Ansys + AIM Photonics + Analog Photonics

"The simulation capabilities enabled by the AIM CML in Lumerical's INTERCONNECT allow us to focus on the application of our designs rather than worry about the function of the individual components, which significantly accelerates our development timelines. The new release that adds the ability to address yield analysis through Monte Carlo simulations in INTERCONNECT will be a critical element in our technology's commercialization path."

Timothy Creazzo / Phase Sensitive Innovation

CASE STUDY

AIM Photonics and Analog Photonics Deliver Improved Manufacturability Through Statistical Compact Models

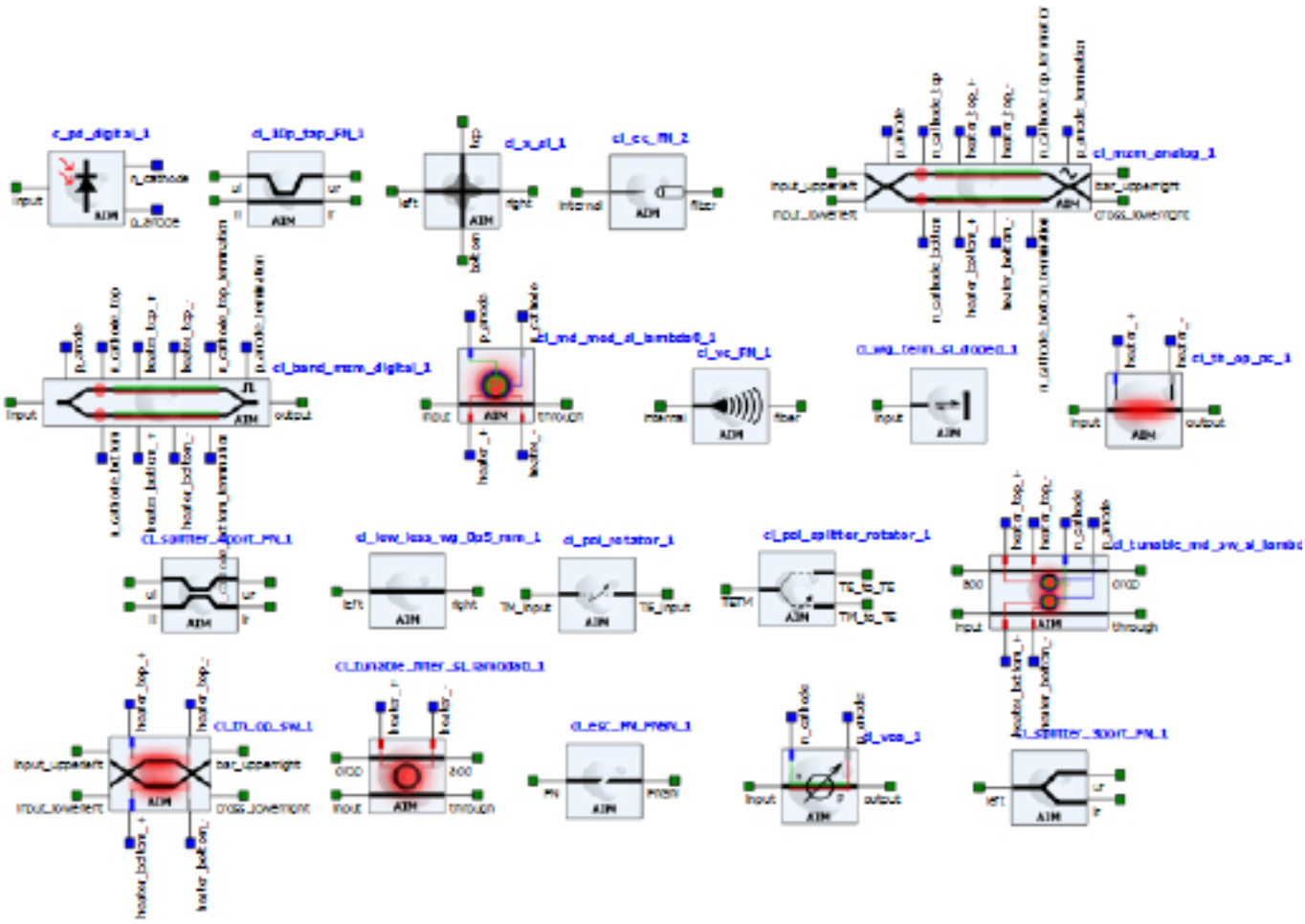

Figure 1. A subset of the 60+ INTERCONNECT compact models in the APSUNY v4.0a compact model library (CML)

Challenges

Design flows continue to mature to meet the cost and scalability demands of manufacturing necessary for broad commercial markets. The introduction of photonic/electronic process design kits (PDKs) in recent years raised the level of abstraction for photonics design to produce unprecedented levels of productivity. This has been made possible with the introduction of advanced circuit-level design flows including Ansys Lumerical's circuit simulation tool **INTERCONNECT**.

There is a growing demand for statistical-enabled PDKs and flows to meet the industry need for improved yield and reduced time to market. Accurately simulating manufacturing variability shrinks the design cycle by reducing the need for costly prototype iterations and minimizing manufacturing risk, which leads to fewer respins. Improved yield results in improved return on investment.

