RSOFT
Design Group

REVIEW
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Cash Conservation through Design and Planning Automation

T his is certainly not the time to waste precious cash. Yet many telecom manufacturers and systems vendors are unaware how much of their cash flow is hitting the floor due to inefficient design and development processes. They are still struggling with the same lessons already learned in other industries... commercial software saves time and money.

Just take a look at the semiconductor and network management arenas. As these nascent industries matured over time, electronic design automation (EDA) and operation support system (OSS) tools, respectively, became increasingly critical for continued market growth and profitability. Software tools were, and are, responsible for the automation, cost reduction, and creation of new technologies.

For example, wasted design time and labor often come from the daily manual processes that are often overlooked or just accepted as common practice. Extra work and rework can be attributed to

something as overt as the policy of building parallel prototypes, to something as simple as a misplaced decimal point, both of which can be very costly if carried throughout the design phase, and ultimately

RSoft Design Group's software solutions cover four areas—Component Design, System Simulation, Network Modeling, Strategic Analysis.

production or service implementation.

Automated (or commercial) design tools can plug many of these holes. Commercial software tools — such as those offered by RSoft Design Group — have a more generalized, sophisticated CAD interface than in-house tools. These tools more tightly tie

WHAT'S INSIDE

To Mesh or Not to Mesh
That is the Question…

You have a burgeoning metro growth problem. Currently, you have a reliable ring infrastructure with well-known SONET protection characteristics and a DWDM ring layer. You also plan to grow this metro ring solution with added capacity. You may have strategically placed MSPP to enhance the varied demand types coming into your metro network from the edges. As a result, you acquired more demand – which is great — but because some of your demands don't require such high reliability, you now think mesh will help you get more out of the unused-but-dedicated capacity that SONET chewed up.

You've heard about the wonders of mesh and the potential for profits – but is it true? There is continued debate over which architecture —ring or mesh — is best suited for implementation in metropolitan networks. On the one hand, metropolitan rings are widely deployed, well studied, and provide sub-second protection. On the other hand, mesh topologies offer more efficient use of capacity and efficient re-routing around failed links.

Fortunately, there's RSoft Design's *MetroWAND™*, the only commercial tool soon to be available, that plans **both** mesh and ring cost-optimized networks. *MetroWAND* makes it easy for you to decide whether to mesh or not to mesh in your network architecture. For example, given a network with the following — existing and planned nodes; current capacity; traffic requiring different levels of QoS; existing equipment/ infrastructure; new equipment architectures; and desired level of failure restoration/tolerance per demand — *MetroWAND* provides cost-optimized results for each architecture.

MetroWAND's flexibility enables you to easily vary these parameters and scan solutions rapidly. Using *MetroWAND*, you can safely decide your network's future direction based on facts.

RSoft Design Introduces Only Commercially Available PBG Tool

The history of research into photonic crystals is now well into its second decade. Despite a vast research amount of research literature and the efforts of many labs around the world, the number of commercialized products using photonic crystal technology remains small. A significant reason for this lack of products, is a lack of powerful and accurate, but simple-to-use design tools. RSoft Design Group is now stepping up to the plate to fill this gap with *BandSOLVE™*, the only commercially available design tool for calculating photonic band structures.

A fully integrated addition to RSoft Design's award-winning *BeamPROP™* and *FullWAVE™* tools, *BandSOLVE* automates and simplifies the calculation of photonic band structures for all photonic
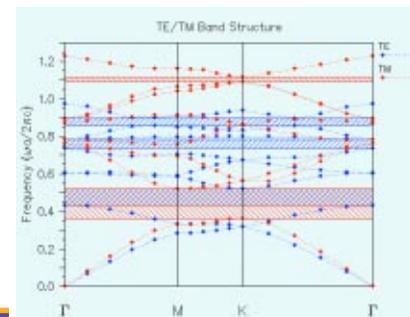
Thoughts on Optical Communication System Optimization

RR: What are some of the challenges in optimizing optical communication systems?

Dr. Whitlock: These systems are deceptively complex due to the interplay between the physical phenomena and nonlinearities in their various components. In long-haul DWDM systems these include frequency chirp, chromatic and polarization mode dispersion, fiber nonlinearities, amplified spontaneous emission noise, receiver noise, and jitter, among others. A system design can compensate for these effects, and even use some of these effects to help mitigate other effects. Dispersion compensation schemes are an example of that.

