OptiSystem

Optical Communication System and Amplifier Design Suite

12

New Features

Created to address the needs of research scientists, optical telecom engineers, professors and students, OptiSystem satisfies the demand of users who are searching for a powerful yet easy to use optical communication system design tool.

Optiwave

Key Features for OptiSystem 12

OptiSystem 12 includes new transmitters, receivers and DSP components for end-to-end 16-QAM, DP-16-QAM and DP-QPSK coherent optical system design and performance analysis. New visualizer components have also been introduced, including dual port visualizers which will allow users to perform simultaneous waveform analysis of any two independent binary, optical or electrical signals. Additional features include:

- A new "View signal" viewer, which allows users to view and save the real/complex signal data array at the output of any component;
- Updates to the Measured-Index Multimode Fiber and Parabolic-Index Multimode Fiber components, including support for alpha profile gradient index designs and new analysis graphs;
- Updates to the QAM Sequence Generator and QAM Sequence Decoder, specifically the ability to import and update user-defined I-Q amplitude maps for the customized design of QAM modulation schemes;
- Updates to the Photodetector PIN and Photodetector APD, specifically the ability to define Responsivity vs. wavelength based on material types (Si, InGaAs, Ge) or customized/measured values; and
- Improvements to the user interface, including the ability to access the sample projects folder directly from the OptiSystem file menu and support for large format workspaces in the Reports tab

New library components

<u>Optical Transmitters</u>: 16-QAM, DP-16-QAM

Two new components (16-QAM Transmitter, Optical DP-16-QAM Transmitter) have been added to the Optical Transmitters library.

The 16-QAM Transmitter simulates a single channel optical transmitter with a 16-QAM modulation format. The Optical DP-16-QAM Transmitter component simulates a single channel optical transmitter with a dual polarization 16-QAM modulation format.

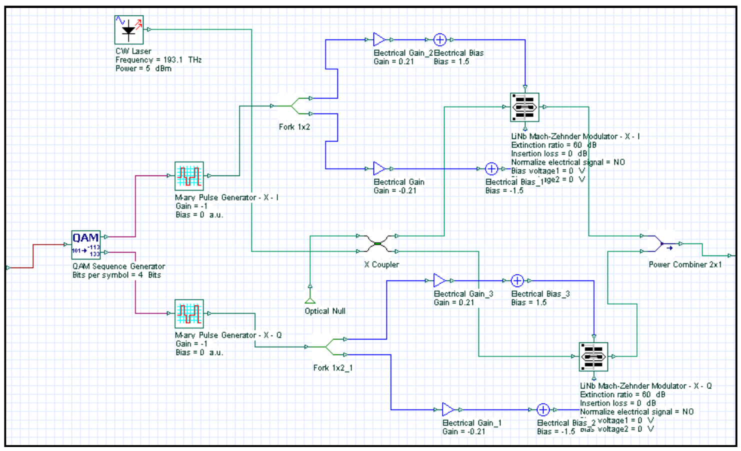

***Fig 1**: 16-QAM Transmitter: The 16-QAM signal is generated by using MZ modulators to translate the QAM symbols onto an optical carrier. Each modulator branch modulates the in-phase (I) and quadrature components (Q) of a carrier. In the example above, an external bit stream is used to initiate the sampled data set.*

