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Silicon to Software™

RSoft Application: All-Optical Wavelength Conversion in Optical Networks

Photonic Crystal Fiber (PCF) As a Highly Nonlinear Element

Overview

A leading North American optical network equipment manufacturer was looking for novel ways to test all-optical wavelength conversion.

The Challenge

Wavelength converters are essential in dynamically reconfigurable optical networks. Traditional wavelength conversion methods use optical-electrical-optical (O-E-O) conversions, which require higher component counts and pose scalability, deployment and reliability challenges. Photonic crystal fibers (PCFs) attract a lot of attention and are used in optical communication systems for specialized applications because of their unique characteristics compared to the conventional fibers. For air-guided PCFs, light is guided in a hollow air hole with almost zero dispersion. In index-guided PCFs, light is guided in a small area surrounded by air holes with enhanced nonlinear effects. RSoft™ FemSIM™ is a generalized mode solver based on the Finite Element Method (FEM) that can calculate any number of transverse or cavity modes of an arbitrary structure on a non-uniform mesh. FemSIM can model a PCF and provide fiber characteristics that can be used in OptSim™.

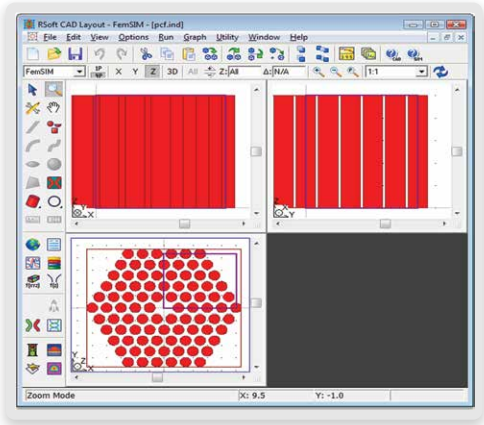

Figure 1. PCF modeled in FemSIM

The Solution

PCF is a highly nonlinear optical component. Strong nonlinearities can induce polarization switching by way of nonlinear polarization rotation, resulting in all-optical wavelength conversion. PCF data is obtained from FemSIM (Figure 1) for modeling an all-optical wavelength converter design in OptSim (Figure 2).

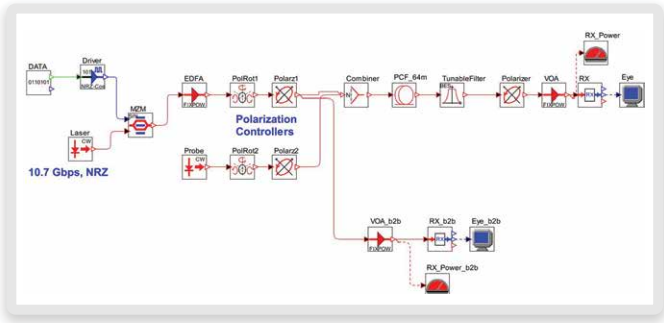

Figure 2. PCF simulation setup schematics in OptSim

The Result

FemSIM and OptSim yielded the following results:

- Data at vertically polarized, control signal wavelength is switched to a 45° linearly polarized probe signal wavelength, thereby achieving all-optical wavelength conversion without the need for O-E-O conversion (Figure 3)
- The wavelength converter is data rate transparent, which means that if the data rate changes in the future, the same device will work, providing future-proof design and cost savings

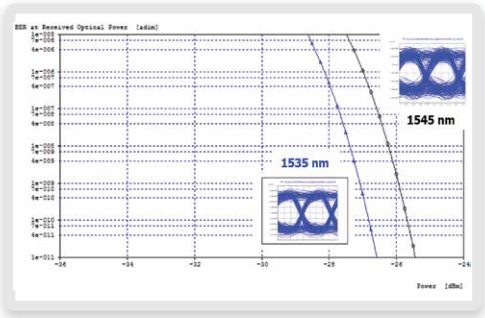

Figure 3. Bit error rate (BER) versus received power for two different converted outputs

For more information, please contact Synopsys' Optical Solutions Group at (626) 795-9101, visit http://optics.synopsys.com/rsoft/, or send an e-mail to rsoft_sales@synopsys.com.

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Synopsys, Inc. • 690 East Middlefield Road • Mountain View, CA 94043 • www.synopsys.com

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