RR: What types of optimizations are employed in such systems?

Dr. Whitlock: Optimizations can include the choice of components according to their physical properties and effect on optical signal propagation, placement of components within a link, the shape and frequency chirp properties of the transmitted signal waveform, and encoding schemes, for example. Because of the complexity of the problem, the only way to explore the full parameter space to optimize your design is with a sophisticated simulation tool like *LinkSIM*™.

RR: What is *LinkSIM*?

Dr. Whitlock: *LinkSIM* is a computer-aided-design (CAD) tool for physical-layer modeling and simulation of optical communication systems. It incorporates a user-friendly, object-oriented simulation engine with physical and behavioral models of a wide variety of components used in state-of-the-art optical networks.

RR: What are some of today's hot applications that benefit from using *LinkSIM* in their design?

MEET BRENT:

Dr. Brent K. Whitlock, Director of Link Level Research and Product Development at RSoft Design Group, has over 10 years experience in the fields of electronics and photonics design automation, including modeling and simulation of optical communication systems. He has co-authored over 10 papers and articles in peer-reviewed conferences and publications.

Dr. Whitlock: Long-haul DWDM systems, metro-area networks, and local area networks are just a sampling of the applications that *LinkSIM* designs. It's also a great simulation tool for soliton-based systems and parallel optical interconnects. In addition, we've found that component manufacturers use *LinkSIM* as part of their sales and marketing efforts to gauge the effectiveness of products in the context of optical communications systems.

RR: These days, curbing costs is of paramount importance. How can *LinkSIM* help reduce design time and the associated expenses?

Dr. Whitlock: *LinkSIM* reduces costs on many fronts. Since the software is intuitively easy-to-use, it decreases nonrecurring engineering (NRE) costs by increasing productivity and reducing design time. Time-to-market is also shortened. With *LinkSIM*, designers quickly run different target system scenarios that help them deploy the best optical communication system with the

➔ *(PBG Tool continued)*

crystal devices. The tool's easy-to-use graphical interface allows designers to draw a structure just once and simulate either band structures, or propagation problems using beam propagation and finite-difference time domain algorithms.

RSoft Design CTO Rob Scarmozzino explains,

"With our market-leading products BeamPROP and FullWAVE, we already have powerful tools for studying the evolution of light through photonic crystal devices. The addition of our band structure tool closes the loop and allows the connections between finite devices and infinite crystal properties to be clearly highlighted."

BandSOLVE is pre-programmed to deal with a large range of standard crystal lattices in one, two or three dimensions, including FCC, BCC and hexagonal lattices. Using the *BeamPROP* CAD Framework for Photonics, users
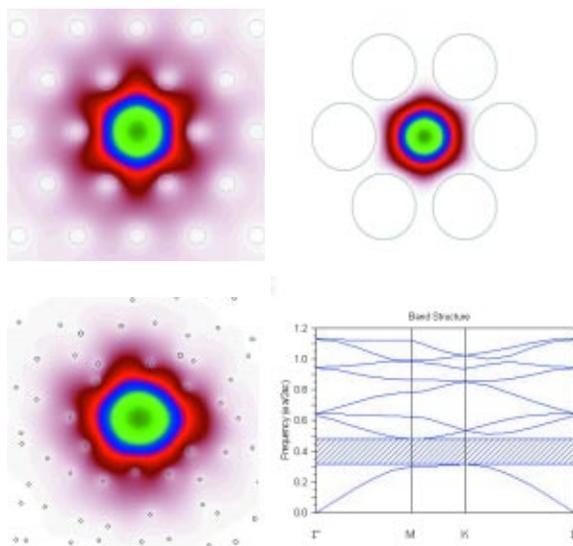
can quickly create lattices of the desired shape and unit cell. The *BandSOLVE* simulation engine then automatically determines the appropriate path through the Brillouin zone of the crystal and generates the band structure diagram.

