Optimal OPAMP Design

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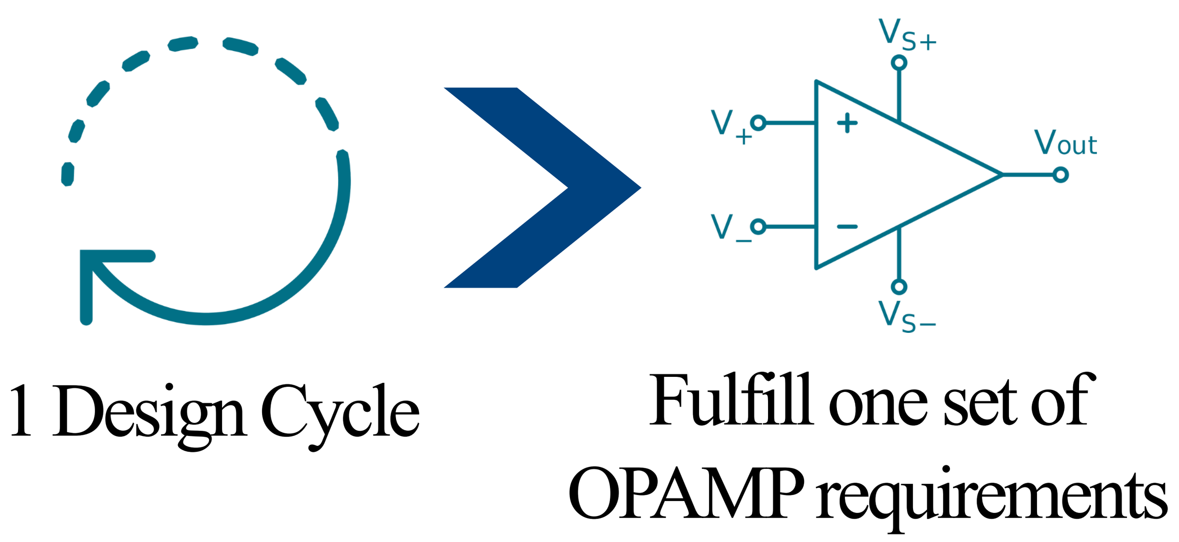
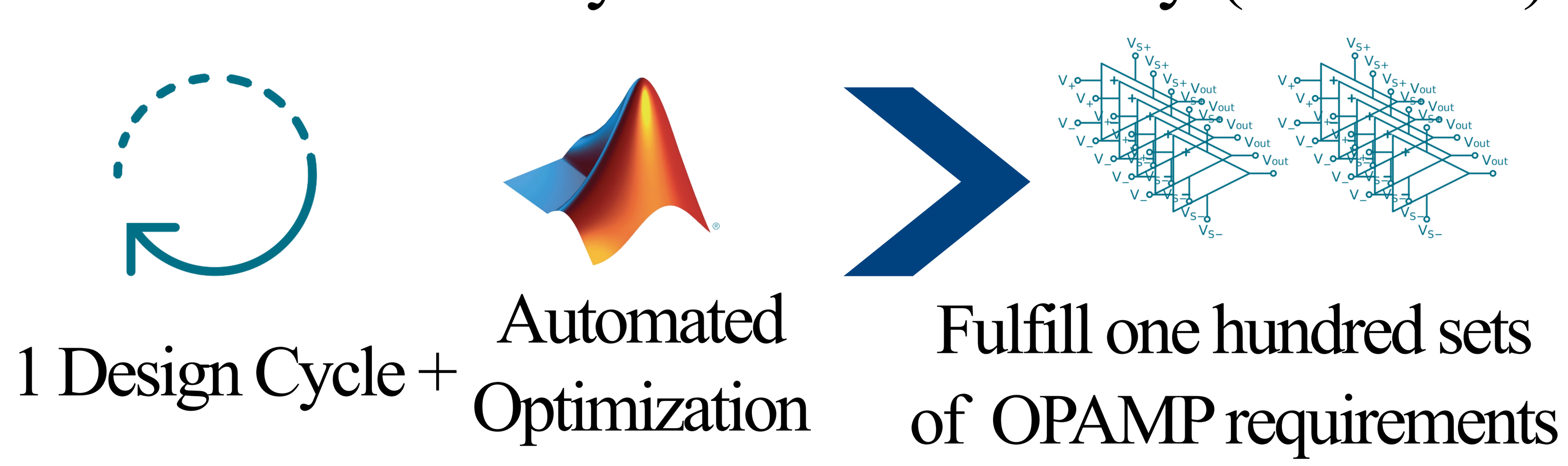
Background

An essential step of Designing an Integrated Circuit involves solving the design problem; that is to find design parameters that meet requirements by hand is challenging and time intensive. Many OPAMP blocks with unique requirements are used in one VLSI. Finding a globally optimal solution to the design problem requires years of experience.



