Optimal Design of a CMOS Op-amp via Geometric Programming

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- Tech report: opamp.pdf
- Final TCAD version: opamp_tcad.pdf
- Talk: opamp_talk.pdf

Some related papers:

- Hershenson, Boyd, and Lee, *CMOS operational amplifier design and optimization via geometric programming*, *Proceedings of the First International Workshop on Design of Mixed-mode Integrated Circuits and Applications*, Cancun, Mexico, pp.15-18, July 1997. opamp_cancun.pdf
- Hershenson, Boyd, and Lee, *Automated design of folded-cascode op-amps with sensitivity analysis*, *5th IEEE International Conference on Electronics, Circuits and Systems*, Lisbon, 1:121-124, September 1998. cascode.pdf

We describe a new method for determining component values and transistor dimensions for CMOS operational amplifiers (op-amps). We observe that a wide variety of design objectives and constraints have a special form, *i.e.*, they are posynomial functions of the design variables. As a result the amplifier design problem can be expressed as a special form of optimization problem called geometric programming, for which very efficient global optimization methods have been developed. As a consequence we can efficiently determine globally optimal amplifier designs, or globally optimal trade-offs among competing performance measures such as power, open-loop gain, and bandwidth. Our method therefore yields completely automated synthesis of (globally) optimal CMOS amplifiers, directly from specifications. In this paper we apply this method to a specific, widely used operational amplifier architecture, showing in detail how to formulate the design problem as a geometric program. We compute globally optimal trade-off curves relating performance measures such as power dissipation, unity-gain bandwidth, and open-loop gain. We show how the method can be used to synthesize robust designs, *i.e.*, designs guaranteed to meet the specifications for a variety of process conditions and parameters.