Characterization of Semiconductor Optical Amplifiers

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Introduction

With the increasing demand for computing power and energy efficiency in data centers, electronic interconnection networks seem to reach their physical limits and optical networks are one of the best alternatives. As part of the RODIN project, the goal of his summer research project was to characterize and explore the uses of an important component in optical networks, the semiconductor optical amplifiers (SOA). Namely, the amplifying performance of a SOA was tested under different conditions and compared to simulated results, the impact of the SOA’s optical noise on signal quality was analyzed. Also, a commercial laser diode driver was used to test its fast-switching function, which can play an important role in improving energy efficiency in optical networks.

Gain Characterization

The above characterization of a commercial SOA, the Kamelian-OPB-12-15, can be used as a reference for more complex experiments involving SOAs. The simulations were performed using the Optisystem software.

Results

- Gain Characterization
  - Polarization Depend. Gain: 1.02 dB at 90mA, 1550nm, -20dBm Input Power
  - Noise Figure: $NF = \frac{N_{out} - 6\text{N}_{in}}{h\nu G_{opt}} + \frac{1}{G}$
    $= 4.03\text{dB}$

- Results
  - Gain Characterization of Commercial SOA
  - Experimental Data vs. Simulated Data

Conclusion

1) The Kamelian-OPB SOA was shown to have high gain with low injection current (15.8 dB gain with 150 mA current) and allows low error rate in data in the presence of noise. These characteristics make the SOA power efficient.

2) Also, although the Picolas diode driver’s output current is too high for common SOAs, producing current pulses at radio frequencies is a first step towards fast-switching SOAs.

Future Work

1) Fine-tune parameters used for the simulation in Optisystem to match more closely the measured results.

2) Use a laser diode driver with lower output current and observe the pulses at the SOA’s output.