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# What's New in OptiSystem 3.0

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OptiSystem 3.0 reflects the strong relationship between Optiwave Corporation and our customers. The new software features all the needs of optical systems designers and component makers. There are almost 300 components available in the new library, combined with an improved the state-of-the-art graphical user interface, script language, bill of materials, and a new report page.

## Component library

### Optical transmitters

**New WDM transmitter component:** encapsulates different components, allowing you to select different modulation formats and schemes for multiple channels in a single component. It is a transmitter array that allows for different modulation types and schemes.

### Optical sources

**New CW laser array ES component:** an array of CW lasers. The emission frequencies are equally spaced (ES), allowing for easy setup of WDM systems.

**Laser Rate equations and Laser Measured:** Additional parameters that determine whether the input driver current will be normalized or not, allowing you to control the input current externally or use the internal settings.

### Optical Modulators

**Dual Drive, Single Drive, Dual Port Dual Drive Mach-Zehnder Modulator Measured and Electroabsorption Modulator Measured:** additional parameters that determine whether the input voltage will be normalized or not, allowing you to control the input voltage externally or use the internal settings.

### Optical Pulse Generators

**New TRC Measurement Data component:** loads Time Resolved Chirp data from measurement files. It can be used as an interface between OptiSystem and time resolve chirp (TRC) measurement instruments, such as the OSA Agilent 86146B with TRC option.



## Multiplexers

**New WDM Mux and Demux ES components:** demultiplexes a user-defined number of WDM signal channels. The center frequencies of the internal filters are equally spaced (ES), allowing for easy setup of WDM systems.

## Optical Fibers

**Improved Optical Fiber component:** total field approach together with new effects and new numerical engines:

- *Raman scattering models*—The most comprehensive vectorial Raman model available in literature. Two different levels of approximation in the calculation of the scalar and vector Raman scattering models.
- *Polarization mode dispersion*—The most advanced solver available in literature: The "course-step method" with variable scattering section lengths, and Gaussian distribution of the fiber trunk lengths.
- *Self-steepening effect*
- *Iterative procedure for calculation of nonlinear propagator with enhanced accuracy:* two forms of implementation of the nonlinear propagator—"exponential" and "Runge-Kutta 4th (2th) order". The second enables vectorial stimulated Raman scattering calculations. You can define frequency (the dispersion effects are specified in terms of the frequency derivatives of the wave vector) or wavelength (the dispersion effects are specified in terms of GVD and slope parameters) domain of presentation of the dispersion effects. This feature is very important in the analysis of soliton effects.
- Dispersion fitting according to the Sellmeier formula, which allows the correct usage of the user's supplied (even noisy) data for either the dispersion or the group delay.

**Linear Multimode Fiber:** new cutback factor to take into account the mode coupling, mixing, and concatenation effects.

## Optical Amplifiers

**New Erbium Ytterbium co doped waveguide amplifier:** allows for the design and simulation of waveguide amplifiers with arbitrary spatial refractive index and doping profiles:

- Allows for the calculation of the gain and noise characteristics of the high-concentration Er<sup>3+</sup>/Yb<sup>3+</sup> co-doped glass waveguide amplifiers
- Considers pump excited-state absorption
- Considers multimode operation for the pump and signals
- Homogeneous upconversion (HUC) from 4I13/2 e 4I11/2 levels
- Pair-induced quenching—PIQ
- Nine energy levels considering double-clad fiber design
- Spectral and longitudinal 3D graphs with forward and backward ASE, signals, and pump power
- Internal mode solver



**Erbium doped fiber and amplifier component:** OptiAmplifier algorithms were improved and redesigned—the new effects and calculation engines are included in OptiSystem:

