Integrated Circuit Design for Implantable Multi-Target Biosensor

Sara Ghoreishizadeh, Sandro Carrara, and Giovanni De Micheli
Integrated system laboratory, EPFL, Switzerland

Design goals
- Enough low power to be remotely powered and implantable.
- Flexible to cover a wide range of biosensors with very different characteristics.
- Intelligent to keep the patch side implementation simple.
- Enable high accuracy measurements.
- Be attached to different implantable to patch communication scheme.

Architecture of the configurable Interface Electronics IC

1. An optimal tradeoff between features and power/area budget is implemented.
2. A second order sigma-delta modulator (OSR 256, 1kHz BW) and a digital CIC filter is designed to realize 14 bit ADC.
3. A 9-bit DAC is shared to provide different voltage profiles for different types of sensor control/measurement.
4. A configurable multi-target platform to activate and read-out data from 7 sensing sites is designed.
5. Two sensing sites are dedicated to pH and temperature for calibration.
6. Sensor conditioning is realized in parallel to the measurements.

Temperature measurement

- A Platinum Resistance Temperature Detection (Pt RTD) is designed close to the sensing area.
- A resistance difference to pulse-width converter is designed to readout the temperature sensor.

Multi-purpose readout circuit

- A common circuit for Cyclic voltammetry, Chronoamperometry, and PH readout is designed.
- The circuit is designed to remain stable for different sensors with different characteristics.

Layout
✓ Implemented in: 0.18um UMC Technology
✓ Power consumption: 700 µW
✓ Area: 1.5mm*3mm

Prototype of the implantable device

Reference: Sara Ghoreishizadeh, Sandro Carrara, and Giovanni De Micheli, "A configurable IC to control, readout, and calibrate an array of biosensors", submitted.