CodeSScientific Photonics IP Simulations Modules

DESCRIPTION OF PHOTONICS IP SIMULATIONS MODULES

CODESSCIENTIFIC

CodeSScientific

Photonics IP Simulations Modules for Scientists and Engineers

Description of IP Simulations Modules

Version 2025.a

CodeSScientific

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CodeSScientific Photonics IP Simulations Modules

Description of Photonics IP Simulation Modules

amp.m

Multiplies the input signal by gain factor and adds noise.

AtoD_convert.m

Analog to digital converter

ber_calc.m

Calculates bit error rate.

ber_calc_qam_ofdm.m

Calculates the symbol error rate.

ber_calc_qpsk.m

Calculates the BER by comparing the received bit pattern with the transmitted bit pattern.

CD_comp.m

This IP simulation module function provides CD compensation in digital domain.

coherent_rx_phase_comp.m

Compensates for laser phase noise in a QPSK system.

computeq.m

This IP simulation module function calculates the mean and variances of bit ’0’ and ’1’ and Q-factor.

computeq_mzm.m

Calculates Q-factors when Mach-Zehnder modulator is used at the transmitter.

constellation_diagram.m

Plots the constellation.

cos.m

Plots electric field as a function of propagation distance for various time-steps.

dd_rx_snr.m

Simulates the signal-to-noise ratio (SNR) of a direct detection receiver.

down_sample.m

This IP simulation module function gets M samples per symbol. M is defined by “factor”.

down_sample_CD.m

This IP simulation module function does down-sampling with number of sample per symbol = down_sample_factor.

DtoA_convert.m

Digital to analog converter

edfa.m

Simulates the EDFA gain by solving the coupled differential equations governing evolutions of signal and pump in erbium doped fiber.

edfa_ode.m

Function describing the differential equations for simulating the EDFA gain

eye_diagram.m

Plots the eye diagram of the optical power.

eye_diagram_pow.m

Plots the eye diagram. The Y-axis is optical power.

fiber.m

Passes the signal through a fiber.

fiber_dispersion.m

Plots the output field/power of an optical fiber with first/second order dispersion.

fiber_dispersion_envelope.m

Simulates the propagation of the electric field/field envelope in an optical fiber as a function of distance for various time-steps.

fiber_modes.m

Solves the transcendental equation to find the propagation constants and the corresponding fiber modes of a step-index fiber.

fiber_prop.m

Propagation in optical fiber (takes into account fiber dispersion and loss)

fiber_prop_CD_comp.m

Calculates and plots the CD compensation in time domain.

fiber_prop_linear_system.m

Simulates a linear fiber-optic link.

fiber_prop_wdm_dd.m

Simulates a linear fiber optic direct detection WDM system.

fiber_tran_abs.m

Fiber transcendental equation function

gammaf.m

Gamma function for small argument

gammaff.m

Gamma function for large argument

gaus.m

The Gaussian distribution. The user should supply the mean (fcent) and standard deviation (f0).

gauss.m

An electrical (low pass) second order Gaussian filter

laser_diode.m

Simulates laser rate equations using DC current to obtain the photon density and carrier density in a laser diode.

laser_diode_pulse.m

Simulates laser rate equations using pulsed current to obtain the photon density and carrier density in a laser diode.

marcum_Q.m

Marcum-Q-function

marcum_Q1.m

Marcum-Q1-function

mzm_iq.m

Calculates outputs of IQ modulators (MZM-I and MZM-Q Mach-Zehnder modulators) in OFDM.

nlse_solver.m

Simulates nonlinear Schrodinger equation using the split-step Fourier scheme (SSFS).

nonlinear_coherent_qpsk.m

Compensates for Chromatic Dispersion (CD) and Self Phase Modulation (SPM) in a Long Haul Coherent QPSK Fiber Optic Communication System through Digital Signal Processing (DSP).

ofdm_qam.m

Simulation of a linear fiber optic coherent OFDM system

ofdm_receiver.m

Performs the FFT operation block by block.

opt_rect_filt.m

Optical ideal band pass filter to demultiplex the central channel

Optical_tx_ook.m

NRZ-OOK transmitter that uses dual drive Mach-Zehnder modulator (MZM) is simulated.

Optical_tx_pam.m

Simulates optical signal field by modulating the laser light of PAM-M (M = 2, 4, 8, 16, ..) data through MZ nonlinear modulators.

Optical_tx_psk.m

NRZ-PSK transmitter that uses dual drive Mach-Zehnder modulator (MZM) is simulated.

Optical_tx_qpsk.m

NRZ-QPSK transmitter that uses two dual drive Mach-Zehnder modulators (MZM) is simulated.

Optical_tx_qpsk_nyquist.m

QPSK transmitter that uses raised-cosine pulses in frequency domain is simulated.

PAM_modulation.m

Modulates the laser light by PAM-M data. The number of symbols M can be specified by the user.

Pb_dd_ook_fsk_dpsk.m

Calculates the error probability as a function of γ^{DD} for direct detection receivers.

Pb_het_ook_psk_fsk.m

Calculates the error probability as a function of γ^{het} for heterodyne receivers.