- Qualitative analyses of inhomogeneous broadening, with possibility to generate homogeneous cross-sections
- Excited-state absorption impact on the EDFA performance
- Ion-ion interaction effects, including Homogeneous Upconversion (HUC), Pair-induced quenching (PIQ) and HUC and PIQ combined
- Rayleigh backscattering and double Rayleigh scattering
- Temperature dependence of the gain
- Includes 5 different possibilities to calculate the integral overlapping
- Includes the power dependence in the integral overlapping calculation
- Potential to load cross-sections and Giles parameters
- Potential to use different models to represent an EDFA: Saleh model, Jopson model, and Giles model
- Wavelength dependent losses and backscattering effects
- Spectral and longitudinal 3D graphs with forward and backward ASE, signals and pump power

**Erbium doped fiber dynamic components:** internal routines were modified to improve accuracy. In the Analytical model, the option to use the saturation parameter is included.

**Erbium Ytterbium doped fiber amplifier:** OptiAmplifier algorithms were improved and redesigned—the new effects and calculation engines are included in OptiSystem:

- Five-level model rate equations
- Homogeneous model for ion concentration dependence
- Wavelength dependent losses
- Analytical and numerical solver for wider range of pump wavelength
- Spectral and longitudinal 3D graphs with forward and backward ASE, signals, and pump power

**Static Raman fiber model:** average power approach is 100 times faster than classical methods. Includes Rayleigh scattering, temperature dependence, and chromatic dispersion effects, and spectral and longitudinal 3D graphs with forward and backward noise, signals, and pump power.

**Dynamic Raman fiber model:** allows the analysis of power transients in Raman amplifiers. Works with counter-propagating, co-propagating, and bidirectional pumping. Allows the transient analysis of cascades of Raman amplifiers.

## Electrical Amplifiers

**Improved Limiting Amplifier:** electrical limiting amplifier. The minimum and maximum output signal values are user-defined parameters.

**New AGC Amplifier component:** an electrical amplifier with user defined noise figure and automatic gain control (AGC).

## Polarization Devices

**New PMD Emulator component:** allows deterministic simulation of the first and second order PMD in fibers, including chromatic dispersion and attenuation effects.

## Electrical Regenerators

**Data Recovery component:** recovers the binary data from the electrical signal. It can be used in 3R generators for the data recovery stage. Additional parameters allow for automatic recovery of time delay (clock), decision instant, and threshold.

**New 3R Regenerator component:** regenerates an electrical signal. It returns the original electrical and binary signal, and it has automatic recovery of time delay (clock), decision instant, and threshold.

## Optical Signal Processing

**New Convert To Parameterized component:** converts sampled signals and noise bins into parameterized signals. You select the type of signals to be converted.

**New Convert To Noise Bins component:** converts sampled signals and parameterized signals into noise bins. You select the type of signals to be converted.

## Binary Signal Processing

**New Duobinary Pre-coder component:** can be used to avoid recursive decoding in the receiver when a duobinary modulation format is required.

## Tools library

**New Limiter component:** can be used as a ring controller module. This component controls the number of signals passing from the input to the output port.

**New Initializer component:** a select switch. The signal entering the first input port will be send to the output a user-defined number of times.

**New Electrical Ring component:** allows you to build systems using ring structures with electrical signals.

**New Command Line Application component:** can create a process with user-defined command line parameters, and can be used to call any windows application.

## Matlab library

**MATLAB Component:** Most of the routines of the MATLAB components were modified to allow the Matlab components to work in different versions of MATLAB, in addition to the new features imported from OptiAmplifier:

- A new parameter allows you to keep the MATLAB open after the simulation is finished, and to use the MATLAB in debug mode.
- A new field was included in the optical signal structure. The field Channels provides OptiSystem and the user an easier way to identify wavelength the channels are in.
- Error handling—if any error is found in the running of the MATLAB files, the OptiSystem will display the number of the line where the problem was found and a description of the problem.

## Visualizers

**BER Analyzer Visualizer:** additional parameters allow you to load threshold levels from measurements and control the calculation time window.

