White Paper

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Choosing the Right Photonic System Design Software

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Introduction

Enhanced productivity and reduced time to market contribute to healthy corporate balance sheets. In the photonics industry, the right design software can help achieve both. Due diligence during the software selection process is an exercise technology companies can't afford to take lightly. Sometimes, the number of available solutions and marketing messages from different software vendors can obscure technical realities of their offerings, making the selection process confusing, if not overly daunting. This document highlights key expectations we recommend you keep in mind when choosing photonic system design software, and how the offerings from the Synopsys Optical Solutions Group can help you maximize engineering efficiency and produce the best competitive product.

Basic Expectations of Photonic System Design Software

There are three basic expectations of any photonic system design software:

- Accuracy
  - Are there any modeling assumptions that can potentially compromise accuracy of the results? Do the simulation setup and model parameters reflect real-life settings?
- Speed and efficiency
  - What are the tradeoffs between speed and efficiency versus accuracy? How demanding is the software on computational resources (hardware and simulation time)?
- Flexibility
  - How does the software scale with the complexity of the problem? Can I use the lab measurements or must I know the physical parameters? How easy is it to import and export results and work with other software tools?

RSoft Photonic System Design Suite Overview

The three products that comprise the RSoft™ Photonic System Design Suite are OptSim™, OptSim Circuit and ModeSYS™. OptSim models single-mode fiber-based systems at the signal propagation level. OptSim Circuit is a modeling tool for next-generation photonic circuits that operate with coupling and feedback of different optical and electrical signal paths. ModeSYS is a design and simulation tool for multimode fiber based systems where both the temporal and spatial attributes of the optical signal propagation are taken into account. While all three products share the same graphical user interface (Figure 1) and work under a common platform, each can also function as a standalone product, providing a cost-effective, needs-based modular solution.

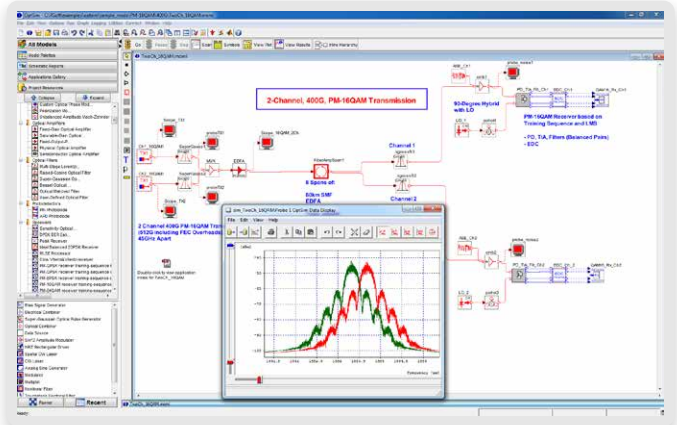

Figure 1: The graphical user interface (GUI) of the RSoft Photonic System Design Suite and an OptSim Layout

Simulation Engines and Technology

A one-size-fits-all approach to choosing photonic system design software does not work efficiently for the ever-evolving nature of the applications and modeling problems. At the same time, too many software choices can be confusing. The RSoft Photonic System Design Suite strikes the optimal balance between the two. While ModeSYS and OptSim Circuit users benefit from the frequency-domain split-step (FDSS) approach, OptSim users can choose to work either with the time-domain split-step (TDSS) simulation engine or with the FDSS simulation engine. The circular-convolution-based FDSS method has been widely used for decades in a variety of modeling problems. OptSim's linear-convolution-based TDSS is especially helpful for modeling problems where periodicity assumptions don't reflect reality, in mixed bitrate situations, and in cases when transmission of a large number of bits is required without creating exorbitant computational requirements.

OptSim Circuit extends OptSim's modeling capabilities to photonic circuits, where forward and backward propagating optical and electrical waveforms are the principle operation. In addition to the library of photonic circuit elements and models, foundry process design kits (PDKs) help bring your design a step closer to production. OptSim Circuit can also help model system problems such as multi-path interference (MPI) and photonic-sensor-based systems such as interferometric fiber-optic gyroscopes (I-FOGs). Since OptSim Circuit shares the same platform as OptSim, the performance of the photonic circuits can be tested and optimized from a fiber-optic communication system perspective.