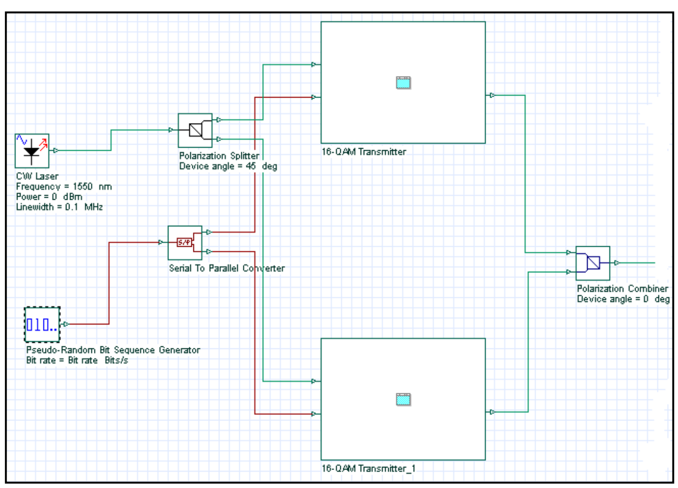

***Fig 2**: Optical DP-16-QAM Transmitter: A polarization beam splitter is used to create two orthogonal polarization components which are modulated separately by 16-QAM transmitters (similar to Fig 1) and then combined using a polarization beam combiner. In the example above, an internal bit stream is used to initiate the sampled data set*

<u>Optical Receivers</u>: Optical Coherent 16-QAM, Optical Coherent DP-16-QAM

Two new components (Optical Coherent 16-QAM Receiver, Optical Coherent DP-16-QAM Receiver) have been added to the Optical Receivers library.

The Coherent 16-QAM Receiver simulates an optical coherent receiver for QAM signals based on a homodyne design. The Coherent DP-16-QAM Receiver simulates an optical coherent receiver for the dual-polarization of 16-QAM signals.

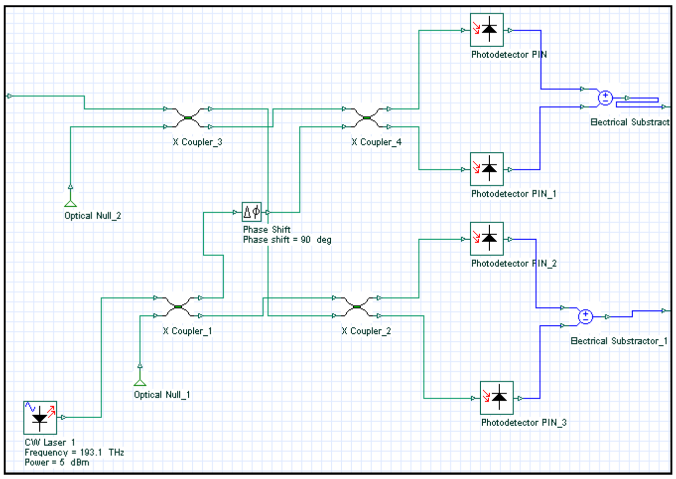

Fig 3*: Optical Coherent 16-QAM Receiver: The optical coherent QAM receiver involves a homodyne receiver design. The component is formed by a set of 3 dB fiber couplers, a local oscillator laser, and balanced detection (to eliminate the local oscillator intensity noise). The resulting electrical outputs are then sent to an external QAM Sequence Decoder and M-ary Threshold Detector to retrieve the original bit sequence.*

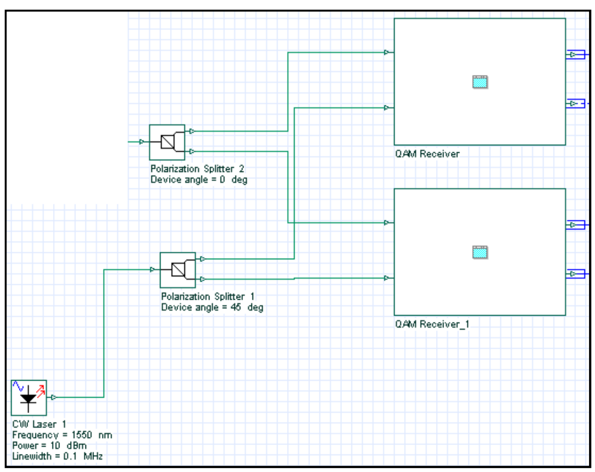

Fig 4*: Optical Coherent DP-16-QAM Receiver: The optical coherent DP-16-QAM receiver includes a local oscillator (LO) laser polarized at 45 degrees relative to the polarization beam splitter. The received signal is separately demodulated by each LO component using two single polarization 16-QAM receivers.*

<u>Digital Signal Processing</u>: DSP for DP-QPSK; DSP for DP-16-QAM

Two new components (DSP for DP-QPSK, DSP for DP-16-QAM) have been added to the new Receivers/Digital Signal Processing library, in addition to the Viterbi-Viterbi feed forward phase recovery components (single port and dual port). These DSP components can be used to build DP-16-QAM and DP-QPSK coherent systems.

