VPIphotonics

Setting the Standard for Optical Simulation & Design Engineering

Product Overview

February 2015 Dr. André Richter



Company Overview

- Leading provider of *flexible simulation software and design services* supporting requirements of
 - \checkmark active/passive integrated photonics applications
 - \checkmark fiber optics applications
 - \checkmark optical transmission system and network applications
 - \checkmark cost-optimized equipment configuration
- Operations out of Berlin, Germany and Boston, USA; globally distributed network of regional representatives
- A SaM Solutions company, with a strong & experienced engineering team driving thought leadership in the industry for over 15 years now

VPIphotonics - Setting the Standard for Optical Simulation & Design Engineering



The Simulation Experts



Value proposition

- ✓ Virtual prototyping for faster product development and reduced R&D efforts
- \checkmark Research on cutting-edge technologies
- \checkmark Teaching optical communications topics





The Standard for industry & academia

- ✓ 140+ public R&D institutions & universities
- \checkmark 100+ private companies
- \checkmark 1000+ citations in scientific publications



Product Portfolio





VPIphotonics Transmission & Component Design

Suite of specialized and interoperable tools supporting a wealth of design, analysis and optimization applications



Integration with 3rd party software python Microsoft" COM+ \mathcal{M} ADS MATLAB SIMULINK Flexible data visualization & analysis Power Axial Distribution pump forward pump backward Power [dBm] WDM data Eye Diagram 100 After Carrier Phase Re MOPA laser tunin 130 150 250 200 Time [ps] ASE from E

Wavelength [µm]



Supporting 100s of Applications

- Bandwidth-efficient WDM systems supporting OOK, DB, APRZ, RZ-DQPSK, (RZ-)DPSK, OFDM
- High-speed / high-capacity transmission
 (100Gb ... 1Tb single-/multi-carrier, Dual Pol, mPSK/mQAM, E/OTDM)
- Electronic equalization and digital signal processing (pre-emphasis, FFE/DFE, MLSE, CMA, MSPE)
- Dynamic optical networking (ROADMs, amplifier transients, electronic control, design rules)
- Optical access and short-haul (Video, FTTx, CWDM, PON, OCDMA ,in-house, free-space)
- Analog transmission and RF over fiber (CATV, wireless backhaul, sensing)
- Photonic Integrated Circuits (micro-ring resonators, coupled waveguides, integrated transmitters)
- Ring lasers, multi-section semiconductor lasers, Optical Signal Processing using SOAs
- Raman and Er/Yb-doped fiber amplifiers and lasers (high-bandwidth/-power, pump optimization)
- ✓ ... and many more



VPIcomponentMaker™ Photonic Circuits

- Photonic Integrated Circuits (integrated transmitters, micro-ring resonators, coupled waveguides)
- Optical Signal Processing using SOAs (regeneration, conversion, routing)
- Semiconductor lasers
 (ring multi section tune







Benefits

Phase Portrait

- ✓ Fast design & optimization of PICs
- Investigate birefringence, polarization coupling dispersion
- ✓ Model bi-directional signal and noise processes
- Investigate large signal dynamics, tuning behavior
- Find settings for stable laser operation, side-mode suppression



VPIcomponentMaker™ Fiber Optics

- Er/Yb/Tm/co-doped-fiber amplifiers
- Raman and parametric amplifiers
- CW and pulsed optical fiber sources
- OSP for telecommunication
- High-power and ultrafast applications







Benefits

- ✓ Design fiber-based lasers, amplifiers and OSP schemes
- Model ultrafast phenomena in optical fibers
- Powerful optimization and automation capabilities
- ✓ Identify impact of physical effects in your designs



VPItransmissionMaker™ Optical Systems

- Aggregation and metro
- Ultra-long haul WDM
- High capacity, high-speed
- Optical networking
- HFC (analog/digital)
- PON, FTTx distribution
- RoF, Microwave photonics

