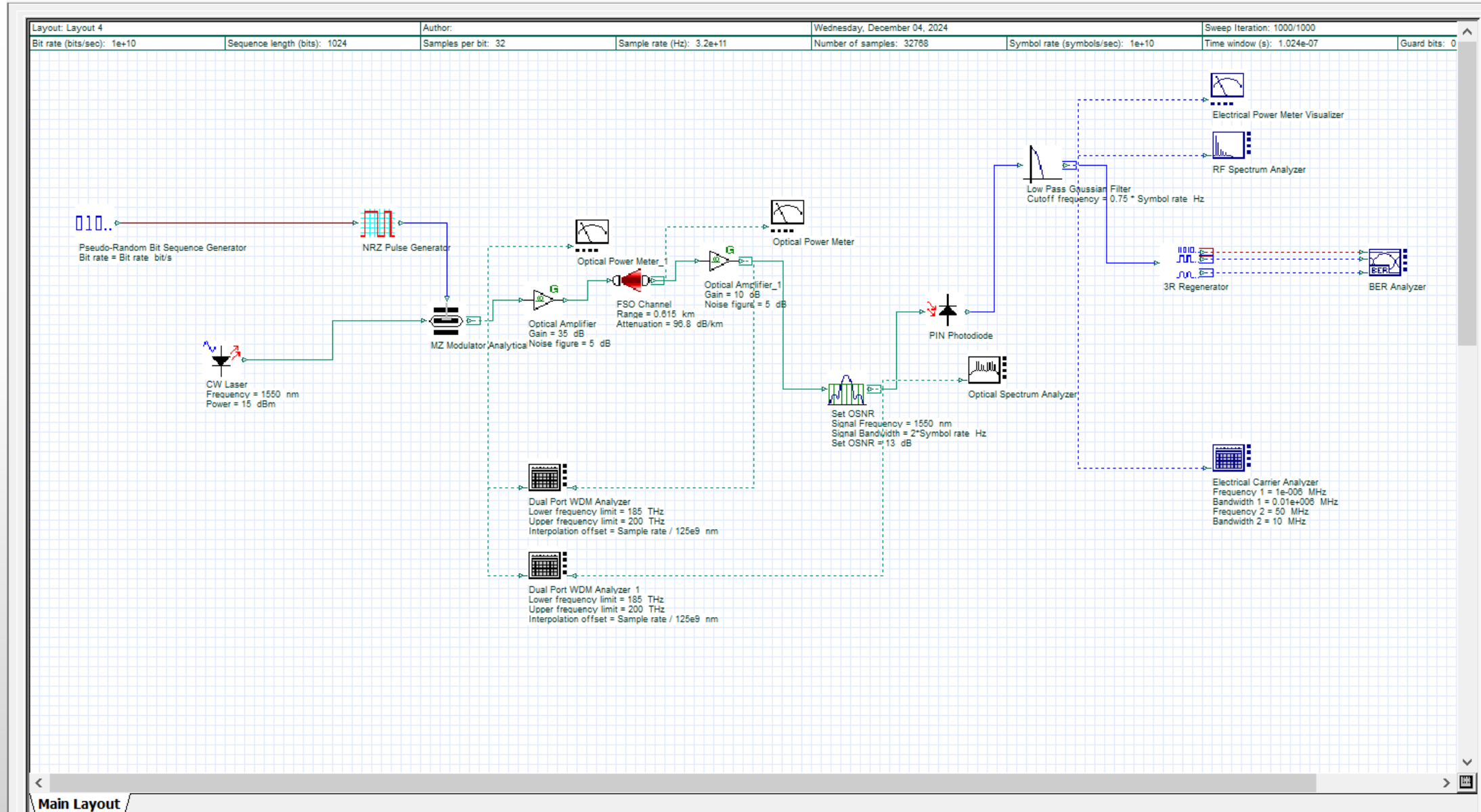
Video Title	Duration	Views	Time Ago
Digital Predistortion and Equalization in Optical...	7:46	33 views	9 days ago
Digital Predistortion and Equalization in Optical...	8:55	18 views	9 days ago
Free-Space Optical Communication in UAV...	6:12	18 views	9 days ago
Free-Space Optical Communication in UAV...	10:31	22 views	9 days ago
Free-Space Optical Communication in UAV...	6:58	20 views	9 days ago

Below the main video grid is a section titled 'Popular videos' which shows a horizontal row of five video thumbnails with durations: 4:28, 0:54, 3:03, 4:36, and 3:27. The thumbnails display various optical simulation results, including beam profiles and intensity distributions.