The software also allows the study of "reduced band structures", and cavity mode properties to capture the behavior of guided modes in PC waveguides. This choice

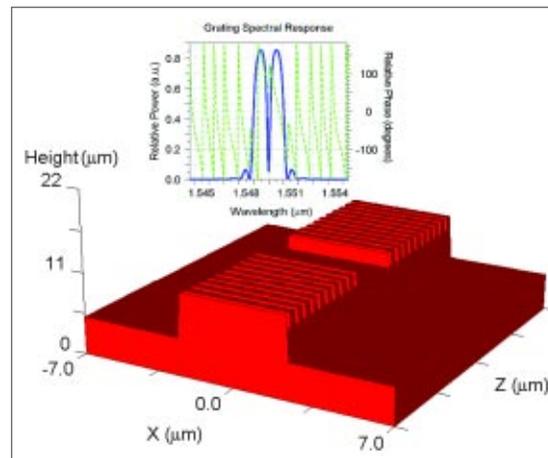# New Tool for Accurate Analysis and Synthesis of Complex Fiber and Waveguide Gratings

GratingMOD™ is a new product from RSoft Design Group developed to address the growing need for a general grating design tool for fiber and waveguide gratings. *GratingMOD* is well suited to a variety of lightwave applications including WDM components and grating sensors. The combination of both analysis and synthesis tools provides users with a complete, easy-to-use platform for designing the types of components used extensively in today's WDM networks, such as dispersion compensation, demultiplexing, add/drop filtering, optical amplifier gain equalization, wavelength converters and phase conjugators.

GratingMOD is capable of analyzing known grating structures (analysis), and of determining the structures of existing gratings from measurements or other known spectra (synthesis). The design algorithm solves the Coupled Mode Equations by Transfer Matrix Method, which is computationally faster than Bi-Directional BPM, and it is equally well suited to both 2D and 3D problems. The synthesis algorithm uses an augmented Layer-Peeling technique.

GratingMOD accommodates nearly any type of waveguide or fiber transverse profile since it incorporates the *BeamPROP*™ CAD Framework for Photonics, *BeamPROP* is RSoft's premier design package for integrated and fiber-optic waveguide devices and circuits. In addition, *GratingMOD* includes a complete, fully functional mode solver, which not only handles slab and fiber structures but also waveguides with arbitrary cross-sections.

The longitudinal grating structure is realized through the use of an arbitrary, periodic, longitudinal taper. Different types and combinations of tapers including index, width, and height tapers can be defined within a single and across multiple sections, making *GratingMOD* the tool of choice for complex grating devices. This feature enables modeling of both index modulation gratings, such as Fiber Bragg Gratings, and surface relief gratings,

GratingMOD™ is well suited to a variety of lightwave applications including WDM components and grating sensors.

➡ *(Cash Conservation continued)*

design to fabrication allowing designers to quickly investigate realistic, fabrication-related issues before money is invested.

In addition, commercial tools generally offer more advanced and accurate algorithms, necessary for design optimization, since they have been developed and improved over years and hundreds of applications. In-house tools may not have the same legacy of successful implementation and may use more approximated methods leading to problematic results.

Then there is the broader, basic element of cost savings from reduced labor and time since commercial software allows its users to run iterative simulations and scenarios by simply changing a few parameters. Computationally-empowered techniques such as parallel computing can drastically reduce complex design and modeling processes from weeks to days, or from days to hours.

Design tools can also help you model your customer's environment, in order to help them with their design and procurement decisions. Demonstrating performance improvement or cost reductions from a new product offering not only differentiates your products, but brings additional value to a customer who is struggling to optimize a new system or network service deployment.

But don't try this at home. In deciding whether to build such tools yourself, or buy them from a commercial vendor, consider the investment required to develop such a software application.

➲ **Expertise:** Developing a leading-edge tool, one worthy enough to trust with your product development and customers, requires access to specialists in technology, algorithm development, and software development—an expensive addition to your staff, or at least a costly redirection of your best talent.

➲ **Development Time**: RSoft's design tools are the product of over a decade of R&D and continuous advancement. A commercial tool with years of R&D and validation could be applied to your design immediately to bring value to your current product portfolio.

➲ **Maintenance:** Keeping up with new technologies — as well as refining and revising old technologies — requires constant updating and testing. Key industry changes are automatically reflected in software upgrades that contain valuable repositories of the latest materials, protocols, cost models, etc.

As markets contract and revenues continue to decrease, competitive differentiation and cost reduction becomes more crucial than ever. Using commercial software in your design and planning processes can help, but just remember... you're in the photonics and communications equipment business, not software development. That's where RSoft Design Group can help.