Milestones

1. Design OPAMP circuit by Hand (Week 7)
2. Create tool to solve design problem (Week 15)
3. Simulate to verify tool functionality (Week 20)

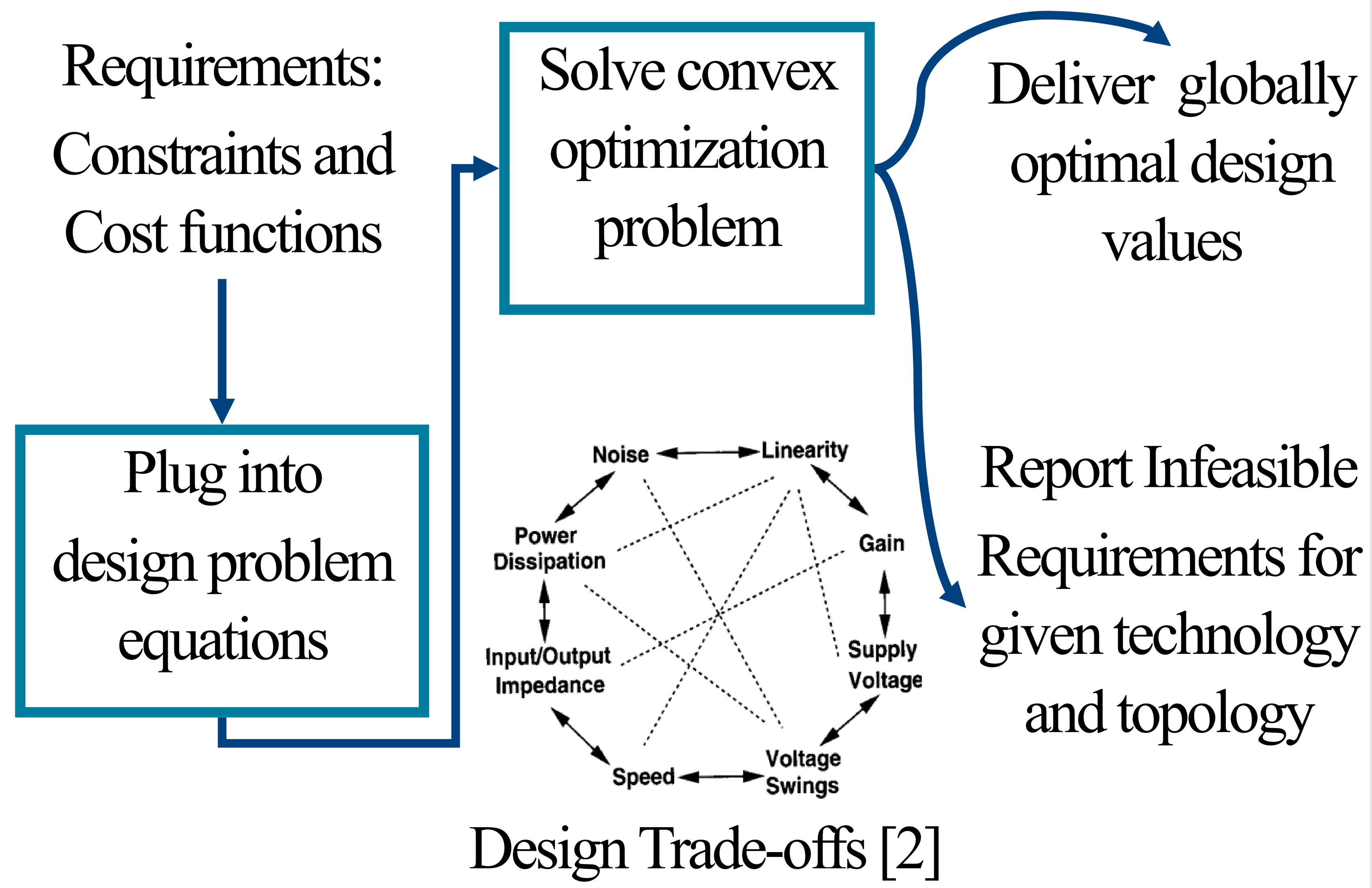


Tools Needed

cādence MathWorks

Project Goal

Design an OPAMP by hand to get a feel for the process. Create a tool that solves the design problem for Miller Compensated Two-Stage OPAMP topology. Formulate the design problem as a geometric program [1]. Reformulate geometric program as a convex optimization problem [1]. Solve efficiently for a globally optimal solution [1].



Design Trade-offs [2]