Pb_vs_snr_homo.m

Calculates the error probability for homodyne receivers.

ph_noise_comp_viterbi.m

This IP simulation module function compensates for phase noise using Viterbi-Viterbi algorithm.

phase_noise .m

This IP simulation module function introduces laser phase noise as a Wiener process. Laser linewidth should be provided.

power_meter.m

Calculates the average optical power in dBm units.

qam_ofdm_transmitter.m

Performs the IFFT of the data sequence on a block by block basis.

raised_cosine.m

Raised cosine function in time domain

raised_cosine_freq.m

Modulates the output of the laser with raised-cosine pulse in frequency domain.

Raised_cosine_pulse.m

This IP simulation module function generates optical Raised cosine pulses in frequency domain.

Raman.m

Simulates the Raman gain by solving the coupled differential equations governing evolutions of signal and pump in Raman amplifier.

Raman_ode.m

Function describing the differential equations for simulating the Raman gain

rate_eqn.m

This IP simulation module function simulates the laser rate equation. The DC current is assumed.

rate_eqn_pulse.m

This IP simulation module function simulates the laser rate equation. The current pulses are assumed.

rect.m

Plots the electric field as a function of propagation distance for various time-steps.

standing.m

Simulates standing wave.

time_diagram.m

Plots the time diagram.

tx_nrz_ook.m

Modulates the output of the laser with OOK data using dual drive Mach-Zehnder modulator.

tx_nrz_psk.m

Modulates the output of the laser with PSK data using a dual drive Mach-Zehnder modulator. This IP simulation module function is also used to generate QPSK signal by modulating the laser light by in-phase/quadrature component (each component is PSK) of QPSK data.

up_sample.m

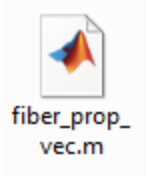
This IP simulation module function introduces the same phase over the entire symbol interval.

ofdm_qam_vector.m

Simulates a Fiber Optic QAM-M coherent OFDM system with dual polarization and PMD compensation. This module takes into account (1) dispersion, (2) nonlinearity, (3) PMD and (4) random coupling between polarizations in the fibers.

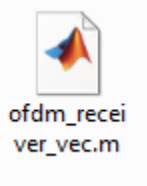
qam_ofdm_transmitter_vec.m

Models the dual polarization OFDM transmitter.

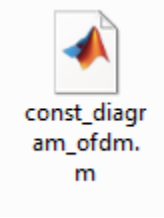


Propagates dual polarization signal in OPTICAL FIBER. The model takes into account the (1) dispersion, (2) nonlinearity, (3) PMD and (4) random coupling between polarizations in the fibers.

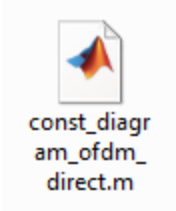
Multiplies the input signal by gain factor and adds noise (the amount of noise is controlled by nsp.



Models the dual polarization OFDM receiver.



This IP simulation module function plots the constellation diagram for optical OFDM. FFT is performed on the OFDM symbol in each frame before plotting the constellation diagram.



This IP simulation module function plots the constellation diagram for optical OFDM without taking FFT of each frame.

QAM_modulation.m

This IP simulation module generates the QAM data. Arbitrary QAM-M can be generated. For example, when XX=4 and YY=4, we get QAM-16. When XX=8 and YY=8, we get QAM-64. This IP simulation module can also generate QPSK data by setting XX=2 and YY=2.

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fiber_prop_vec_no_rot.m

This IP simulation module solves the Manakov equations using a split-step Fourier scheme.

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ber_calc_qam.m

Calculates the BER by comparing the received bit pattern with the transmitted bit pattern.

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norm_spectrum.m

This IP simulation module function plots the normalized spectrum of the signal.

power_meter_vec.m

Calculates the average power in dBm of the polarization multiplexed signal.

QAM_modulator_nyquist.m

This IP simulation module generates the QAM data. Arbitrary QAM-M can be generated. For example, when XX=4 and YY=4, we get QAM-16. When XX=8 and YY=8, we get QAM-64. This IP simulation module can also generate QPSK data by setting XX=2 and YY=2. Nyquist pulses are generated with arbitrary roll-off factors.

DBP.m

This IP simulation module function realizes DBP. DBP can be turned on/off using DBP_flag.

Q_dB-calc.m

This IP simulation module function calculates Q-factor (dB). This code assumes that the noise is Gaussian and projects the Q-factor based on BER.

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coherent_rx.m

This IP simulation module function realizes a balanced IQ receiver. An optical 90 degree hybrid with in-phase and quadrature outputs is implemented. The output of 90 degree hybrid passes through the array of photo-detecrors. Shot noise and thermal noise are introduced.

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fiber_optic_link.m

This IP simulation module function realizes the fiber optic link consisting of N fiber spans and N amplifiers. This IP simulation module function calls fiber_prop_vec_no_rot.m to realize fiber propagation and amp_vec.m to realize inline amplifier. Fiber propagation can be turned on/off using the fiber_prop_flag.

Transmitter_realization.m

This IP simulation module realizes the WDM transmitter. The computational time to realize the WDM transmitter increases with the number of channels. Sometimes, it is a good idea to generate the transmitter data only once and save it so that multiple fiber optic link runs can be done using the stored data. Use tx_realization_flag to turn on/off the transmitter realization part.

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init_parameter_file.m

All the system and signal parameters are specified here.

SUPPORT

For any Scientific and Technical Questions, contact: sales@codesscientific.com.

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