The DSP for DP-QPSK includes a 2-bit down-sampler, a dispersion compensator, a polarization de-multiplexer using a constant modulus algorithm, and a dual-polarization carrier phase estimator using a Viterbi-Viterbi feed forward algorithm.

The DSP for DP-16-QAM includes a 2-bit down-sampler, a dispersion compensator, a polarization de-multiplexer using radius-directed equalization, and a carrier phase estimator using decision directed carrier phase recovery.

For a complete example of a DP-16-QAM or DP-QPSK coherent system, please refer to the “100 Gbps DP-QPSK DSP 800 km.osd” and “400Gbps DP-16-QAM DSP 100 km.osd” example projects in the *Samples/Advanced modulation systems* folder.

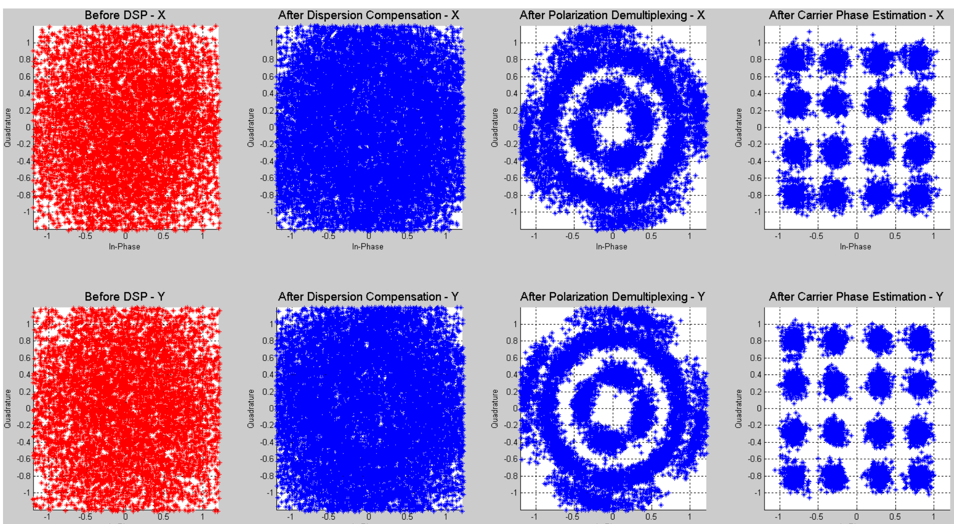

Fig 5*: DSP for DP-16-QAM*

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Visualizers: New dual port components

Six new components (Dual Port Binary Sequence Visualizer, Dual Port M-ary Sequence Visualizer, Dual Port OTD Visualizer, Dual Port OSA, Dual Port Oscilloscope, and Dual Port RF Spectrum Analyzer) have been added to the Visualizers library. They allow for the simultaneous capture of two independent data monitor sources to enable accurate comparative analysis of signal waveforms (binary, m-ary, electrical, and optical) and spectra (electrical and optical).

