VCSEL MODEL PARAMETER EXTRACTION: DEEP LEARNING VS. EVOLUTIONARY ALGORITHMS

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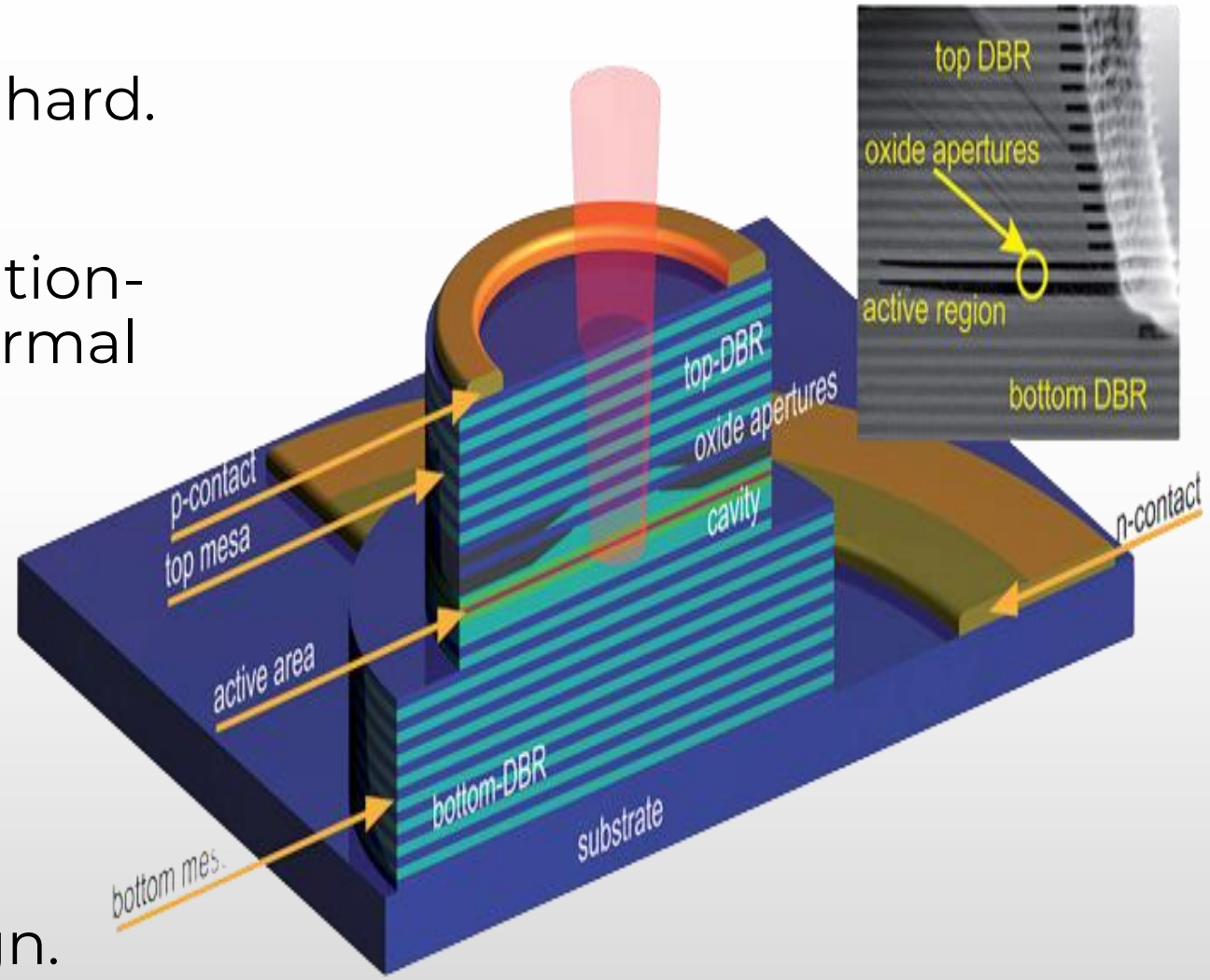
Introduction

- Characterizing VCSELs from measurements is important but hard.
- Extract parameters for rate equation-based model (with empirical thermal equations).
- Use the extracted parameters in Synopsys Optsim™ to perform system-level simulations.
- Same approach for inverse design.



