

Preface

Sigma-Delta Modulators ($\Sigma\Delta$) have gained a lot of ground over the last several years as one of the premier solutions in signal conversion, for low frequency, high-resolution applications. $\Sigma\Delta$ s use negative feedback to reduce the quantization error, where a filter circuit is placed before the quantizer in order to define the frequency band where the quantization error is attenuated.

This filter is traditionally built using ideal integrator stages, implemented with operational amplifiers (OpAmps) in an integrator configuration. These OpAmps require a large DC gain and bandwidth in order for the behaviour of the integrator circuits to be close to the ideal integrator behaviour. If the $\Sigma\Delta$ is built using discrete components in a Continuous-Time (CT) design, it is difficult to find fully differential OpAmps, resulting in a circuit that uses a single ended topology with all the disadvantages associated.

The work reported in this book focuses on the design of a 3rd Order CT- $\Sigma\Delta$ where the integrator stages of the filter are implemented with Bipolar-Junction Transistors (BJT) differential pairs. By replacing the OpAmps with differential pairs, it is possible to build an equivalent filter circuit for the $\Sigma\Delta$ using lossy integrators. The finite gain and bandwidth of the differential pairs can be accommodated during the filter design process.

Both 1-bit and 1.5-bit quantization are studied, as well as the effect of spreading the zeros of the CT- $\Sigma\Delta$ along the signal bandwidth. Electrical simulations and experimental results validate the feasibility of the proposed design and demonstrate that it is possible to design a CT fully-differential BJT-based $\Sigma\Delta$ with a performance fairly similar to that of a OpAmp-based $\Sigma\Delta$, without an increase in power dissipation and area.

Design and Implementation of Sigma Delta Modulators
($\Sigma\Delta$ M) for Class D Audio Amplifiers using Differential
Pairs

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