Abstract – We present an 8-channel biomedical data acquisition ASIC achieving 108dB of dynamic range (DR). Each channel includes a 13bit DAC to compensate differential input offset of up to ±300mV, preventing saturation of the high-gain instrumentation amplifier. Chopper stabilization and DAC-noise low-pass filtering lead to an input-referred noise of 0.8µV RMS. Data processing algorithms, implemented on an FPGA, are employed to remove artifacts due to sudden DAC-switching and to cancel 50/60Hz mains interference including its harmonics. The chip is fabricated in 130nm CMOS, occupying an active area of 2.2mm² and consuming 15mW from 1.2V and 3.3V supplies.

1. System Overview

- **Data Acquisition ASIC**
  - ECG/EEG signals acquisition
  - Electrode impedance meas.
  - Temperature sensor
- **Xilinx Spartan 6 FPGA**
- **Signal processing**
  - Chopper-stabilized IA [3]
  - 82dB SNR (13.3 ENOB) 8x ADC
  - 8 electrode channels
  - 2 aux. channels
  - 1.2V & 3.3V supply
  - 15mW max. power

2. Data Acquisition ASIC

- **Main features**
  - 130nm CMOS
  - 2.19mm² area
  - 8 electrode channels
  - 2 aux. channels
  - 1.2V & 3.3V supply
  - 15mW max. power

3. Analogue Front-End

- **Chopper-stabilized IA [3]**
- **3.2kHz low-pass filter**
- **±300mV electrodes offset compensation DAC**
- **8-channels MUX**
- **82dB SNR (13.3 ENOB) ΣΔ ADC**
- **8kS/s max. sampling rate**

4. Digital Data Processing

- **Mains interference cancellation**
  - by subtraction of a noise replica
- **Power line harmonics removal**
- **Optional high-pass filtering**
- **Reconfigurable decimation**

5. Measurement Results

- **Low IR noise of 0.82 µV_RMS**
- **107dB max. DR due to compensation DAC**
- **Moderate impact of DAC on noise performance**
- **High CMRR (101dB) and input impedance (235MΩ)**

6. Performance Summary

<table>
<thead>
<tr>
<th>Analog. Bandwidth</th>
<th>Sample Rate</th>
<th>8kS/s</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.2kHz</td>
<td>107.6dB</td>
<td></td>
</tr>
<tr>
<td>±300mV</td>
<td>Max. SFDR^2</td>
<td>66dB</td>
</tr>
<tr>
<td>82mV/√Hz</td>
<td>Imp. Impedance</td>
<td>235kΩ</td>
</tr>
<tr>
<td>82mV/√Hz</td>
<td>RMS IR Noise^3</td>
<td>0.82µV</td>
</tr>
</tbody>
</table>

References: