DEEP: Developing Extremely Efficient Runtime On-Chip Power Meters

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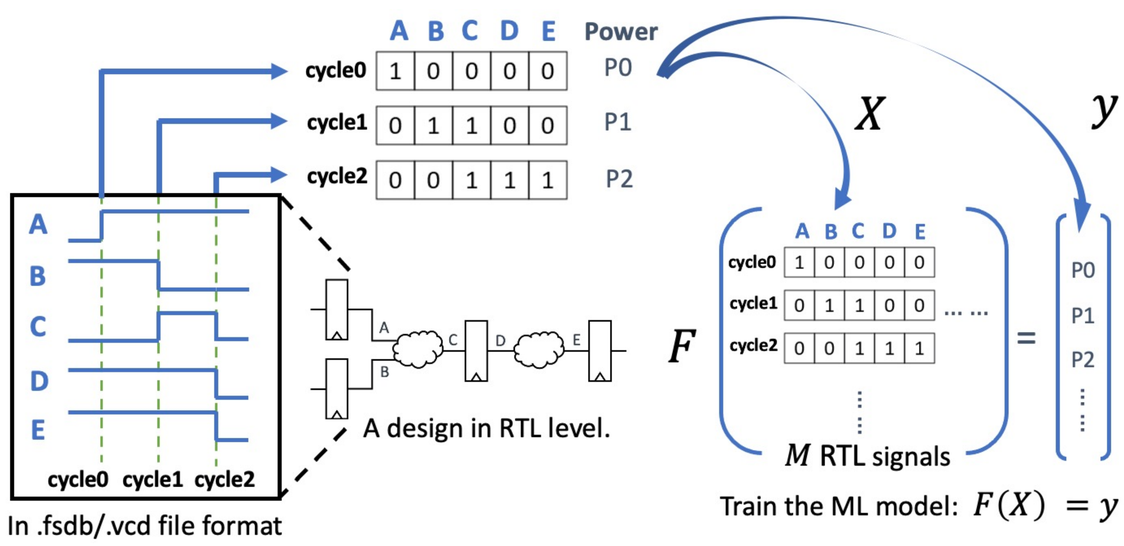
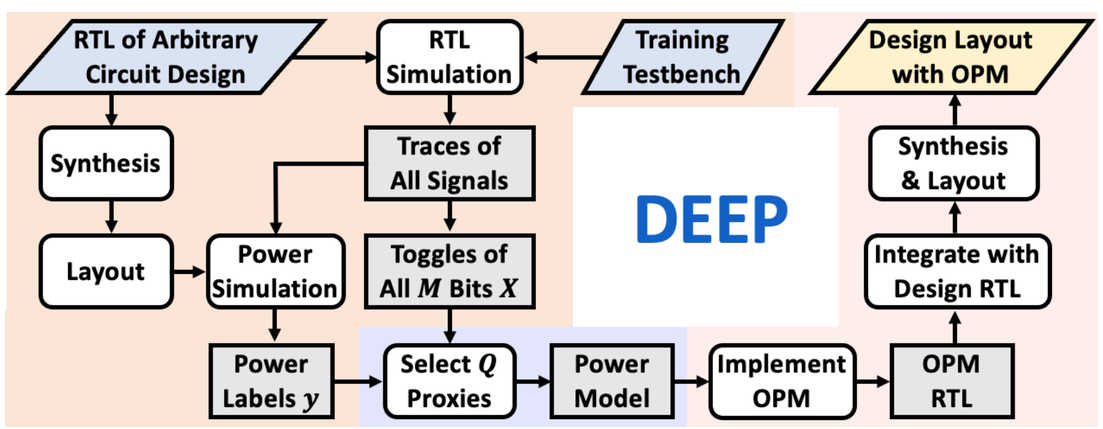
INTRODUCTION