References

[1] M. d. Hershenson, S. P. Boyd and T. H. Lee, "Optimal design of a CMOS op-amp via geometric programming," in *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems*, vol. 20, no. 1, pp. 1-21, Jan. 2001.

[2] B. Razavi, *Design of analog CMOS integrated circuits*. McGraw-Hill Educaition, 2001.

[3] N. Gougol, "CMOS Operational Amplifier Design," EECS Department, University of California-Berkeley, CA, UCB/EECS-2016-223. Dec. 2016.

Completed Work

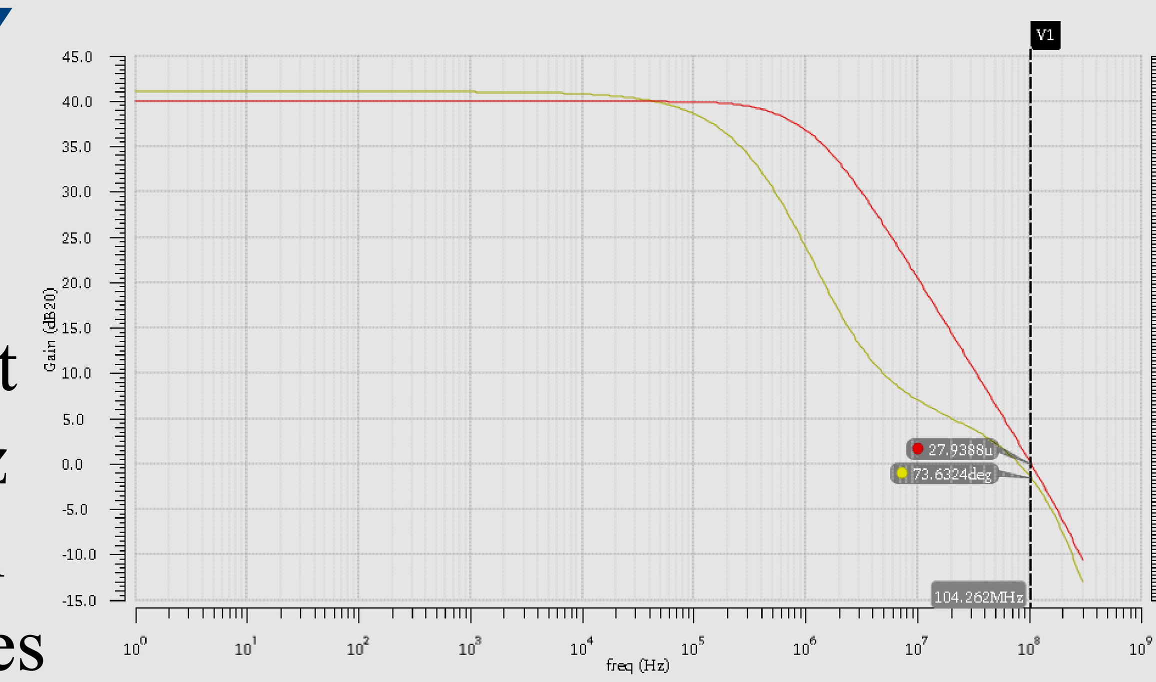
1. Setup Design and Simulation Environment
2. Design OPAMP on 45nm tech by hand [3].