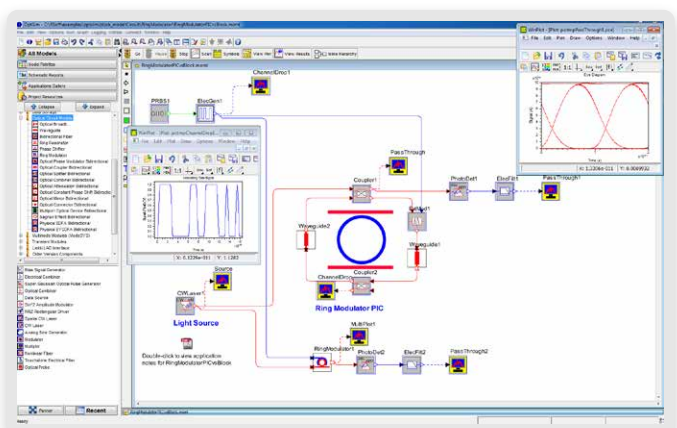

Figure 2: OptSim Circuit layout of a ring modulator photonic circuit

Multimode system modeling and simulation is inherently difficult because detailed spatial attributes of the optical signal are difficult to analyze at the system level. ModeSYS, the first commercial modeling tool for multimode systems, offers an excellent balance between device-level simulation accuracy and system-level modeling efficiency.

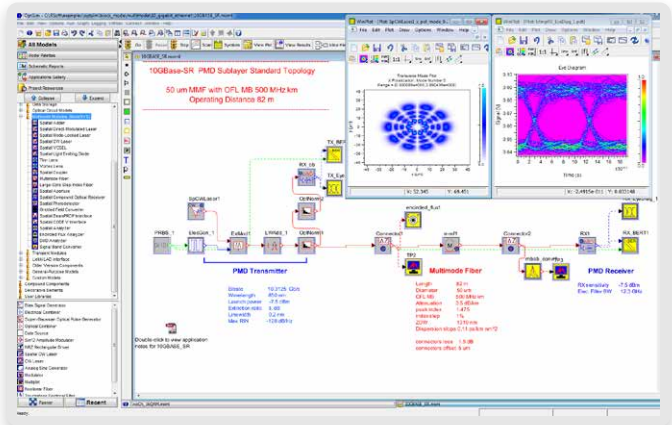

Figure 3: ModeSYS layout of an OM4 multimode-fiber-based 10Gbps Ethernet link

For ModeSYS users, important modeling challenges include inter-component coupling, large core multimode fibers, mode coupling due to microbends, effects of refractive index variations and manufacturing imperfections on the system performance, measurement of effective modal bandwidth (EMB), encircled flux (EF) and differential modal delay (DMD).

Library of Models and Interfaces for a Broad Range of Applications

An important consideration when selecting the right modeling solution is whether the software you choose now will still be helpful if your team, organization and applications grow and diversify in the future. As previously discussed, OptSim, OptSim Circuit and ModeSYS provide support for a broad range of photonic system simulations. In addition, interfaces and co-simulations with external software such as RSoft device modeling tools, CODE V®, MATLAB®, and SPICE make it convenient to collaborate with other teams within your organization and model interdisciplinary applications. Figures 4 and 5 show two such cases. In Figure 4, cosimulation with CODE V helps multimode system designers understand performance bounds in response to the manufacturing tolerances in the lens assembly.