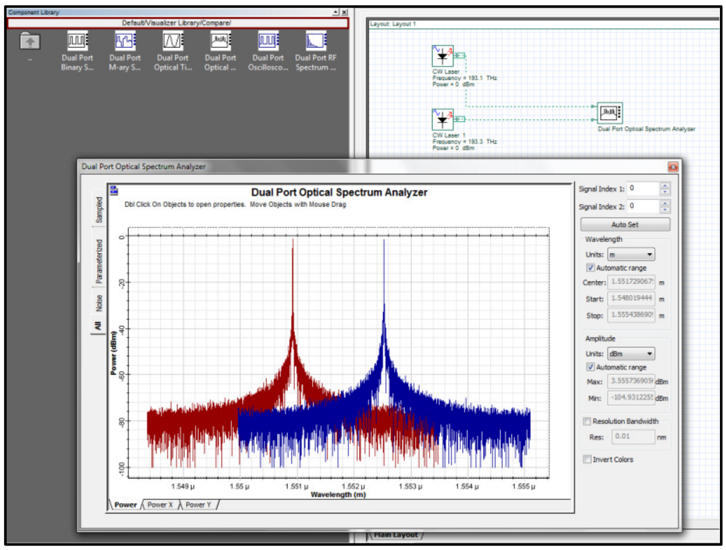

***Fig 6**: Dual Port OSA Visualizer*

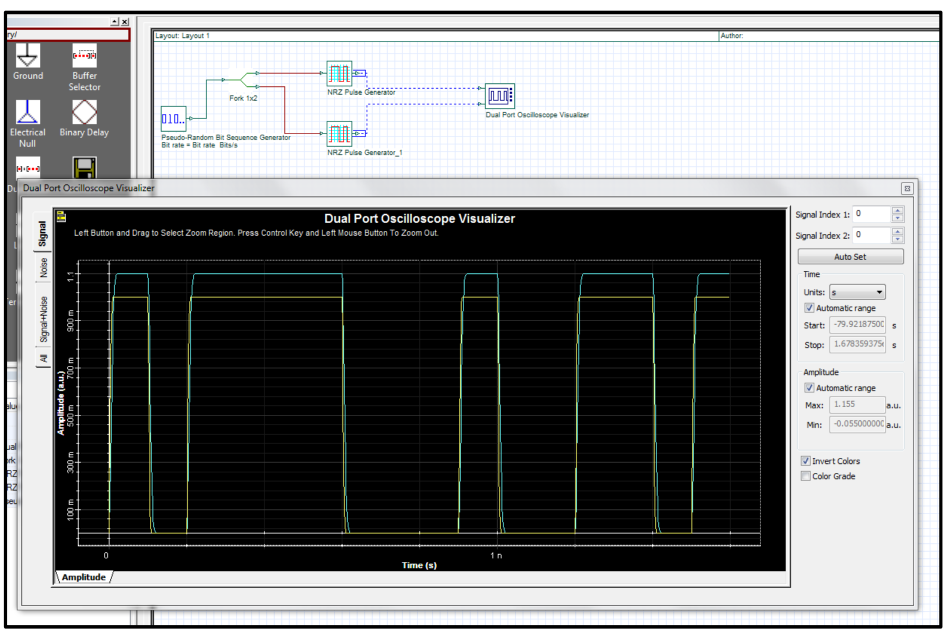

***Fig 7**: Dual Port Oscilloscope Visualizer*

Visualizers: New "View signal" component

A View Signal Visualizer component has been introduced to allow users to directly access the native data set (real & complex data arrays) associated with all OptiSystem signal types. Output data can be inspected by scrolling through the entire signal data associated with the output of a component. It is also possible to externally save these data sets to a text or Excel file format.

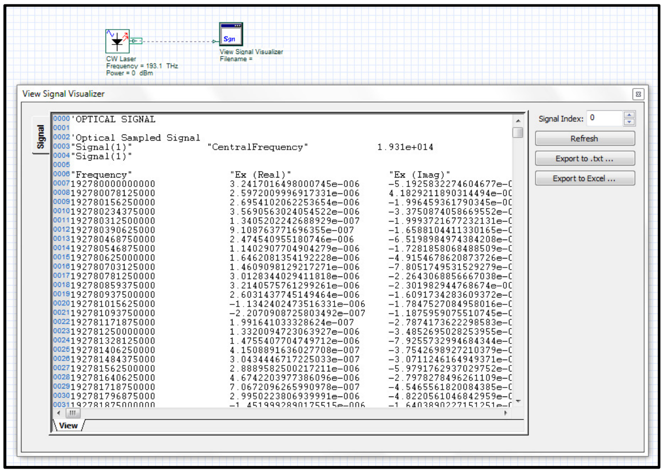

Fig 8: *View Signal Visualizer*

Library Component Enhancements

Measured-Index Multimode Fiber component: Support for alpha parameter index profiles