Deep Learning vs. Particle Swarm Optimization

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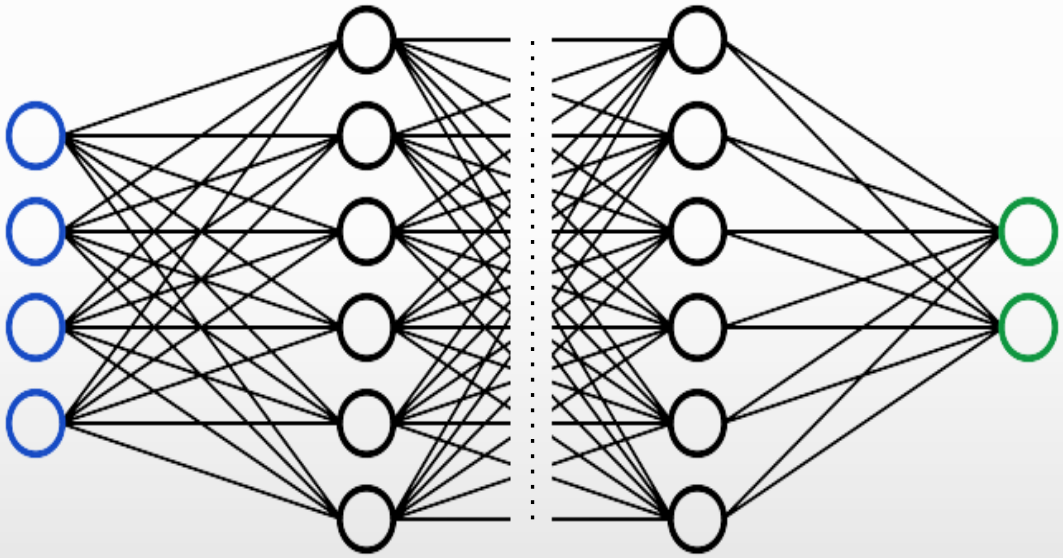
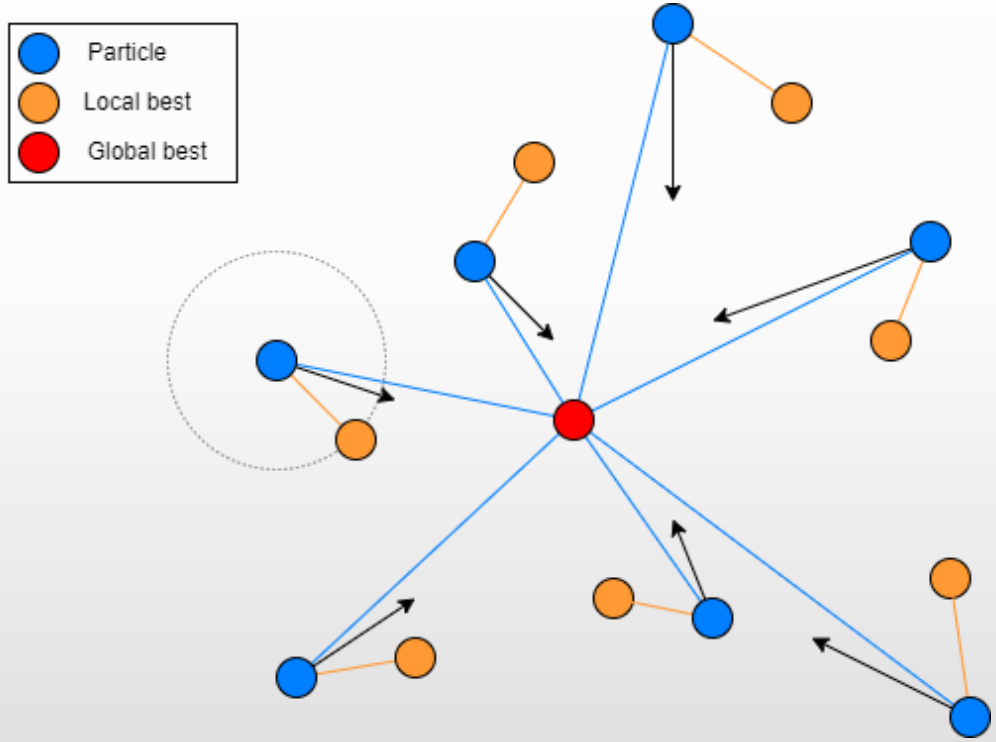
DL



PSO



DL vs. PSO – Pros and Cons

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DL

- PROS:
  1. After training, predictions are instantaneous.
  2. After the dataset, no need to call the solver again.
- CONS:
  1. Long time for dataset generation.
  2. DNN hyperparameter optimization.
  3. Limited flexibility.