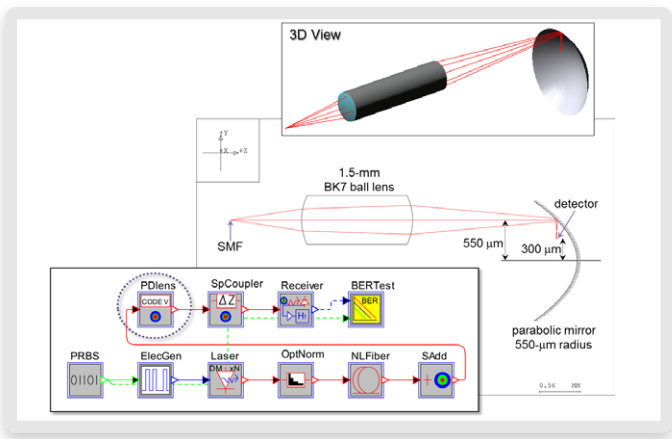

Figure 4: ModeSYS co-simulation with CODE V

Figure 5 illustrates a cross-team collaboration scenario where a device design team designs a laser using the RSoft laser modeling tool, LaserMOD™. The system design team then tests this laser for its performance in a fiber optic system using OptSim. OptSim's Laser Toolkit helps with the parameter extraction and generates a SPICE circuit file for the laser. The electronic design automation (EDA) team uses this circuit file in SPICE to design the electrical driver for the laser. The number of supplied models, library of commercial components and flexibility to add to and modify parameters of these models should be another metric to consider when choosing the right systems modeling software.

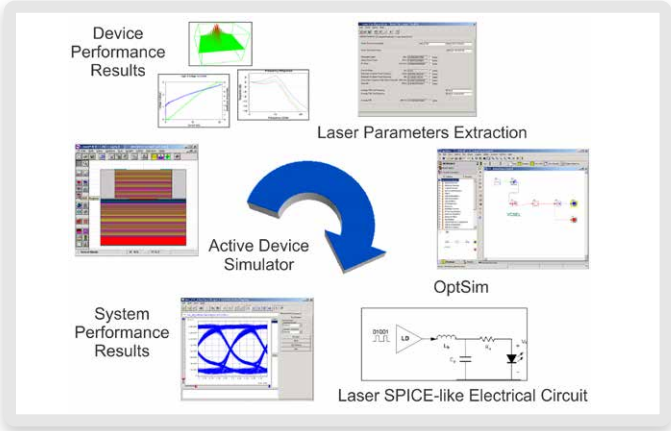

Figure 5: Multiproduct design flow

The RSoft Photonic System Design Suite comes with a rich library of models. Users have full access to all the parameters. In many cases, measurement-based data files are also supported. Commonly used components like lasers and fibers come with libraries of vendor models where parameters reflect those in the datasheets. It's easy to edit, expand and customize these libraries as needed.

Ease of Use and Product Support

Ease of use and product support are important considerations during the software selection process, since shorter learning curves equate to faster times to market. The RSoft Photonic Design Suite comes with more than a hundred pre-supplied design examples with relevant explanations of the layout, parameter settings, principle of operation, discussion of results and additional references. This makes it easy to begin with a pre-supplied design that is closest to the problem of interest and to build upon it, thereby significantly speeding up the design process. In addition, every customer has access to the online Customer Support Portal, where users can freely access training videos, frequently asked questions and tips, design case studies and presentations. Training classes are periodically scheduled and onsite training is also offered.

With more than 40 years of combined photonics experience and numerous publications, RSoft's technical support is second to none in the industry. The technical support team has a close working relationship with the product's R&D team, who also work directly with customers on advanced and development-related issues. Customer success is our support team's overriding objective and it determines our priorities and objectives. Our customers consider us to be partners and collaborators, rather than just a software vendor.

Summary

Selection of the right photonic system design software is a decision that impacts innovation, productivity, efficiency, and ultimately the bottom line of your business. Instead of being swayed by ostensible claims, marketing buzzwords and cursory specifications, paying close attention to the underlying simulation technology, modeling assumptions, accuracy of results, flexibility and scalability of the software can help ensure success.

In this white paper, we discussed a number of important considerations to keep in mind while looking for the right photonic system design software, and how the RSoft system modeling tools meet these requirements. The RSoft Photonic System Design Suite delivers a full spectrum of solutions with the accuracy, speed, efficiency, and flexibility needed to design current and next-generation fiber-based systems and photonic circuits. In addition, we offer unlimited technical support from a team of experts who understand photonic design and engineering, as well as a dedicated customer website with application tips, case studies, video tutorials, and many other resources to help you be successful with our products.

To Learn More

At https://www.synopsys.com/optical-solutions/rsoft.html, you can find detailed RSoft product information, application notes, e-newsletters, and the RSoft product catalog. You can also contact us at optics@synopsys.com to request more information and a 30-day free trial of our software solutions.

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