The Measured-Index Multimode fiber has been updated to include support for alpha gradient profiles and the definition of index contrast and peak/cladding refractive indices

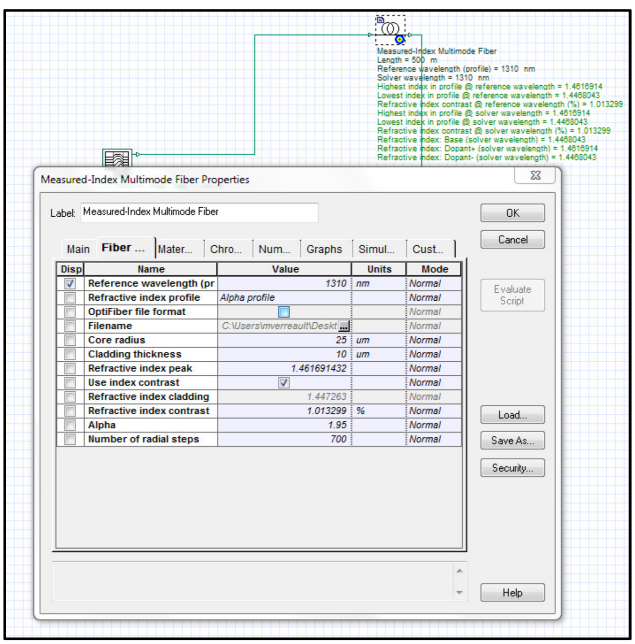

Fig 9: *Measured-Index Multimode Fiber – New alpha profile, index contrast, peak and cladding refractive index parameters*

Measured-Index & Parabolic-Index Multimode Fiber components: Fiber transfer function graph

The Measured-Index and Parabolic-Index Multimode fibers have been updated to include new analysis graphs to view the fiber transfer function and relative group delay. Also the Measured-Index Multimode fiber now shows the refractive index profile at the reference and test wavelengths when “Material properties” is enabled.

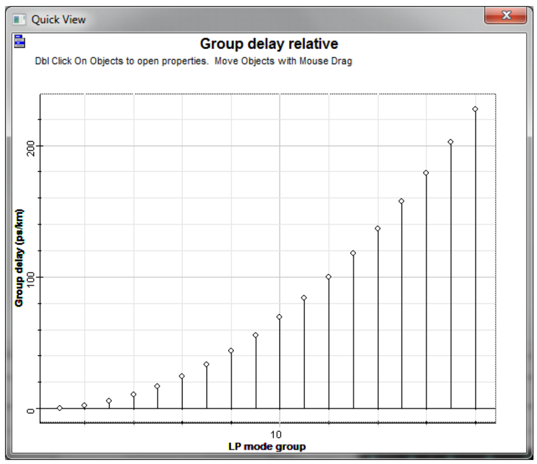

Fig 10: *Group delay relative as a function of group mode number*

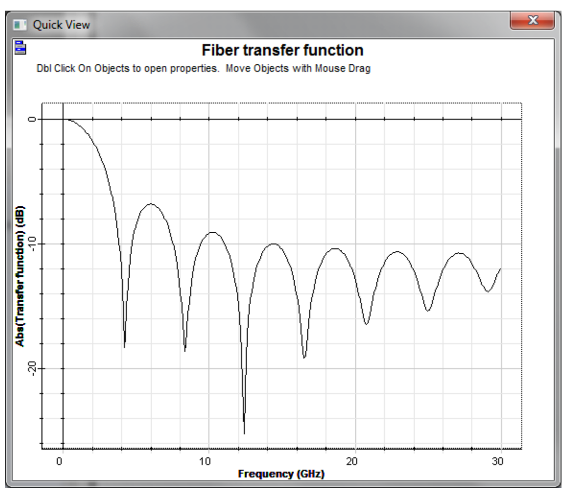

Fig 11: *Fiber transfer function (magnitude) as a function of frequency (GHz)*

<u>QAM Sequence Generator and QAM Sequence Decoder components</u>: User-defined I-Q mapping

It is now possible to design customized QAM modulation schemes for n-QAM systems. When "User-defined I-Q map" is selected within the QAM Sequence Generator, the component will allocate symbol maps based on amplitudes contained in the I-Q amplitudes MxN parameters array (these QAM modulation schemes can be even and odd bits per symbol settings. I-Q data, and associated source symbols, can be loaded initially from a data file.