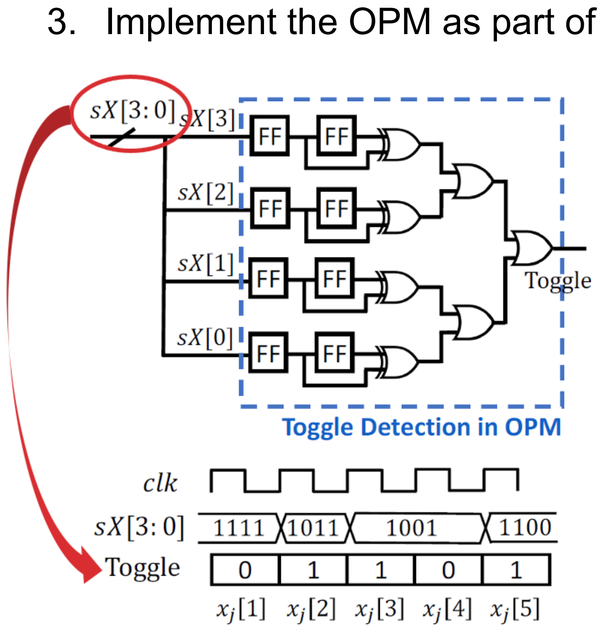
Baseline Methods	Model Input Candidate V_M (Candidate Count M)	Temporal Resolution	Claimed OPM Area Overhead
B1. MICRO'21 [38]	All RTL signals (178 K)	Per-cycle	< 1%
B2. MICRO'19 [20]	All RTL signals (178 K)	100s cycles	N/A
B3. DATE'18 [25]	Registers (67 K)	> 1K cycles	7%
B4. DATE'18 [41]	Module I/O signals (< 178K)	100s cycles	4 – 10%
B5. ASPDAC'15 [39]	Registers (67 K)	Per-cycle	16%
DEEP (this work)	All bits of RTL signals (578 K)	Per-cycle	**< 0.1%**



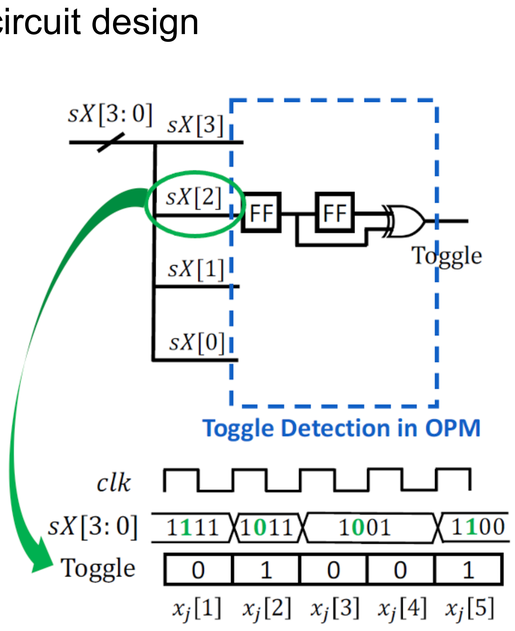
METHODOLOGY



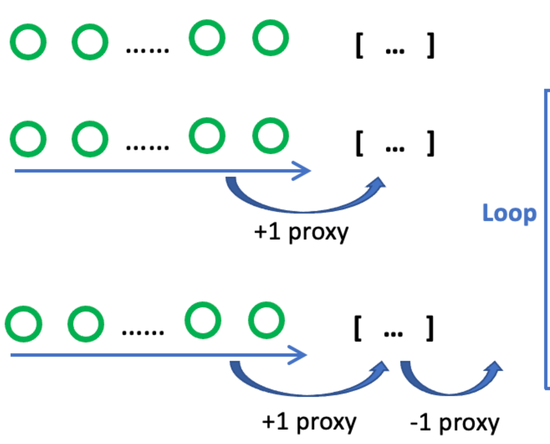
1. Generate data with **waveform of signals** and **power labels**
2. Develop OPM by selecting minimum signals as input
3. Implement the OPM as part of circuit design



Signal-level selection: [MICRO'21]



