ABSTRACT

A Current Balancing Instrumentation Amplifier (CBIA) Bioamplifier with High Gain Accuracy

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Ebenezer Dwobeng

Chair of Advisory Committee: Edgar Sanchez-Sinencio

Electrical signals produced in the human body can be used for medical diagnosis and research, treatment of diseases, pilot safety etc. These signals are extracted using an electrode (or transducer) to convert the ion current in the body to electron current. After the electrode, the very low amplitude extracted signal is amplified by an analog frontend that typically consists of an instrumentation amplifier (IA), a programmable gain amplifier (PGA), and a low pass filter (LPF). The output of the analog frontend is converted to digital signal by an analog to digital converter (ADC) for subsequent processing in the digital domain. This thesis discusses the circuit design challenges of the analog frontend instrumentation amplifier, compares existing circuit topologies used to implement the IA and proposes a new frontend IA. The proposed circuit uses the Current Balancing Instrumentation Amplifier (CBIA) topology to achieve high gain accuracy over a wide range of the output impedance. In addition it uses common circuit design techniques such as chopper modulation to achieve low flicker noise corner frequency, high common mode rejection (CMRR) and low noise efficiency factor (NEF). The proposed circuit has been implemented in the 0.5um CMOS ON-semiconductor process and consumes 16uW of power. The post-layout simulated gain accuracy is better than 94% for gain values from 20dB to 60dB, measured NEF is 7.8 and CMRR is better than 100dB.