The same capabilities are included within the QAM Sequence Decoder to allow for the proper decoding of the original user-defined QAM mapping. The QAM Pulse Generator and Electrical QAM Modulator components have also been updated with this capability.

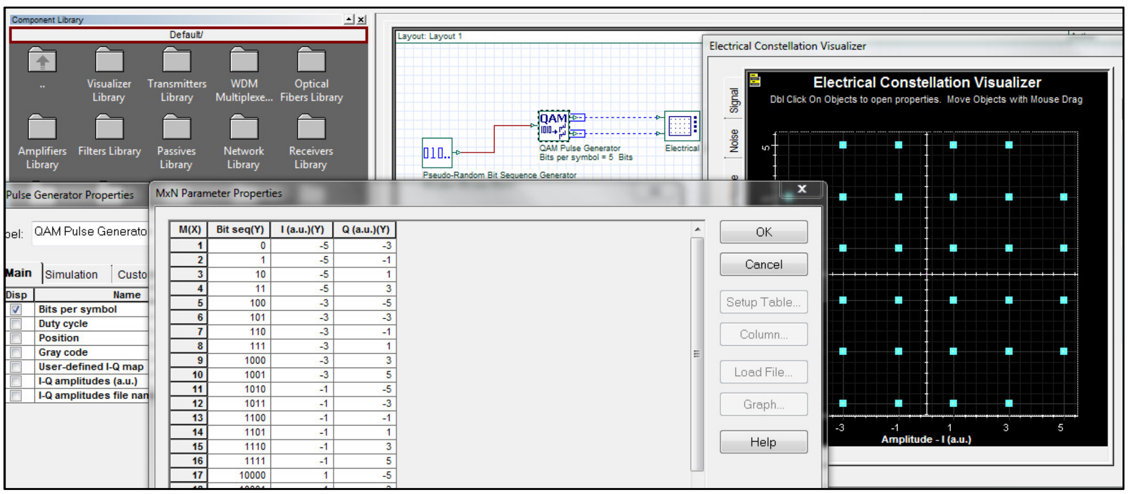

***Fig 12**: New user-defined I-Q maps for QAM generation and decoding*

<u>Photodetector PIN and Photodetector APD components</u>: Responsivity vs. wavelength curves

It is now possible to define Responsivity as function of wavelength for the Photodetector PIN and Photodetector APD components. The user can either select pre-defined curves for Si, Ge and InGaAs (see *Fig. 13*) or customize Responsivity vs. wavelength data via data file import. This capability has been integrated into all the Optical Receivers library components.

