A 1/f noise optimized correlated multiple sampling technique for CMOS image sensor

liu yalei[1], Jiangtao Xu[1], Wanbin Zha[1], and Kaiming Nie[1]

[1]Tianjin University School of Microelectronics

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Abstract

Summary: This paper proposes a 1/f noise optimized correlated multiple sampling (NOCMS) technique based on differentiated sampling weights for CMOS image sensor. Transfer functions of standard CMS and NOCMS for analyzing the suppression effect of random noise respectively are derived based on the Fourier Transform theory. NOCMS shows a dramatic advantage in the suppression of 1/f noise. For implementing NOCMS, the ramp generator provides multiple sets of ramps with different slopes to quantize the reset and signal voltages. Sampling weights are increased with the decrease of ramp slopes. The last reset and first signal values are weighted more due to their potentially higher correlations. Simulation results under 110nm CMOS technology illustrate that the ADC achieves DNL of -0.80/+0.70LSB and INL of -0.70/+0.90LSB after the NOCMS operation. The input-referred random noise is 142.9μV $_{\text{rms}}$ under standard CMS and 120.9μV $_{\text{rms}}$ under NOCMS when the number of samples equals 8. The noise reduction effect is improved by 15%. NOCMS makes it possible to further reduce 1/f noise of CMOS image sensor.

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