Bit-level selection: **DEEP**



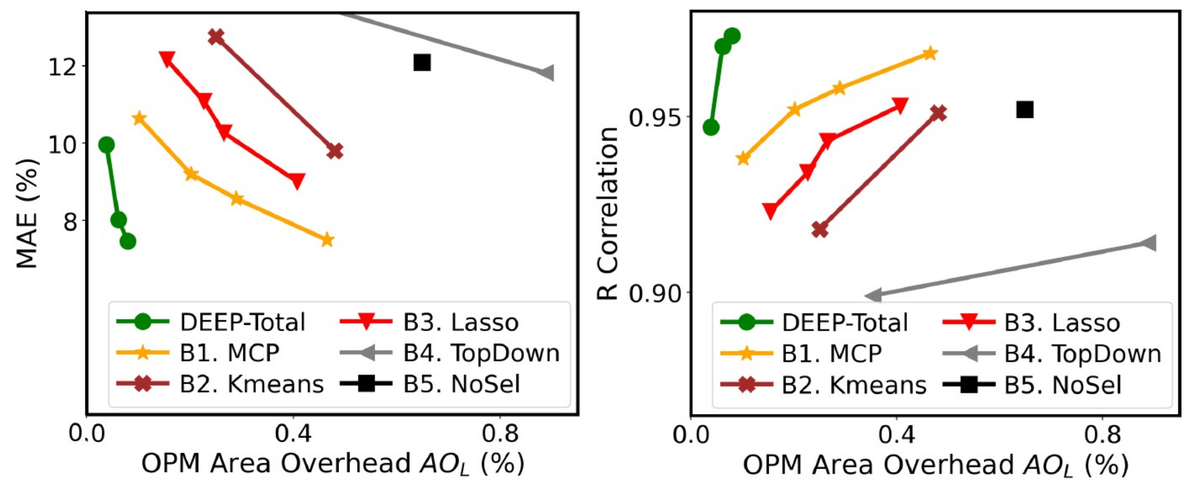
I feature candidates, an empty selected list

Loop

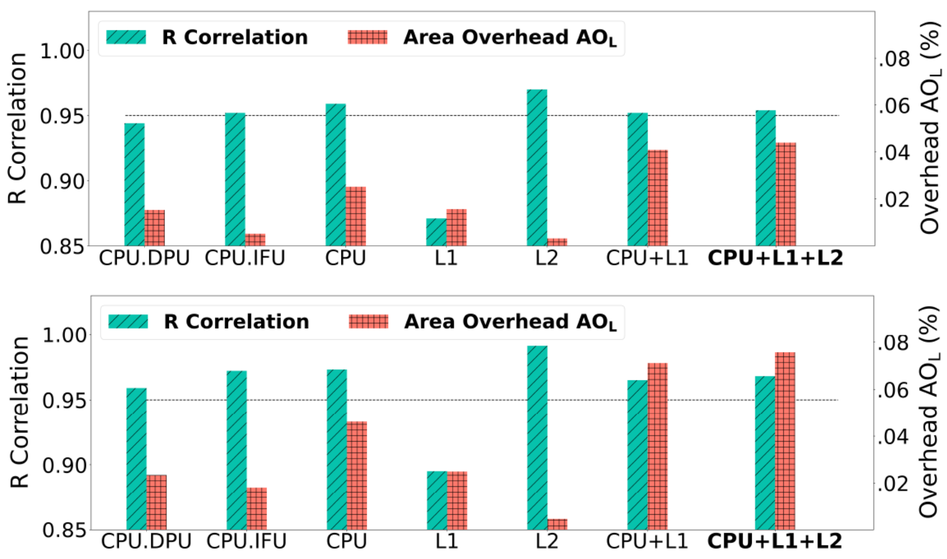
1. Adding:
- Sweep all candidates, find the one adds most accuracy
- Add it to selected list

2. 'Refresh':
- Remove each element from selected list
  - Repeat Step 1 to add one element
- Stop when no changes in the list