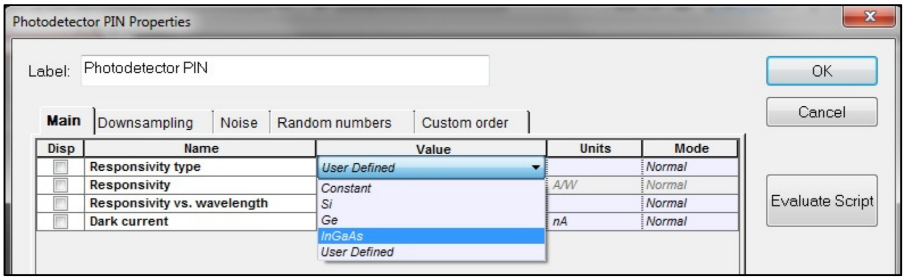

***Fig 13**: New Responsivity vs. wavelength feature*

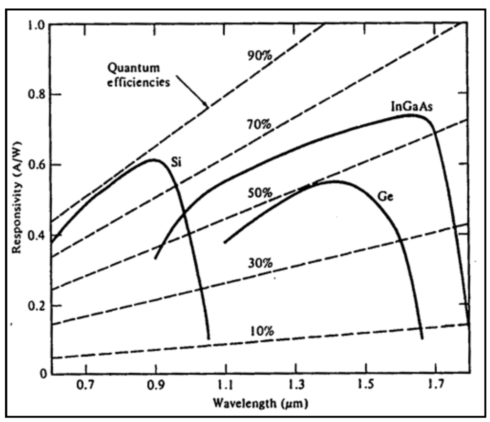

***Fig 14**: Responsivity curves for Si, Ge, and InGaAs. Source: Agrawal, G.P., Fiber-Optic Communication Systems, John Wiley & Sons, New York, (1997)*

Other enhancements

Direct access to samples directory

An “Open sample” file menu button has been added to the top menu bar to enable direct access to the OptiSystem samples folder

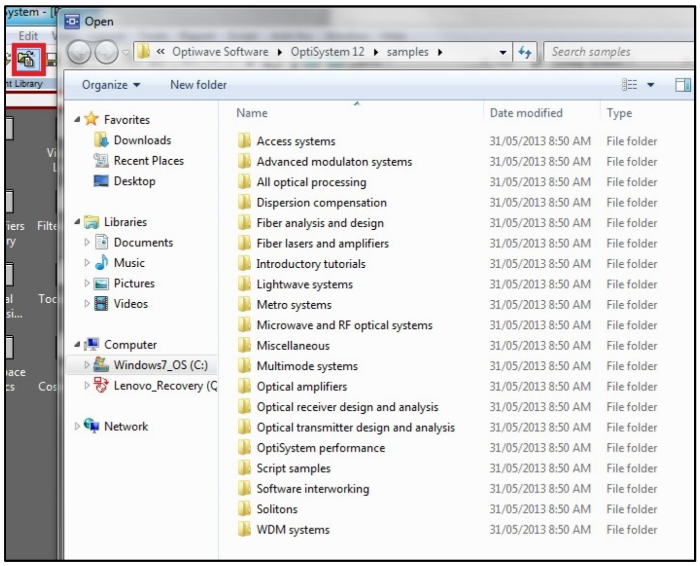

Fig 15*: Direct access to samples directory via OptiSystem menu*

Large format workspace

To allow for a larger workspace to view and organize analysis results, a new 70 x 80 inch layout size has been added to the Report properties “Page” properties panel

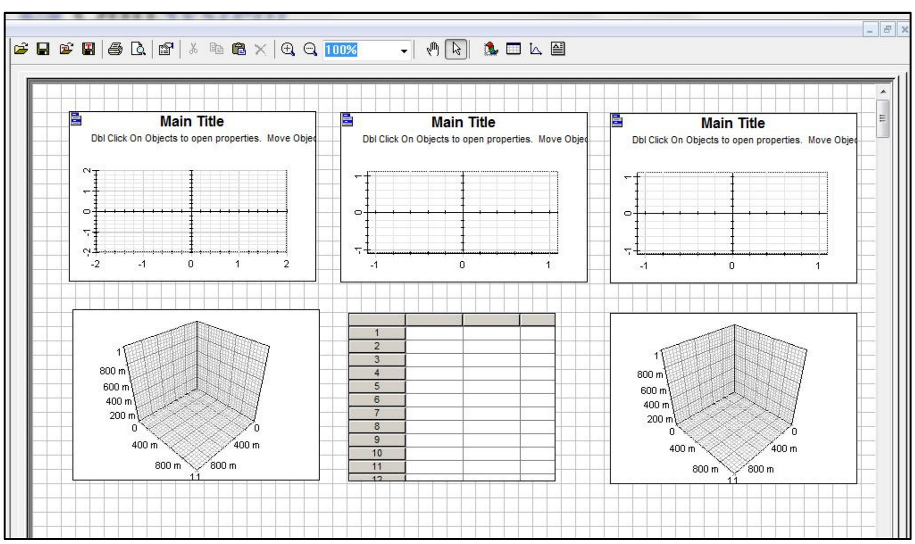

Fig 16*: New 70 x 80 inch large format layout for the Reports page*

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