**WDM Analyzer Visualizer:** additional parameters allow you to control the calculation time window.

## EDA Cosimulation library

**New Load Spice CSDF File component:** can load Common Simulation Data Format (CSDF) files from EDA tools that can export PROBE results into CSDF file format. The `.csd` files are signal data files exported from circuit simulators such as PSpice.

**New Save Spice Stimulus File component:** can save ASCII files in a user-defined format. By default, the file has the PSpice Stimulus data format `.st1`. The `.st1` files are signal data files used in PSpice. They contain time-domain waveform data, based on a piece-wise linear algorithm, for defining the signals associated with certain sources and nodes.

## Signal Tracing

Improved signal tracing algorithm: much faster simulation when using large time windows, allowing for fast power budget calculations during EDFA and Raman amplifier design using dynamic models.

## Plug-in Optimizations

The new architecture allows for pluggable optimizations. This architecture will allow future calculation algorithms to be added effortlessly. The UI structure allows you to view the progress of the calculation and follow the progress of the active optimization. Optiwave provides two default optimizations with OptiSystem:

**NEW Multiple Parameters Multiple Result Optimizations:** allows for optimization of a set of parameters targeting a set of results, with or without constraints. Allows for

Minimization, Maximization, Goal Attaining, Gain Flattening, and LSQ optimizations. Based on industry standard MATLAB optimization engines. Some of the applications are:

- Flattening the gain of broadband Raman amplifier
- Optimizing the pump powers and frequencies of Raman amplifier
- Optimizing the EDFA gain for WDM Lightwave systems

**Single Parameter Single Result Optimization:** improved functionality and numerical engines allows for Goal Attaining, Minimization, and Maximization of results.

## Project Browser

The project browser has been redesigned and optimized for maximum ease of use for the user. Main features include:

**New customized tree control:** an accurate and full view of the system being designed in an easy-to-read tree form.

**Search Engine:** engine for the searching of any object in the design with the following possible categories: Layout, Component Name, Component Type, Parameter, Result, Port, Graph, Optimization, Path, By Phrase Word, or Word Combinations.

**Sorting of Layout information:** sort order—Layout Order or Name, Sort Type-Ascending or Descending.

**Second column for user selected data:** components—Cost and Type, Layout—Size, Current Iteration, Number of Components, and Total Cost, Subsystem—Number Of Components, Size, and Cost.

**Display filters:** filtering by Component, Graph, Parameter, Results, Paths, and Layouts.

## Report Page

The report page has replaced the result grid and the Graph tabs with a new fully customizable report designer and data sheet.

### Key features

**Customization:** layout can be any combination of 2D Graphs, 3D Graphs, Grid Controls and Text Fields. Custom associations can be created between dragged data and the control that should display it.

**Dynamic update after simulation:** all data entered into the UI elements above will be updated dynamically based on the incoming simulation data.

**Templates (pre-formatted layouts):** loading and saving of user-defined templates and default templates.

**Full Printing and Print Preview functionality:** Foreground Color Selection, Background Color Selection, Report Color, Font Types, Layout Sizes in standard Printer Options, and Report Page Names.

**Multiple page reports:** you can add any number of additional pages to the report.

**Editing and viewing standard features:** Zooming, Load, Save, and Print.

**HTML export:** Exporting to HTML for Web display of data and presentations.

**Project Browser integration:** Drag and drop function in Project Browser allows for simple creation of reports.

## Report components

**2D Graph control:** drag any graph from the Project Browser to the control to create single iteration and multiple iteration graphs. Standard analysis tools for the graph including markers, tracers, difference tracers, and zooming. User can drag paths to the control for a view of signal data as it passes through the system.

**3D Graph control:** drag any graph from the Project Browser to the control to create single iteration and multiple iteration graphs. Standard analysis tools for the graph including markers, tracers, difference tracers, and zooming.

**Grid control:** drag and drop any form of data. Includes Graphs - automatic generation of a table of data points, and Results - automatic generation of a table of values of results through sweeps.