Whether you're designing integrated optical components or developing network and service plans for your wired and wireless networks, RSoft Design Group has award-winning tools to help you cost effectively optimize your offerings. With more than 10 years expertise, RSoft develops and markets software tools and provides consulting services in four areas: Component Design (*BeamPROP™, FullWAVE™, LaserMOD™, BandSOLVE™ and GratingMOD™*); System Simulation (*LinkSIM™*); Network Modeling (*MetroWAND™*); and Strategic Analysis (*BroadbandSWAT™, WirelessSWAT™*). ▬

least amount of capital expenditures. For example, in a long-haul system, designers can optimize the dispersion map, amplification type, and amplifier spacing to achieve the desired performance while minimizing the number and costs of components.

RR: Is *LinkSIM* easily integrated with RSoft's *BeamPROP* and *FullWAVE* physical-layer software solutions**?**

Dr. Whitlock: Absolutely. With the integration capability, device-level designs are optimized for system-level performance. For instance, the *BeamPROP—LinkSIM* combination can simulate a device design such as an arrayed waveguide grating (AWG) in a target system such as a long-haul DWDM optical link. Simulations are performed together in a mixed-level simulation environment or separately utilizing file-based data exchange.

RR: Does *LinkSIM* model semiconductor optical amplifiers in addition to EDFAs and Raman amplifiers?

Dr. Whitlock: Yes, our semiconductor optical amplifier (SOA) model accurately simulates single- and multi-channel signal amplifications, optical switches, wavelength conversions, and other nonlinear optical applications. It also includes wavelength-dependent gain and models the gain tilt on the noise.

RR: I understand that component manufacturers use *LinkSIM* as a sales and marketing tool in addition to a systems design tool. How does that work?

Dr. Whitlock: Customers of components and systems often want to see how a particular vendor's products will perform in their target systems. By using *LinkSIM*, component manufacturers can accurately simulate and demonstrate the value of products in their customers' target application. *LinkSIM* then becomes a powerful marketing and sales tool to prove-in their product's design to their customers.

RR: Any parting thoughts?

Ease of use, flexible component models, and strong technical support are all critical elements for a design tool. *LinkSIM* provides all of these elements and helps our customers lower their project costs. ■

Something to Write Home About

Students enrolled in Sonoma State University's Master of Optical Engineering program will be participating in a unique learning experience using RSoft Design Group's award-winning physical layer software. When the school officially opens its state-of-the-art photonics lab in early fall 2002, these lucky students will be able to simultaneously incorporate their lab and lecture work in a single setting.

Sonoma State purchased RSoft's *BeamPROP*, *FullWAVE*, and *LinkSIM* software solutions and will be using the tools to help students understand the design and analysis of passive and active integrated optical components and optical communications systems. Students can perform real-life simulations and analyses to augment their conceptual understanding of photonic structures.

"We've always had a strong commitment to the academic community, ever since we introduced *BeamPROP*— our first product," said LuAnn Scarmozzino, president of the Physical-Layer Division of RSoft Design Group.

> *"We are extremely honored that Sonoma State University has chosen RSoft's tools for their new laboratory."*

In addition to using RSoft Design Group's software solutions, Sonoma State has invited the company's experts to lecture on specific topics. Dr. Michael Steel, Senior Scientist, will be presenting a special lecture on photonic crystals. Dr. Steel is the principal developer of RSoft's new *BandSOLVE* software, the only design tool for the design and modeling of photonic crystal (PC) components on the market today. The software is used both by academic researchers in universities and laboratories as well as by

Broadband Access Strategies:
Fixed Wireless, DSL, or Both?

Faced with competition from cable operators (up to twice as many deployed cable versus DSL lines) and increasing pressure from state regulators to improve their broadband penetration, the LECs are considering various options to expand their service coverage. Fixed wireless, based on new approaches like OFDM

(Orthogonal Frequency Division Multiplexing), has the potential to supplement, or replace DSL for broadband access service. In considering fixed wireless the LECs should consider the following key factors:

➲ Service consistency: Will the services provided with fixed wireless technology mirror those provided by DSL? If not, how will the differences influence user take rates?

➲ Reliability/service availability: Can reliability and service levels be maintained across the two technology offerings? If so, what are the required fixed wireless antenna and base station deployment costs?

