**Research Background and Goal**

**Background**
- Treating method of severe mental disorder
- Development of new BMI (Brain Machine Interface)
- Deep research of neural signal and synaptic signal is needed!

**Goal**
- Development of device obtaining minute signals

**Research subjects**
- Reliable ADC
- System requirement
- Power supply circuit
- Implementation

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**Reliable ADC Design**

**SAR ADC using redundancy**

- **Proposed solution**
  - Using Fibonacci sequence for p(k): \( p(k) = F_{n+1} \)
- Binary weight: \( 64, 32, 16, 8, 4, 2, 1 \)
- Radix 1.8 weight: \( 34.0, 18.9, 10.5, 5.8, 3.2, 1.8, 1 \)
- Radix 1.62 weight (Radix 1.62 weight)
- Property converging to “Golden ratio”
- Realize radix 1.62 weight by using only integers!

**Effective ADCs in incompletely settling**

- Advantage of DAC
-\[
    \text{ADC settling time} = \frac{1}{2} \left( \frac{V_{ref}}{2^N} \right) \left( 1 + \frac{2^N}{2^N - 1} \right)
\]
- Fibonacci SAR ADC is faster than radix SAR ADC!

**High efficiency**

- **Previous work**
  - To confirm simulation result of basic SIDO converter operation using ZVS-PWM control
- **This work**
  - To implement ZVS-PWM control into SISO boost converter

**Comparison of switching waveforms**

- Boost SISO without ZVS
  - Power loss: \( P_{sw} = 102mV \)
  - Switching loss: \( P_{sw} = \frac{2}{3} \cdot V \cdot I \cdot \Delta t \)
- Boost SISO with ZVS
  - Power loss: \( P_{sw} = 16mV \)
  - 64% reduction

**Future Works**

- Reliable ADC
  - Verification with actual equipment
- **System requirement**
  - High-efficiency noise guard
  - Analysis of notch characteristic
  - ZVS-PWM control implementation into SIDO boost-boost converter
- **System requirement consideration**
  - Characterization of neural and synaptic signals
  - Program development to extract features
  - Extraction of changing pattern around electrode
- **Design and prototype of data transmission**
  - Neural signal acquisition
  - More small-scale transmission device realization

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**System Requirement**

- Fusion of biology, brain science and electronics
- To get beneficial information from activity change of neurons and synapses nearby a probe
- System requires as following:
  1. Measurement of activity voltage at synapse
  2. Drebrins gather at synapse
  3. Degrees of gliosis are few

**Transmission Device**

- Transmission experiment of prototype device
- Develop sub-system to realize coding/decoding signal transmission and communication

**Future Works**

- Our challenge is underway