

On the Study of Improving Noise Shaping Techniques in Wide Bandwidth Sigma Delta Modulators

By

Du Yun

**Master Degree in
Electrical and Electronics Engineering**

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Faculty of Science and Technology

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Supervisor: Dr. Sai-Weng Sin

Co-supervisor: Prof. Seng-Pang U

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ABSTRACT

As with the development of the wireless telecommunications technologies, the demands of mobile applications by consumers and the robust network bandwidth management by supplier increases explosively, speeds up the adoption and deployment of 4G network in recent years, which benefits from its high speed, relative low cost and high security. To catch up with such requirements of 4G, the most important interface, analog-to-digital converter, inside the 4G network is constantly being improved. One most suitable type of ADCs for such high speed is sigma-delta modulator, with the attractive property of noise shaping performance. In this thesis, I will focus on this property to improve, meanwhile to overcome some limitations of the old methods.

The first part is based on the zero optimization method. One new loop filter structure is designed with the relaxed zero shifting feedback coefficient. This proposed structure couples one local positive feedback with 2 negative feedbacks to balance the NTF. The same zero optimization performance is achieved with a more comfortable value of feedback by several times, which makes the circuit realization much easier.

The second part is based on the order increasing method. To release the power budget, VCO-based SDM for multi-bit quantization is selected. In case of high resolution, The proposed structure with VCO-assisted VCO-based quantizer is designed for reducing the nonlinearity of VCO itself, while maintaining the implicit DEM function and intrinsic additional first order noise shaping performance of VCO-based quantizer.

Key Words

Discrete Time Sigma Delta Modulator

Continuous Time Sigma Delta Modulator

Noise Shaping Technique

Zero Optimization

VCO-based Quantizer

VCO-assisted VCO-based Sigma Delta Modulator



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To
My Family and
My Sister's Daughter



List of Abbreviations

<i>AFF</i>	Analog Feed-forward
<i>ADC</i>	Analog-to-Digital Converter
<i>B</i>	Bit
<i>BW</i>	Bandwidth
<i>CMOS</i>	Complementary Metal Oxide Semiconductor
<i>CMFB</i>	Common mode feedback
<i>CT</i>	Continuous Time
<i>DAC</i>	Digital-to-Analog Converter
<i>DBB</i>	Digital Base Band
<i>DC</i>	Direct Current
<i>DEM</i>	Dynamic Element Matching
<i>DFF</i>	D-Flip-Flop
<i>DNL</i>	Differential Non-Linearity
<i>DT</i>	Discrete Time
<i>DR</i>	Dynamic Range
<i>DWA</i>	Data Weight Averaging
<i>ELD</i>	Excess Loop Delay
<i>ENOB</i>	Effective Number of Bit
<i>GBW</i>	Unity Gain Frequency
<i>GSM</i>	Global System for Mobile Communications
<i>HD</i>	Harmonic Distortion
<i>HSPA</i>	High Speed Packet Access
<i>IC</i>	Integrated Circuit
<i>INL</i>	Integral Non-linearity
<i>LSB</i>	Least significant bit
<i>MASH</i>	Multi-Stage Noise Shaping
<i>MSB</i>	Most significant bit
<i>N</i>	Number of Quantization Bit
<i>NMOS</i>	N-Channel Metal Oxide Semiconductor
<i>NRZ</i>	Non-Return Zero
<i>NTF</i>	Noise Transfer Function
<i>Op-amp</i>	Operational Amplifier
<i>OSR</i>	Over-Sampling Ratio
<i>PA</i>	Power Amplifier
<i>PMOS</i>	P-Channel Metal Oxide Semiconductor
<i>PSD</i>	Power Spectral Density
<i>RZ</i>	Return Zero
<i>SC</i>	Switched capacitor

<i>SDM</i>	Sigma-Delta Modulator
<i>SFDR</i>	Spurious-Free Dynamic Range
<i>SI</i>	Switched current
<i>SNDR</i>	Signal-to-Noise-and-Distortion Ratio
<i>SNR</i>	Signal-to-Noise Ratio
<i>SR</i>	Slew rate
<i>STF</i>	Signal Transfer Function
<i>THD</i>	Total Harmonic Distortion
<i>VCO</i>	Voltage Controlled Oscillator
<i>3G</i>	Third Generation
<i>4G</i>	Forth Generation
<i>TD-SCDMA</i>	A Time Division Synchronous Code Division Multiple Access
<i>WCDMA</i>	Wideband Code Division Multiple Access
Δ	Step-Size
$\Sigma\Delta$	Sigma-Delta
C_S	Sampling Capacitor
C_I	Integration Capacitor
C_f	Feedback Capacitor
G_m	Transconductance of a Transistor
f_s	Sampling Frequency
T_s	Sampling Time
V_{CM}	Common-Mode Voltage
V_{DD}	Supply Voltage
V_p	Signal Amplitude



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