Machine Learning FSO System



FSO Communication System



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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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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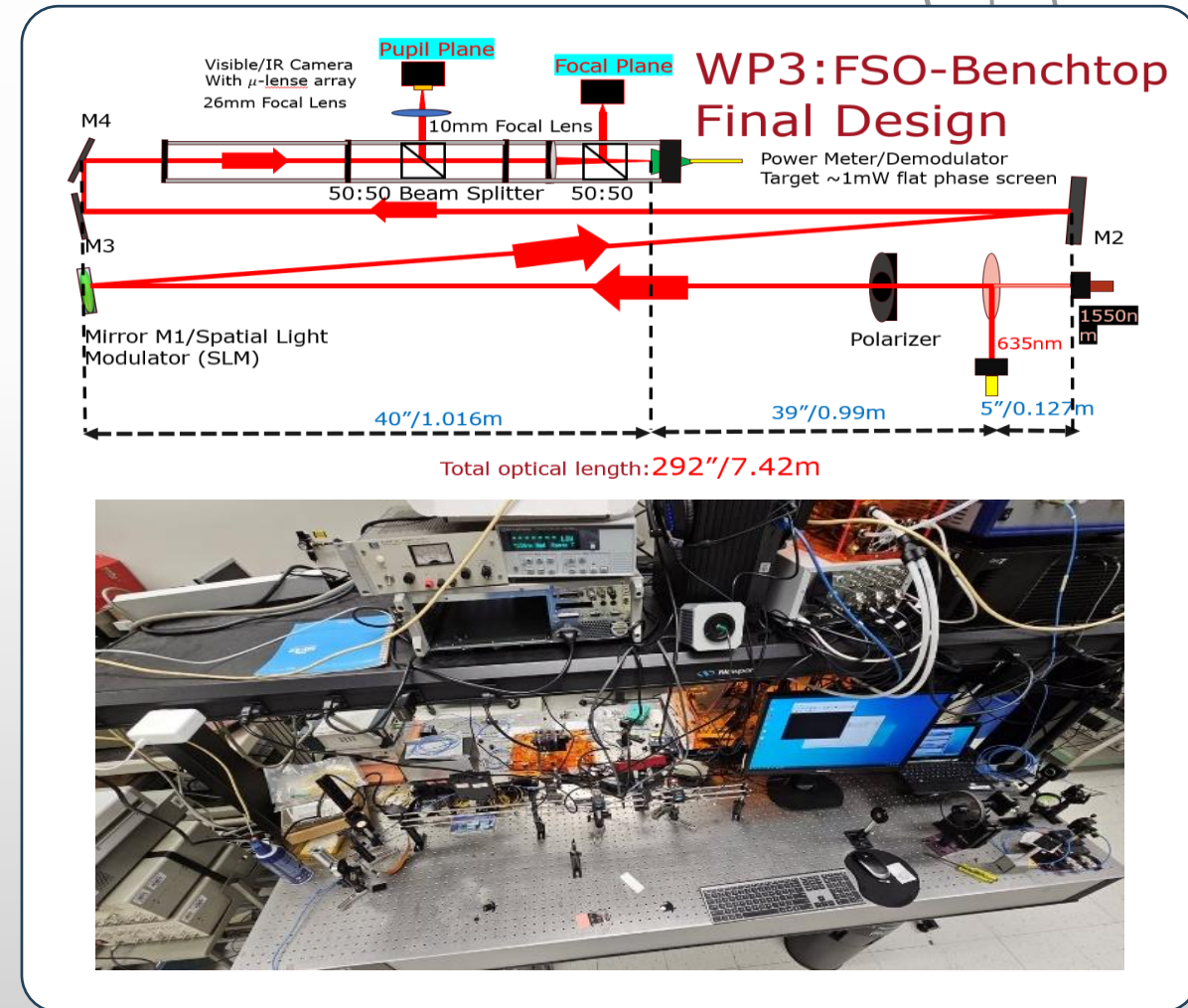
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Adobe Acrobat Document