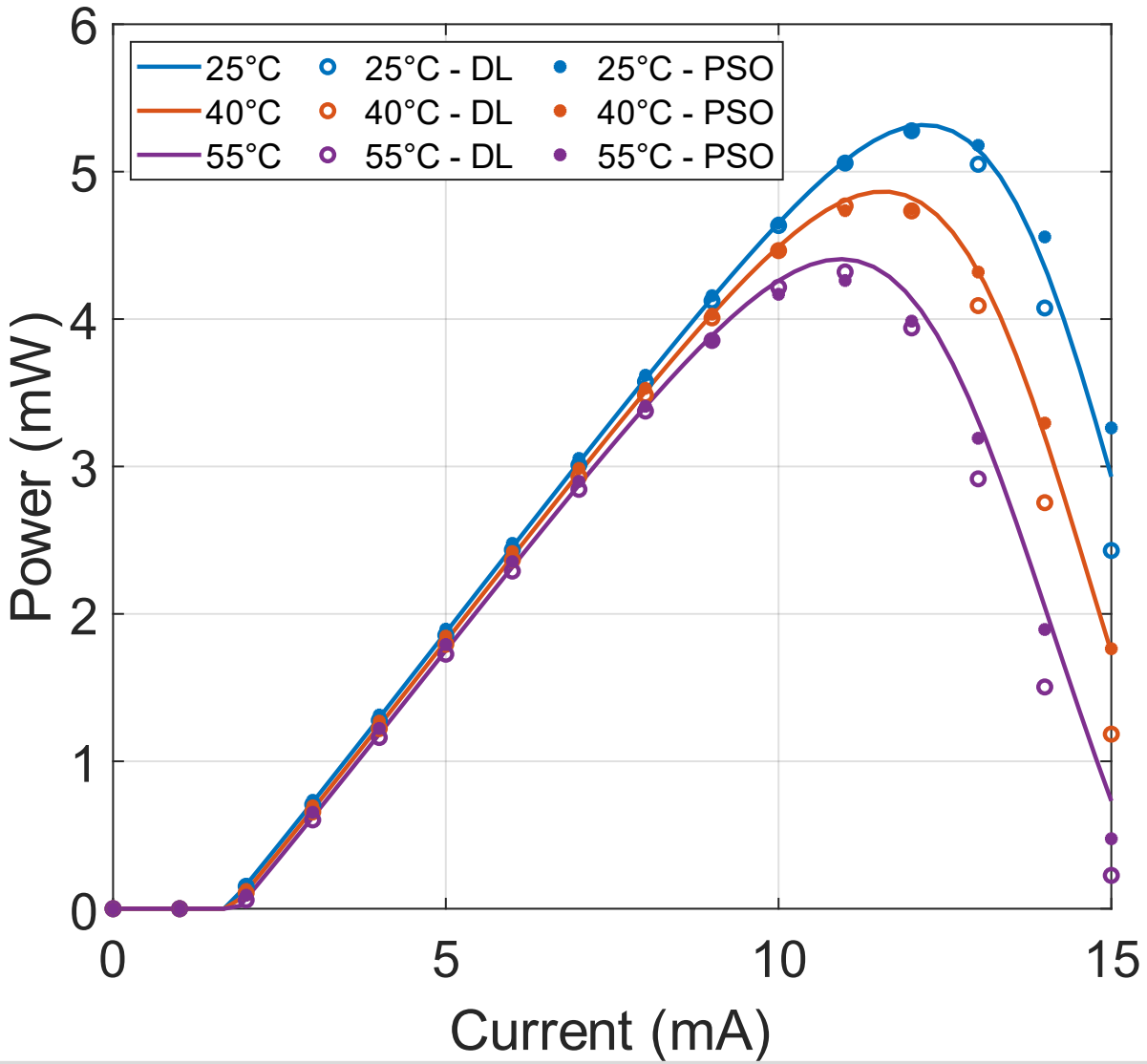
Total time: ~ several hours (considering dataset generation and model training)