➲ Deployment strategy: Are overlay (fixed wireless service available to all subscribers) or supplemental (fixed wireless service only available beyond DSL's reach) strategies

Potential Deployment Scenarios
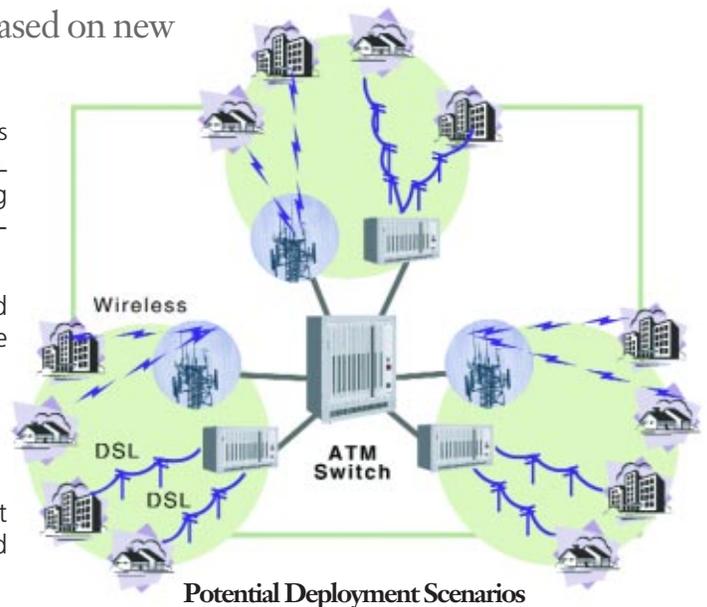
more economical? For new areas, is it more economical to deploy DSL or fixed wireless?

➲ Profitability: Which service offerings and deployment options are more profitable for the LEC (including both capital and ongoing operations expense)?

LECs need to include the above considerations in their business plans **BEFORE** money is invested in detailed RF engineering studies and network deployments. Plans must be developed quickly, based on a thorough analysis of the marketing, engineering and financial issues.

BroadbandSWAT™, a unique strategic analysis tool from RSoft Design Group that integrates market, service, engineering and financial considerations, can simplify and accelerate the creation of these plans. *BroadbandSWAT* provides a set of reports that captures the complex interactions planners need to quickly ascertain the most profitable approach to an effective plan that maximizes corporate profitability while achieving service coverage targets. ▪

As network operators look to migrate ring-based optical backbones to a more hybrid architecture over time, there needs to be a simpler way to look at existing and proposed infrastructure and services. *MetroWAND* is the only ring and mesh design planning tool on the market that can take on the complex multi-service nature of metro network design for the next decade. ▬

commercial researchers and fabricators of PC components.

Sonoma State University is part of the California State University System and has the largest portion of its undergraduates majoring in physics within the 22-campuses. With an eye towards encouraging the growth of optics in northern California, the school is building advanced high-tech laboratories supported with donations from corporations including Agilent and JDS Uniphase ▬

of tools, controlled with a single switch, allows a wider range of materials and geometries to be studied using a common interface.

BandSOLVE will be previewed at both this year's ECOC (Stand #46) and NFOEC (Booth #2233) conferences. ▬

IN BRIEF

VISIT US AT:

ECOC 2002, Stand #46
September 8-12, 2002
Copenhagen, Denmark

NFOEC 2002, Booth #2233
September 15-19, 2002, Dallas, TX

APOC 2002
October 14-18, 2002
Shanghai, China

LEOS 2002, November 11-14, 2002
Glasgow, Scotland

Photonics West 2003
Booth# 518
January 25-31, 2003, San Jose, CA

TRAINING SEMINARS

October 21, 22, 2002, Eatontown, NJ
MetroWAND
October 23, 24, 25, 2002, Ossining, NY
BeamPROP/FullWAVE
November 18, 19, 2002, Eatontown, NJ
BroadbandSWAT/ WirelessSWAT
November 20, 21, 2002, Ossining, NY
LinkSIM
February 4, 5, 2003, Milpitas, CA
LinkSIM
Check our website for additional seminar dates.

Ask about our international training seminars!

IN THE MEDIA
Look for the article on photonic crystal design written by RSoft technical expert, Fabio Pizzuto.

Article Title:
FDTD Method Simulates Photonic Crystals

Author:
Fabio Pizzuto

WDM Solutions
SEPTEMBER, 2002
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such as ridge waveguide DBRs.

Grating profile, apodization, and chirp can be chosen from pre-defined functions, or specified by user-defined expressions or data files.

Other features include powerful post-processing such as spectrum analysis for the determination of bandwidth and side lobe characteristics, delay and dispersion, curve-fitting to grating characteristics, and field pattern display. ▬

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Full Spectrum Photonic and Network Design Automation