

# Techniques for CAD Tool Parameter Auto-tuning in Physical Synthesis: A Survey

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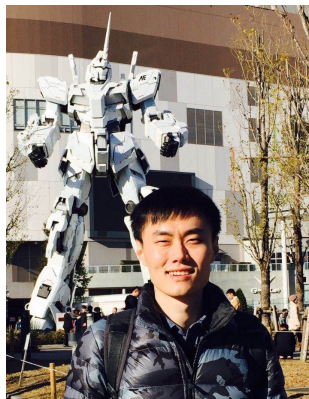


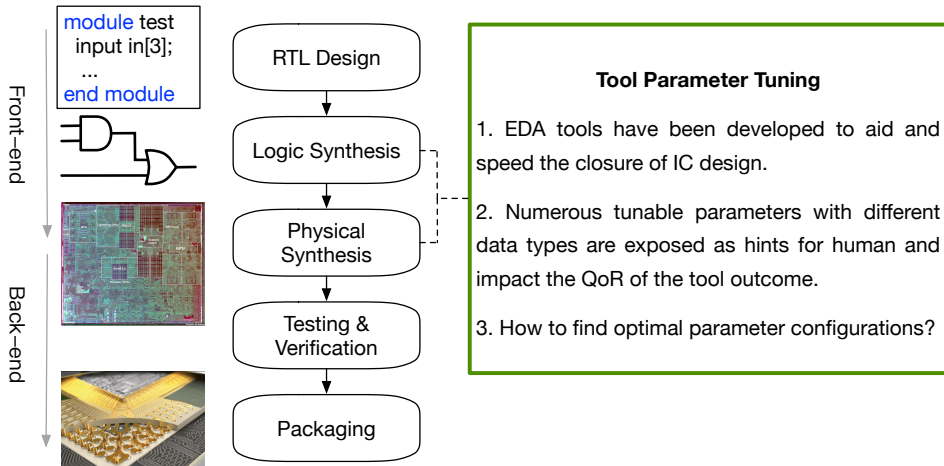
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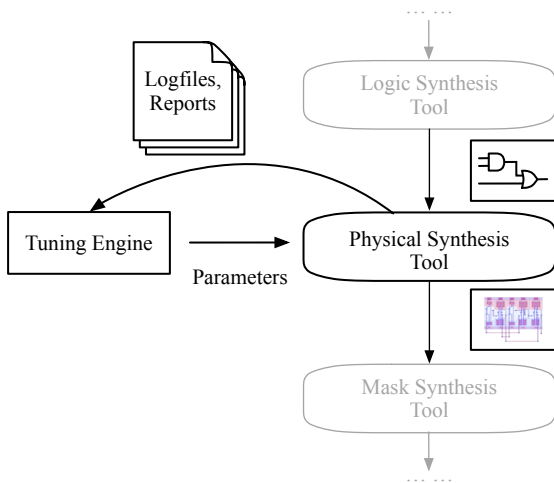
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Hao is a postdoctoral researcher at the Department of Computer Science and Engineering, the Chinese University of Hong Kong. Prior to that, he pursued his Ph.D. degree under the supervision of Prof. Bei YU in the same university. His research interests include design space exploration, machine learning, deep learning and the optimization methods with applications in VLSI CAD. He has received one best paper award nomination from ASPDAC 2019.





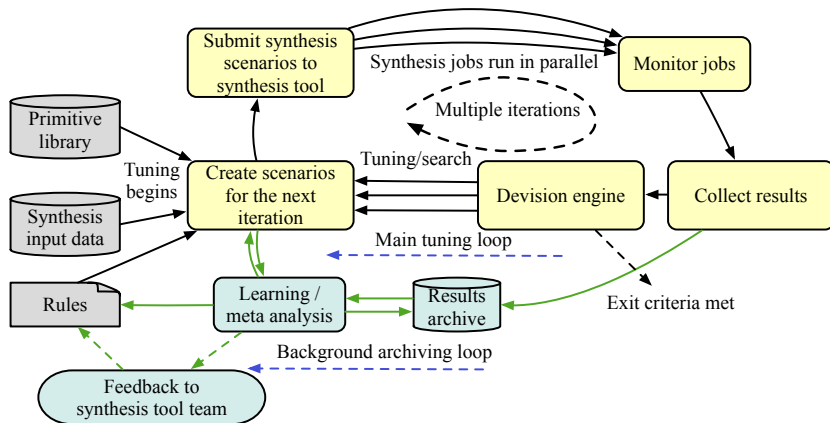
# What is Physical Design Tool Parameter Tuning?