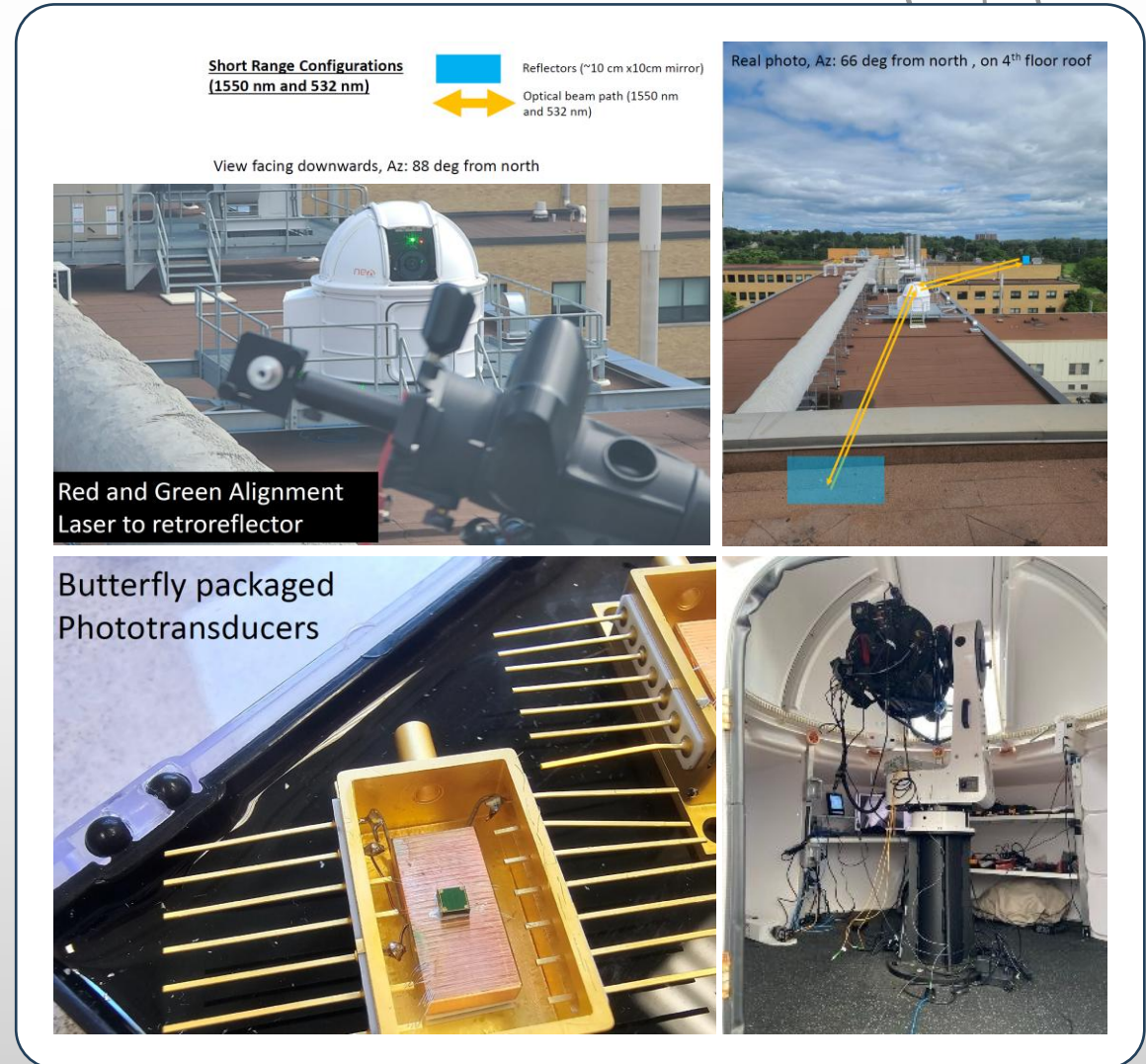
Accomplishments – Indoor FSO Demonstration

- 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.



UAV Reflector Gimble



Thank You
Any Question

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support@optiwave.com

