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Low Noise, Low Distortion CMOS Front-End For PoC Biomedical Sensing Applications

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Most common patient treatment procedures are performed by taking blood samples in the human body, analyzing them in the laboratory and providing medications based on the test results. This conventional procedure however, has the drawback of lengthy, time consuming treatment cycles and prevents real time monitoring of disease progress. This drawback stems mainly because of the use of bulky, expensive laboratory instruments and one way to overcome this drawback would be to replace them with highly miniaturised portable biomedical sensing systems. The goal of the project **IsyPeM (Intelligent Integrated Systems for Personalized Medicine)** is to realize such a biomedical system with the purpose being to shorten treatment times, enable real time monitoring of disease progress and facilitate quicker, simpler and more personalized patient treatments.

Point-of-Care (PoC) Biomedical Sensing

Low Noise, Low Distortion CMOS Front-End

The work presented here is related to the biosensor front-end that does the initial signal processing in the biomedical sensing system (Fig. 2).

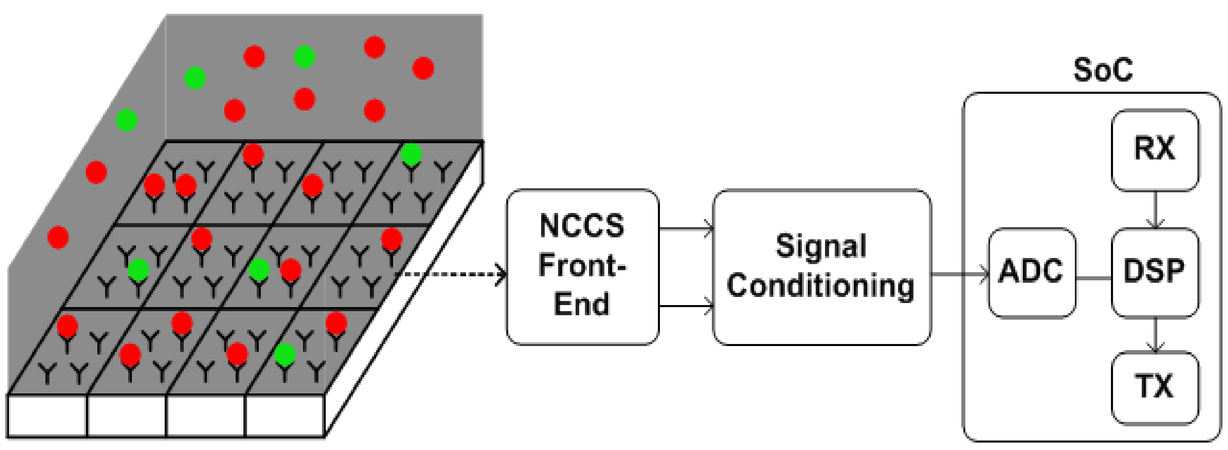

Fig. 2 Biomedical Sensor Interface

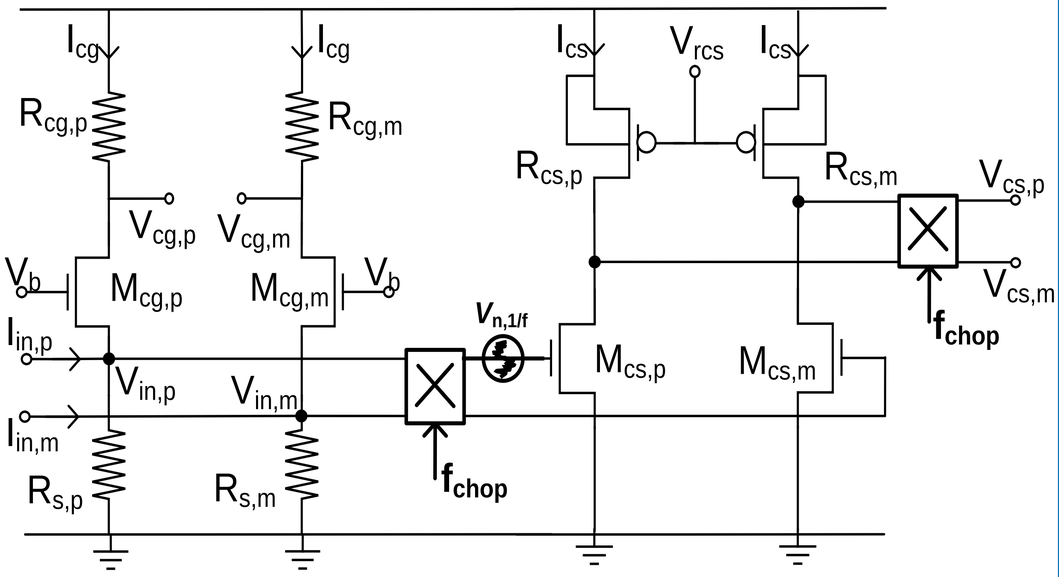

Fig. 4 Front-End.

The proposed front-end is a transimpedance amplifier with the low noise and improved linearity features achieved using **canceling techniques**. In the proposed front-end, we first take advantage of the canceling principle to reject the 1/f noise and distortion in the primary stage by gain matching (Fig. 3) and subsequently we use chopping, distortion optimization to minimize the auxiliary stage 1/f noise and distortion (Fig. 4). By employing the above techniques, the resulting front-end is almost **1/f noise free, exhibits lower distortion and provides higher dynamic range at minimal low power consumption**.

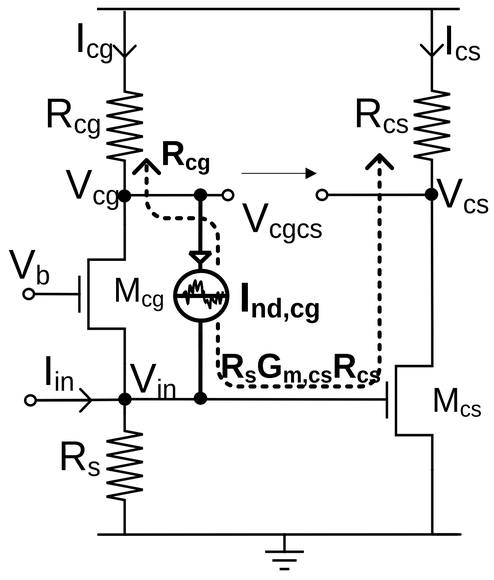

Fig. 3 Canceling Topology.