1.6 Tbit/s (40x42.7 Gbit/s) transmission over 3600 km using CSRZ



- Component characterization
- Modulation schemes
- PMD/CD/IMD mitigation
- Raman amplification
- Power transients

Benefits

- ✓ Analyze OSNR, Q, BER, ...
- ✓ Optimize amplifier placement
- Evaluate component performance and impairments
- ✓ Optical Crosstalk analysis
- ✓ Compensate impairments
- ✓ Compare upgrade strategies

VPIIabExpert[™]

Advanced signal processing and analysis functions - ready for usage in a lab environment

- \checkmark Virtualize lab equipment by emulating optical and electrical components
- ✓ Develop lab-ready signal processing solutions using simulations
- Unify methodologies and tools for simulation and lab environments

DSP Library (toolkit)

DSP Library for Coherent Optical Systems

- developed by Fraunhofer Heinrich Herz Institut (HHI)
- pluggable toolkit to VPItransmissionMaker Optical Systems and VPIlabExpert

Algorithms

- Resampling*
- I/Q imbalance correction (GSOP)*
- Signal normalization
- CD estimation* and FD CD compensation*
- FFT-based Frequency-Offset correction*
- Clock phase recovery and Clock recovery
- Polarization rotation
- 2x2 adaptive TDE (CMA, PS-CMA, MMA, DD-LMS*)
- Carrier Phase Recovery (Block-based or Slidingwindow Viterbi-Viterbi, Blind Phase Search (BPS)*, two-stage BPS/maximum likelihood*)
- Frequency shifter*
- Visualizer* (constellation, time-domain, frequency-domain, SOP)

* Modulation-format-independent

Modulation formats

- mQAM
- DP-mQAM (DP-BPSK,DP-QPSK,...)

НН

DSP

- PS-QPSK
- mSP-QAM
- and others

VPIlinkConfigurator™

An intuitive software tool for the engineering of links

- Technology agnostic approaches
- Managed equipment libraries & engineering rules (customization mode for experts & application mode)
- Method for handling the engineering process
 (topology & channel plan ⇒ performance evaluation ⇒ reporting)

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EDFA-15P-N EDFA-21P-N

T400G-V2

Benefits

EDFA-21P-

 Optimize node and hut locations, fiber types and equipment

2,800.00

190,300.00

- ✓ Support green & brown fields for SDH&SONET, linear-ADM/OADM, hub-rings and branched networks
- ✓ Evaluate performance limitations
- ✓ Create performance charts, BOM, configuration reports

We provide Value

Cutting edge tools for cutting edge research

- Versatile development and engineering platforms for realistic photonic equipment design and cost-optimized configuration
- Very *robust* simulation *engines* addressing thousands of modeling applications
- Module *libraries with* more than 900 items emulating optical & electrical equipment characteristics, and performing signal processing and supplementary functions
- Many adjustable parameters & detailed models allowing to simulate realistic characteristics
- ✓ Over 700 application examples providing a tremendous tutorial value
- Detailed documentation about design knowledge, modeling details and usability functions

We provide Value

Cutting edge tools for cutting edge research

- Flexible licensing schemes
 (individual/group, time-limited/permanent, local/remote)
- *Excellent* technical *support* & *service* team providing fast and expert-level solutions
- Customers in forward-looking groups, product design and marketing teams from over 100 commercial corporations across the world
- International University Program that attracts educators and researchers from over 140 academic institutions
- More than 70 technical publications per year referencing the usage of VPIphotonics' products and services
- Active participation in national and international *R&D projects* and collaborations (SASER, OCEAN, MIRTHE, ...)

- We created the market for professional tools supporting Photonic Design Automation for optical subsystems and systems
- Our strong applications and design team ensures expertise in the field of photonics
- Our strong liaisons with industry and academia allow to stay tuned on market trends
- Our software can dramatically expand learning with interactive and engaging tools that bring current industry practice to the classroom.

VPIphotonics - The Simulation Standard for Optical Transmission Systems and Photonics applications

Thank You!

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VPIphotonics.com