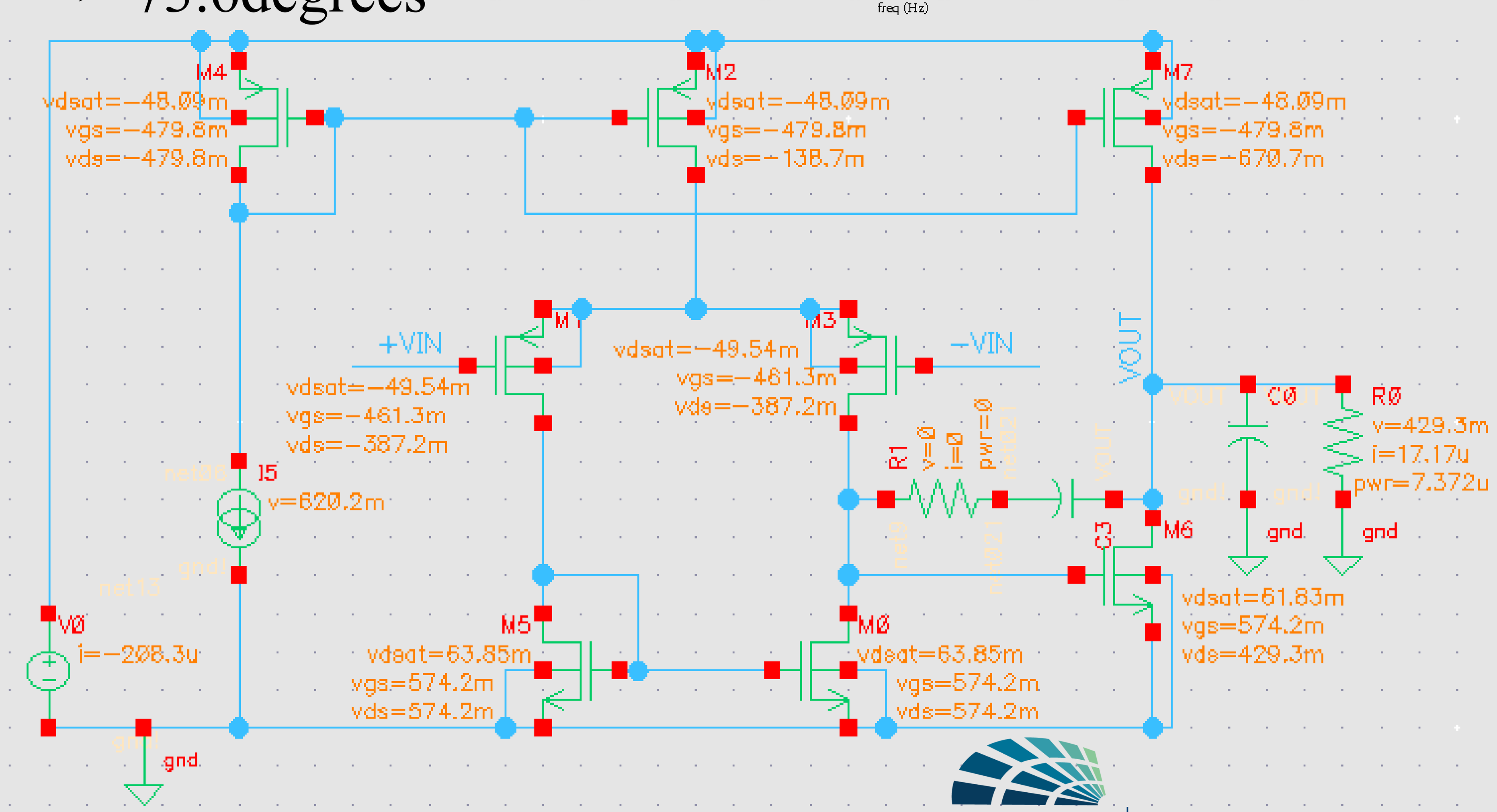
Future Work

1. Understand and Write Equations of DC Gain, GBW Product, Stability, CMRR, Noise.
2. Formulate equations as geometric program.
3. Reformulate as convex optimization problem.
4. Solve for globally optimal design.

Summary

1. DC Gain
→ 39.9dB
2. GBW Product
→ 104.2MHz
3. Phase Margin
→ 73.6degrees





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