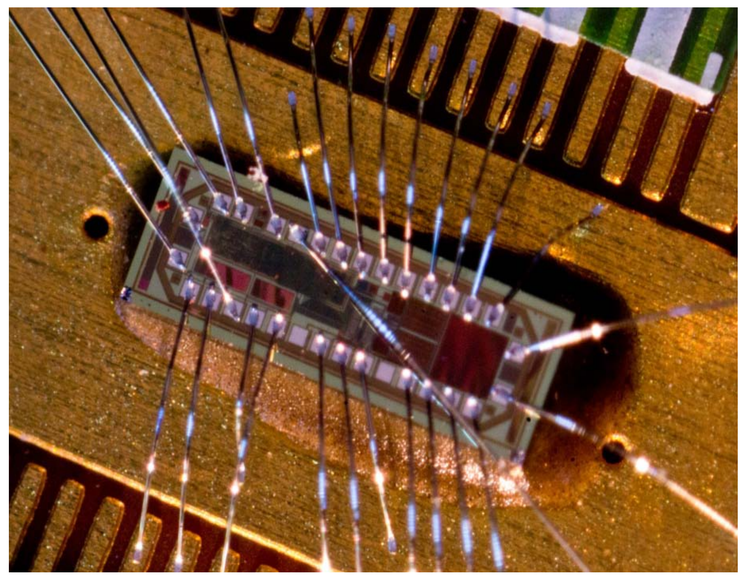

Fig. 5 0.18µ Biosensor Front-End

Results

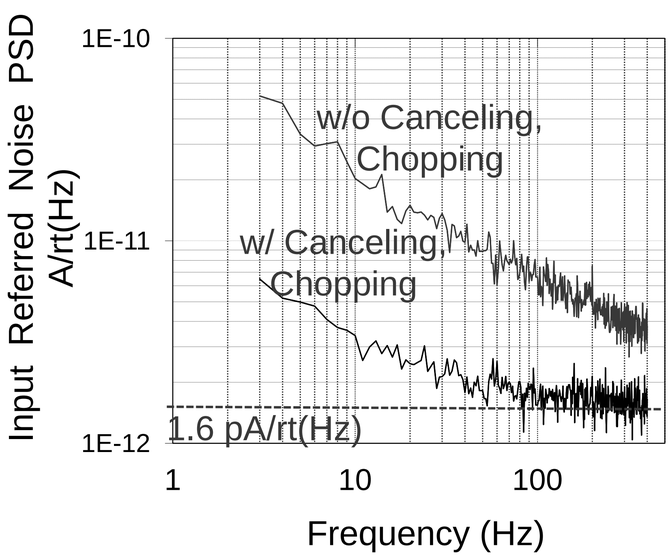

Fig. 6 Measured Input Referred Noise PSD.

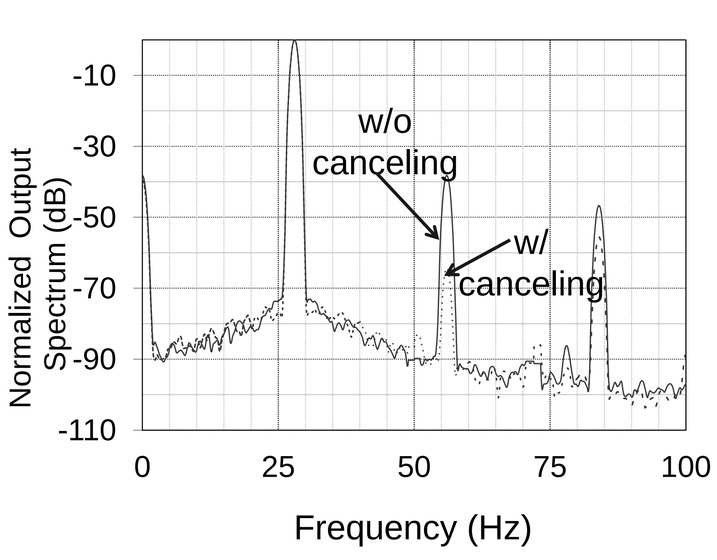

Fig. 7 Normalized Output Spectrum showing HD canceling.

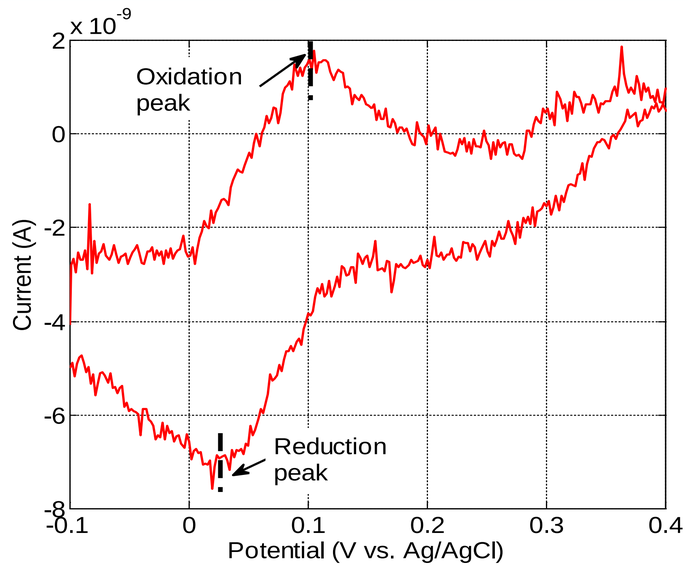

Fig. 8 Detected Front-End Response from CV Tests.

The proposed front-end along with a second gain stage has been integrated in a 0.18 µm CMOS process and consumes **50 µA** from a 1.8 V supply voltage.

Figs. 6 and 7 shows the effect of canceling and chopping in the front-end. Fig. 8 shows the detected front-end response from the CV tests.