/ AP_SUNY PDK

AIM Photonics, NY CREATES, Analog Photonics, and Ansys set out to address the need for a statistical-enabled PDK. The PDK component library, owned by Analog Photonics, was the first to support statistical models in INTERCONNECT, based on the measured wafer-scale data of photonic components. It provides statistical variation data for waveguides and passive and active components. The PDK provides SMEs with a key resource for the development of the baseline technology and design of photonic products manufactured by AIM Photonics' multiproject wafer (MPW) services, which are produced at NY CREATES' Albany Nanotech advanced 300-mm microelectronics chip fabrication facility.

The AP_SUNY PDK 4.0a is the seventh major update of the Silicon Photonics Process Design Kit on 300-mm wafers with Lumerical compact models in the past four years. It includes more than 60 verified and best-in-class modulator and detector components that are compatible with three AIM technologies (passive, full-build, and passive interposer). The PDK statistically enables all process-sensitive components within the component library; five waveguides, five passive elements (c+l-band 3-port splitter, c+l-band 4-port splitter, c+l-band 99/1 tap, c+l-band 90/10 tap, o-band 4-port splitter), and 12 active elements (3 Mach-Zehnder modulators, 4 c+l-band tunable microdisk modulators, 4 c+l-band tunable filters, and 1 o-band microdisk modulator).

AP_SUNY PDK 4.0a improves upon the previous PDK v3.5b with the inclusion of statistical variations for doping profiles for its Mach-Zehnder modulators. Further, it includes four new components that include statistical distributions for physical variations.

Dr. Erman Timurdogan, director of PDK Development at Analog Photonics, said, "With PDK v4.0a, users have access to statistical models for full-build, passive technologies based on the experimental data, and the component library is adapted to support a brand-new technology offering: Active Interposer. The statistical models allow for the prediction of the device, system, or product performance; yield; and corner analysis without spending the time and money to fabricate and test it. The models will also help with design for manufacturability (DFM) practices at AIM Photonics."

"Delivering statistical compact models for the first time is another major milestone in delivering the commercialization environment that our customers are demanding," said Ansys Fellow James Pond.

AIM Photonics COO and Director of EPDA, Test, Packaging, and Process Development Dr. David Harame said, "We are proud to be the first to offer statistical compact model libraries (CMLs) from Ansys. With the most recent PDK 4.0a, we continue to push the photonic integrated circuit (PIC) ecosystem's leading edge with statistical distributions based on doping profiles."

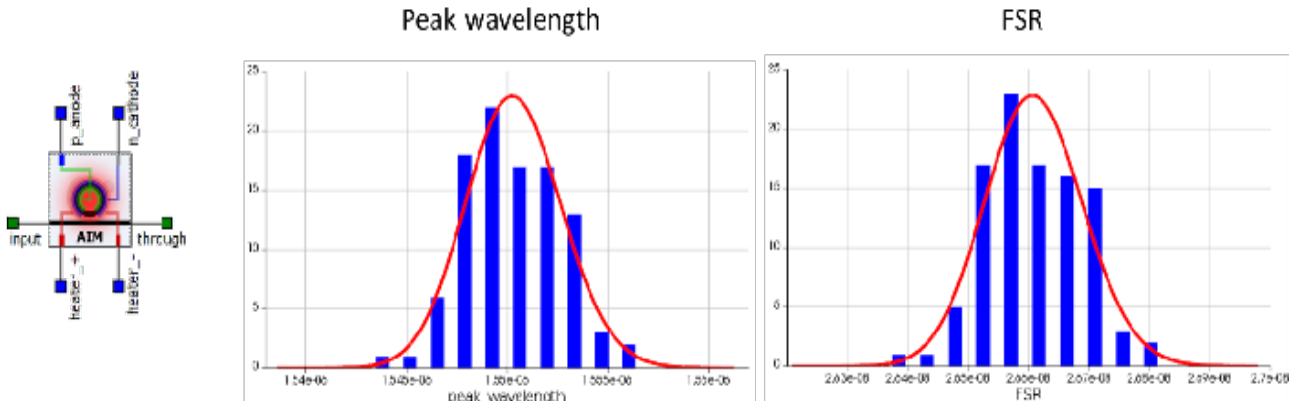

Figure 2. CL-band statistical ring modulator from the AP_SUNY CML

/ Results

The 25-plus statistically enabled compact models in the AP_SUNY v4.0a CML empower photonic circuit designers to perform Monte-Carlo analysis in Lumerical INTERCONNECT to account for manufacturing variations in waveguide width, height, and doping profiles (active elements). Figure 2 shows one of the 16 statistically enabled active elements in the AP_SUNY v4.0a CML. The compact model for this c-band ring modulator accounts for fabrication variations in the width and height of the ring waveguide. The plots show the variations in the resonant wavelength and the FSR of the ring from a Monte Carlo simulation run in INTERCONNECT.

Note: *NY CREATES manages the fabrication facilities in Albany, NY, and oversees all AIM Photonics operations. Future versions of the PDK will be renamed to reflect this change.*

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