The overview of the parameter tuning of a physical design tool



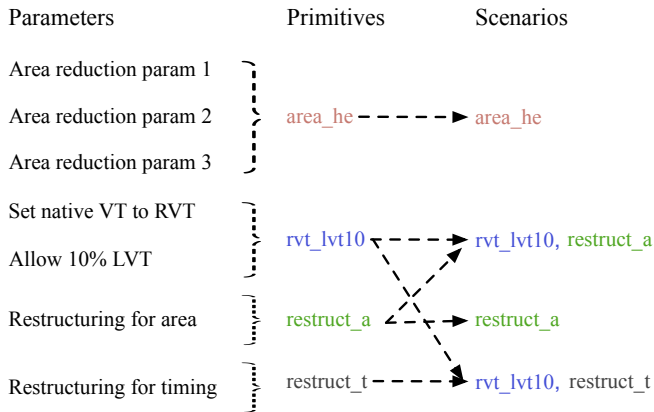
- 1 Oceans of values of design parameters need to be determined or tuned
- 2 Multiple quality-of-result (QoR) metrics (e.g., area, power, and delay) to be optimized
- 3 "Black-box" parameter-to-performance mappings: **no** explicit function expressions
- 4 Time-consuming EDA tool evaluation
- 5 Existing methods: Heuristic Method-based, Machine Learning-based



The framework of the SynTunSys.

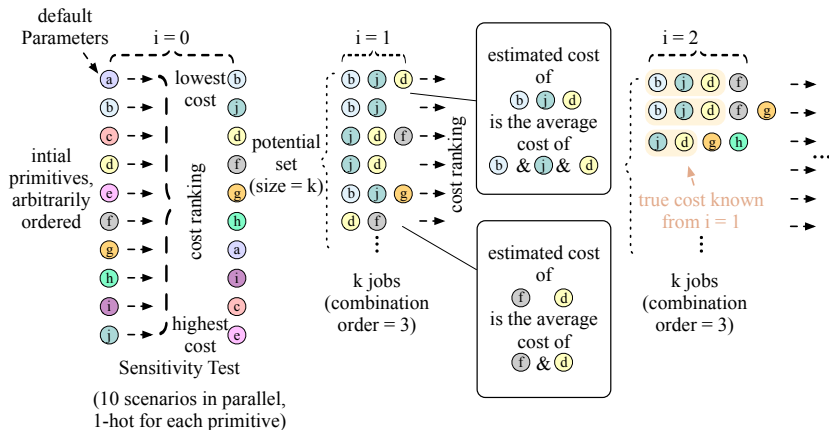
<sup>1</sup>J. Kwon et al., "Scalable auto-tuning of synthesis parameters for optimizing high-performance processors," ISLPED, 2016.

<sup>2</sup>M. Ziegler et al., "A synthesis-parameter tuning system for autonomous design-space exploratio" DATE, 2016.



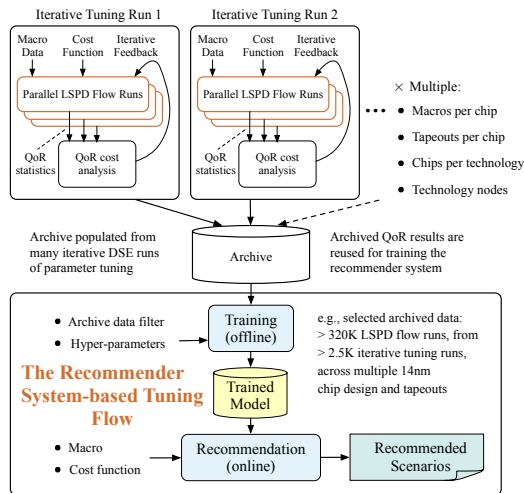
The illustration of the interaction of parameters, primitives, and scenarios in the SynTunSys.