EVALUATION & RESULTS

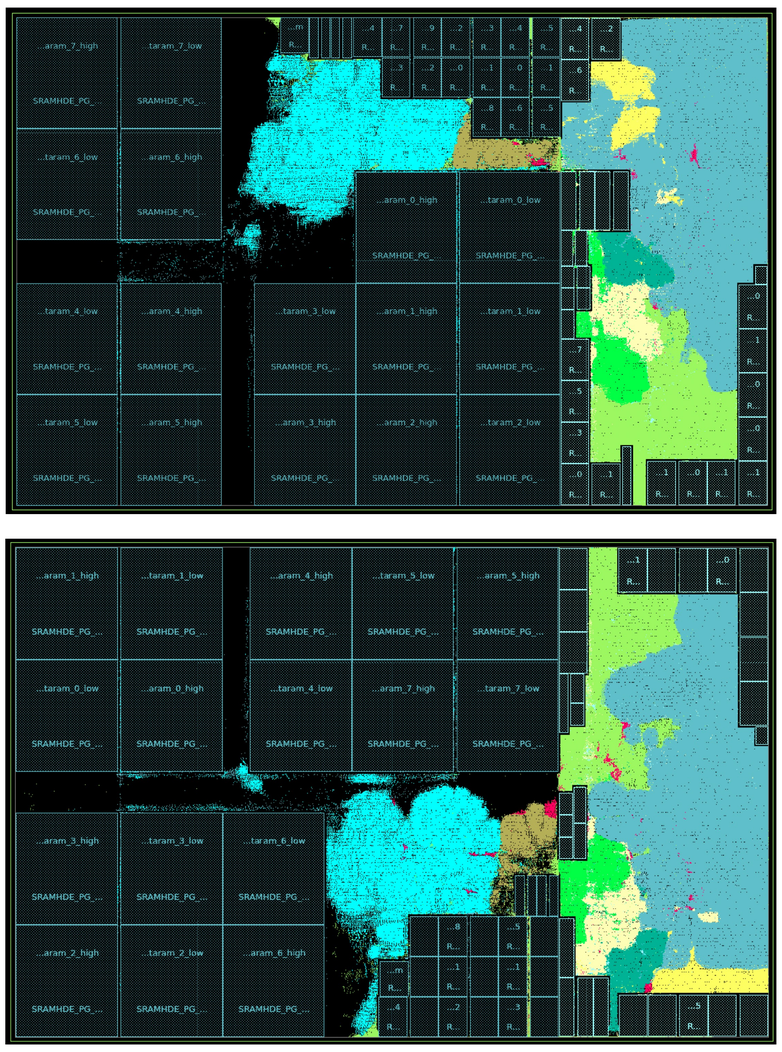


OPM hardware cost vs. per-cycle power prediction accuracy.



(a) Sub-OPMs with a total area overhead 0.04%

(b) Sub-OPMs with a total area overhead 0.08%

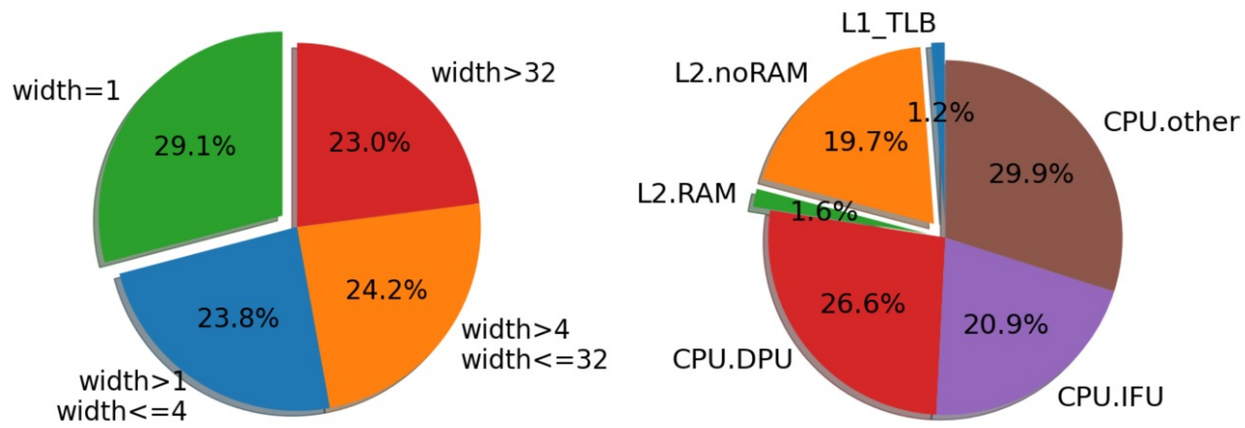


Pink regions are OPM on the layout

- The area overhead of OPM is **0.04%**
- MAE = 9.5%
- R = 0.954
- This **DEEP** method

Pink regions are OPM on the layout

- The area overhead of OPM is **0.16%**
- MAE = 9.5%
- R = 0.951
- **Baseline** [MICRO'21]



Analysis of 244 selected proxies.