**Rich Text control:** allows you to create custom labels or long texts.

## Script Page

The new script tab allows you to write script using the VB Script Language to manipulate and control OptiSystem, including calculations, layout creation, and post processing.

**COM technology:** automation of system recognized COM Components including Microsoft Excel, Microsoft Word and any other application that supports COM or ActiveX Technology. allowing for possible data export and analysis by other applications.

**Standardization:** full Microsoft VB Script compatibility.

**Automatic script generation:** creates a script from the current layout, which can then be manipulated to automate a sequence of calculations.

**Script editor:** Undo/Load/Save/Copy/Paste Scripts.

**Full automation of OptiSystem:** automation of layout design, automation of calculations, and automation of result gathering.

**Optimizations:** ability to design custom optimizations by writing scripts that can optimize parameters and results.



## Plug-in Calculation Schedulers

The new architecture allows for pluggable calculation schedulers. This architecture will allow future calculation algorithms to be added effortlessly. The UI structure allows the user to view the progress of the calculation and follow the progress of the active calculation scheduler.

## Bill Of Materials

Provides a cost analysis of the system being designed in a table, arranged by system, layout, or component. This data can be exported to another application or spreadsheet.

## Application and Validation Projects

Between new and improved projects, more than 45 additional applications and validation projects were added to the OptiSystem documentation and sample files:

### New Projects

**Optical transmitters:** LED Modulation response, Laser L-I curve, Semiconductor Laser Modulation response, Semiconductor Laser Large Signal Modulation.

**Modulators:** chirp in Mach-Zehnder Lithium Niobate Modulators.

**New Optical Fiber Model:** Polarization mode dispersion, SPM induced spectral broadening, Combined effects of GVD and SPM: Modulation instability, Cross-phase modulation effect, Four-wave mixing effect, Raman amplification (scalar and vectorial).

**New PMD emulator component:** Effects of PMD on pulse propagation.

**New EDFA component:** Gain and noise characteristics of EDFA, Excited state absorption impact on the EDFA performance, Ion-ion interaction effects, Rayleigh backscattering in EDFA, Inhomogeneous broadening, Temperature dependence of the gain, Transients in EDFA.

**New Raman average power model, steady state and dynamic models:** Raman threshold calculation, 100 nm bandwidth flatten - gain Raman amplifier - Average power model, Raman amplifier - Steady state model, Raman amplifier - Dynamic model, Gain in Raman Fiber Amplifiers, Flattening the gain of broad band Raman amplifier, Optimizing the pump powers and frequencies of Raman amplifier.

**New waveguide amplifier model:** Improved gain characteristics in high-concentration Er<sup>3+</sup>/Yb<sup>3+</sup> co-doped glass waveguide amplifiers.

**Dispersion compensation and Cosimulation with OptiGrating:** Compensation of dispersion - Ideal dispersion compensation, Compensation of dispersion - Fiber Bragg Grating, Compensation of dispersion with OptiGrating.

**Soliton effects:** Birefringence and solitons, Soliton interactions, Decay of higher order solitons in the presence of the third-order of dispersion, Decay of higher order





solitons in the presence of intrapulse Raman scattering, Decay of higher order solitons in the presence of self-steepening.

**Multi-parameter optimization Engines:** Extracting the thermal noise parameter for specific receiver sensitivity, Optimizing the EDFA gain for WDM lightwave systems.

**Matlab component:** Amplitude modulator, Designing a Visualizer using the Matlab Component.

## Improved Projects

**System modeling:** Dispersion compensation schemes-a system perspective, Comparison of RZ and NRZ modulation formats for 16/32 channels, WDM 40 Gb/s transmission systems, Engineering the fiber nonlinearities and dispersion.

**Optically "transparent" networks:** Power level management in optical metro networks, Migrating to 10 GBs in Metro Networks, Negative Dispersion Fiber for Metro Networks, Interchannel Crosstalk in Metro Networks, WDM Ring-Wavelength Independent Subscriber Equipment.

