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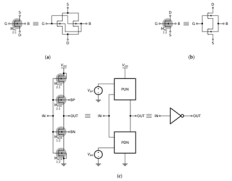
Selected Papers

DOI:10.3390/electronics10080935

Self-Biased and Supply-Voltage Scalable Inverter-Based Operational Transconductance Amplifier with Improved Composite Transistors

Authors: Luis Henrique Rodovalho, Cesar Ramos Rodrigues and Orazio Aiello

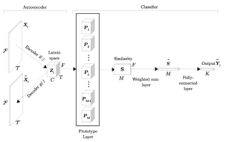


Abstract: This paper deals with a single-stage single-ended inverter-based Operational Transconductance Amplifiers (OTA) with improved composite transistors for ultra-low-voltage supplies, while maintaining a small-area, high power-efficiency and low output signal distortion. The improved composite transistor is a combination of the conventional composite transistor and forward-body-biasing to further increase voltage gain. The impact of the proposed technique on performance is demonstrated through post-layout simulations referring to the TSMC 180 nm technology process. The proposed OTA achieves 54 dB differential voltage gain, 210 Hz gain–bandwidth product for a 10 pF capacitive load, with a power consumption of 273 pW with a 0.3 V power supply, and occupies an area of 1026 μm^2. For a 0.6 V voltage supply, the proposed OTA improves its voltage gain to 73 dB, and achieves a 15 kHz gain–bandwidth product with a power consumption of 41 nW.

DOI:10.3390/electronics10070850

An Interpretable Deep Learning Model for Automatic Sound Classification

Authors: Pablo Zinemanas, Martín Rocamora, Marius Miron, Frederic Font and Xavier Serra



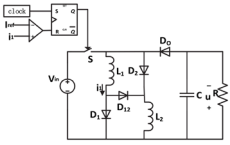
Abstract: Deep learning models have improved cutting-edge technologies in many research areas, but their black-box structure makes it difficult to understand their inner workings and the rationale behind their predictions. This may lead to unintended effects, such as being susceptible to adversarial attacks or the reinforcement of biases. There is still a lack of research in the audio domain, despite the increasing interest in developing deep learning models that provide explanations of their decisions. To reduce this gap, we propose a novel interpretable deep learning model for automatic sound classification, which explains its predictions based on the similarity of the input to a set of learned prototypes in a latent space. We leverage domain knowledge by designing a frequency-dependent similarity measure and by considering different time-frequency resolutions in the feature space. The proposed model achieves results that are comparable to that of the state-of-the-art methods in three different sound classification tasks involving speech, music, and environmental audio. In addition, we present two automatic methods to prune the proposed model that exploit its interpretability. Our system is open source and it is accompanied by a web application for the manual editing of the model, which allows for a human-in-the-loop debugging approach.

DOI: 10.3390/electronics10040452

Dynamic Analysis of the Switched-Inductor Buck-Boost Converter Based on the Memristor

Authors: : Yan Yang, Dongdong Li and Dongqing Wang

Abstract: The direct current (DC)–DC converter presents abundant nonlinear phenomena, such as periodic bifurcation and chaotic motion, under certain conditions. For a switched-inductor buck-boost (SIBB) converter with the memristive load, this paper constructs its state equation model under two operating statuses, investigates its chaotic dynamic characteristics, and draws and analyzes the bifurcation diagrams of the inductive current and phase portraits, under some parameter changing by the MATLAB simulation based on the state equation. Then, by applying certain minor perturbations to parameters, the chaotic phenomenon suppression method is explored by controlling peak current in continuous current mode (CCM) to keep the converter run normally. Finally, the power simulation (PSIM) verifies that the waveforms and the phase portraits controlling the corresponding parameters are consistent with those of the MATLAB simulation.

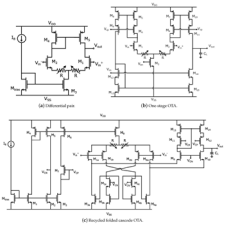


DOI: 10.3390/electronics10243148

On the Sizing of CMOS Operational Amplifiers by Applying Many-Objective Optimization Algorithms

Authors: Martín Alejandro Valencia-Ponce, Esteban Tlelo-Cuautle and Luis Gerardo de la Fraga

Abstract: In CMOS integrated circuit (IC) design, operational amplifiers are one of the most useful active devices to enhance applications in analog signal processing, signal conditioning and so on. However, due to the CMOS technology downscaling, along the very large number of design variables and their trade-offs, it results difficult to reach target specifications without the application of optimization methods. For this reason, this work shows the advantages of performing many-objective optimization and this algorithm is compared to the well-known mono- and multi-objective metaheuristics, which have demonstrated their usefulness in sizing CMOS ICs. Three CMOS operational transconductance amplifiers are the case study in this work; they were sized by applying mono-, multi- and many-objective algorithms. The well-known non-dominated sorting genetic algorithm version 3 (NSGA-III) and the many-objective metaheuristic-based on the R^2 indicator (MOMBI-II) were applied to size CMOS amplifiers and their sized solutions were compared to mono- and multi-objective algorithms. The CMOS amplifiers were optimized considering five targets, associated to a figure of merit (FoM), differential gain, power consumption, common-mode rejection ratio and total silicon area. The designs were performed using UMC 180 nm CMOS technology. To show the advantage of applying many-objective optimization algorithms to size CMOS amplifiers, the amplifier with the best performance was used to design a fractional-order integrator based on OTA-C filters. A variation analysis considering the process, the voltage and temperature (PVT) and a Monte Carlo analysis were performed to verify design robustness. Finally, the OTA-based fractional-order integrator was used to design a fractional-order chaotic oscillator, showing good agreement between numerical and SPICE simulations.



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Guest Editors: Andrea Ballo, Gaetano Palumbo and Orazio Aiello
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Guest Editors: Costas Psychalinos, Ahmed S. Elwakil, Abdelali El Aroudi and Esteban Tlelo-Cuautle
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