# Heuristic-based Work: SynTunSys (STS)



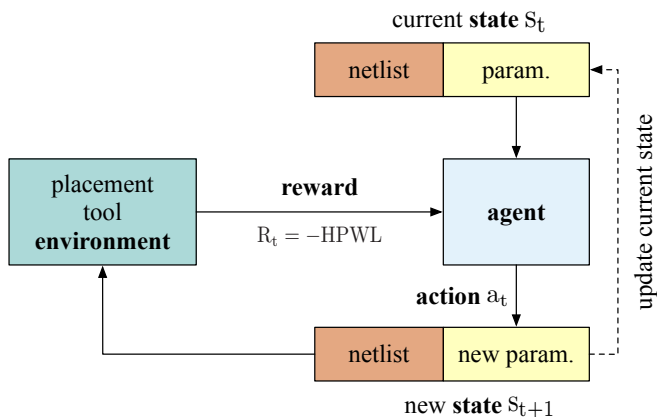
The learning decision algorithm of the SynTunSys.





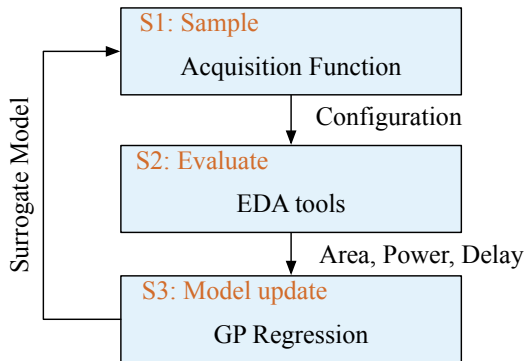
The associated tuning framework in DAC'19<sup>1</sup>.

<sup>1</sup>J. Kwon et al., "A learning-based recommender system for autotuning design flows of industrial high-performance processors," DAC, 2019.



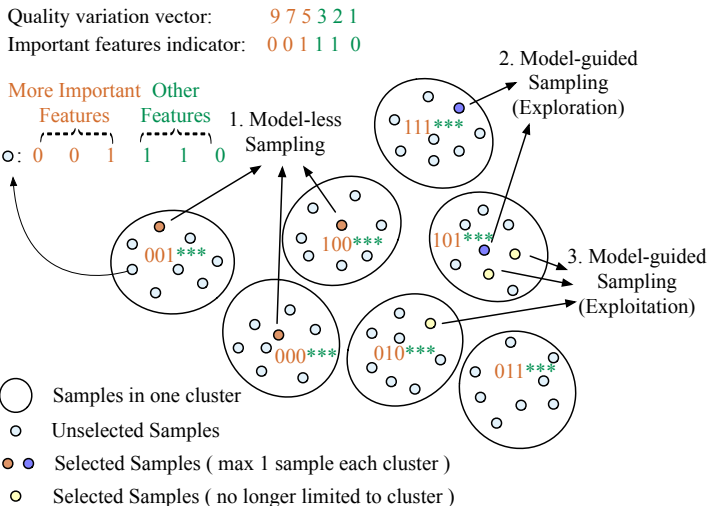
Deep reinforcement learning-based parameter tuning of a placement tool<sup>1</sup>.

<sup>1</sup>A. Agnesina et al., "VLSI placement parameter optimization using deep reinforcement learning," ICCAD, 2020.



The diagram of the workflow proposed in MLCAD'19<sup>1</sup>.

<sup>1</sup>Y. Ma et al., "CAD tool design space exploration via Bayesian optimization," MLCAD, 2019.



An example of sampling by clustering in ASPDAC'20<sup>1</sup>.

<sup>1</sup>Z. Xie et al., "FIST: A feature-importance sampling and tree-based method for automatic design flow parameter tuning," ASPDAC, 2020.



- A survey of recent line of arts in tool parameter tuning
- Parameter space auto-pruning
- Rethinking Gaussian process in iterative refinement tuning frameworks like Bayesian optimization
- Collectively considering parameter auto-tuning of multiple tools exploited in the whole design flow
- ... ..

**THANK YOU!**