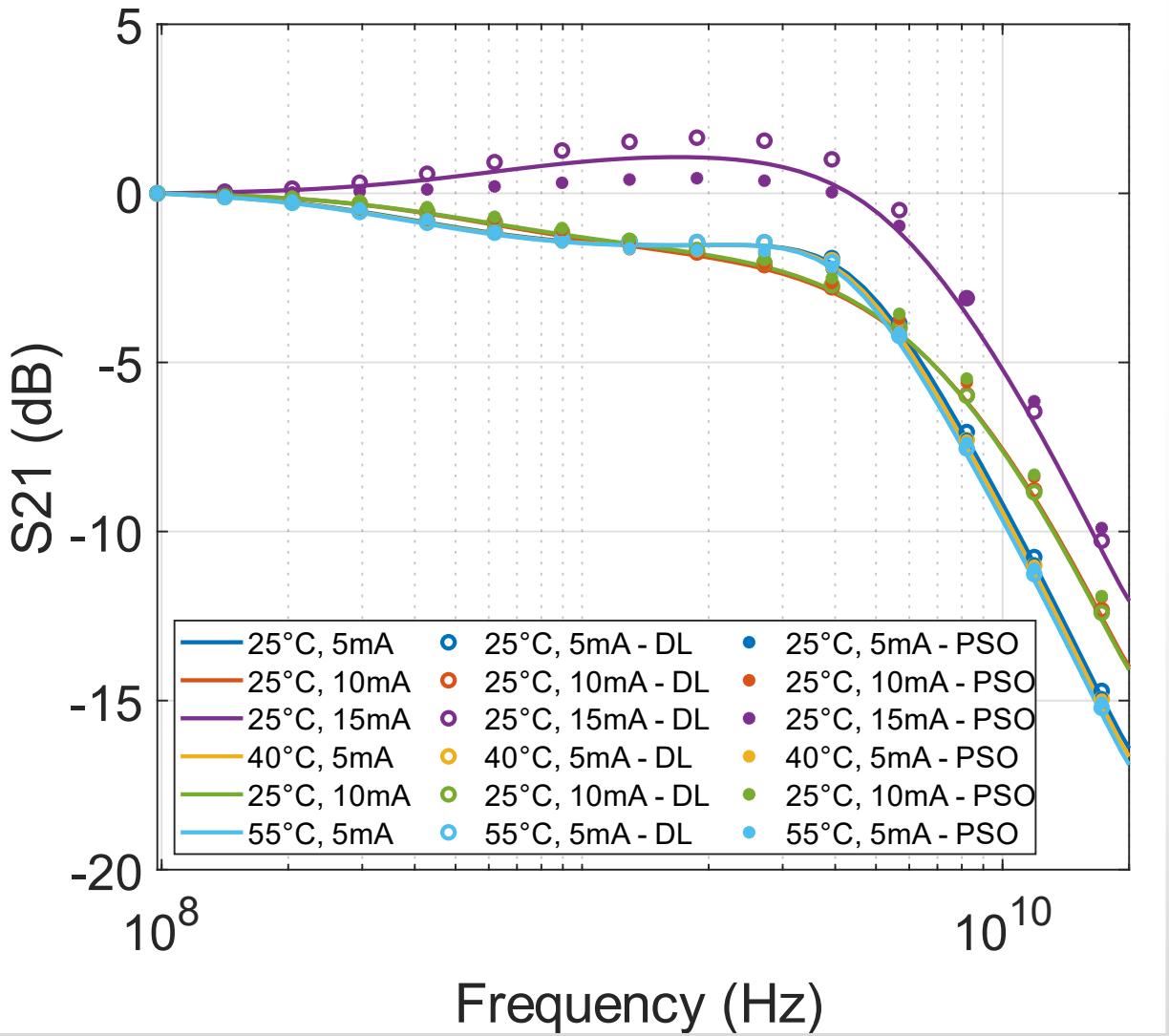
PSO

- PROS:
  1. No need for a dataset.
  2. Very good flexibility.
  3. Takes care automatically of the unphysical curves.
- CONS:
  1. It is a one-off optimization process.
  2. It takes time (each particle calls the solver at each step).

Total time: ~ 10 - 25 minutes per optimization (depending on number of steps and particles)

PI and S21


25°C
40°C
55°C
25°C - DL
40°C - DL
55°C - DL
25°C - PSO
40°C - PSO
55°C - PSO
Power (mW)
Current (mA)
0
1
2
3
4
5
6
0
5
10
15


S21 (dB)
Frequency (Hz)
5
0
-5
-10
-15
-20
10^8
10^{10}
25°C, 5mA
25°C, 10mA
25°C, 15mA
40°C, 5mA
25°C, 10mA
55°C, 5mA
25°C, 5mA - DL
25°C, 10mA - DL
25°C, 15mA - DL
40°C, 5mA - DL
25°C, 10mA - DL
55°C, 5mA - DL
25°C, 5mA - PSO
25°C, 10mA - PSO
25°C, 15mA - PSO
40°C, 5mA - PSO
25°C, 10mA - PSO
55°C, 5mA - PSO

THANK YOU FOR YOUR ATTENTION!