Electrode Agnostic, Supply Variant Stimulation Engine For Implantable Neural Stimulation

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SUMMARY

UCLA researchers in the Department of Electrical Engineering have invented an innovative universal agnostic electrode for implantable neural stimulation and sensing.

BACKGROUND

Neural stimulators in a neuromodulation (NM) unit play a significant role in every neural treatment, where the stimulator's power dominates the overall NM power and its integrated circuit (IC) design is driven by electrode performance (e.g., impedance, contact size). Different applications need different types of electrodes (e.g., deep brain stimulation, epiretinal stimulation), where macro and micro electrode contacts have a large range in tissue-electrode capacitances (nF – μF). In order to support various electrodes and a large range of stimulation current, it is crucial to have a stimulation mechanism that is not electrode dependent.

INNOVATION

Researchers led by Professor Dejan Markovic have developed a novel universal electrode agnostic stimulation engine that is fully programmable and supply rails are variable to further save power, with an increased battery life up to 15x in overall NM applications. This system shows superior current matching and makes concurrent stimulation and sensing possible during the simultaneous, multichannel, differential stimulation. This technique has a very precise, high-compliance, and ultra-high output resistance current mirror for the source/sink part of the stimulation engine (SE), which is also superior in gathering super-high output impedance. Additionally, this system can be fabricated fully on-chip.

APPLICATIONS

- Universal agnostic electrode for a variety of implant applications
- Implantable neural stimulation and recording
- Deep brain stimulation
- Epiretinal stimulation

ADVANTAGES

- Universal electrode for an array of neural simulation applications
- Simultaneous stimulation and sensing
- Very precise, high-compliance, and ultra-high output resistance current mirror
- Super-high output impedance and high accuracy
- 15x increased battery life
- Fabricated fully on-chip

STATE OF DEVELOPMENT

Two prototype stimulation ICs have been designed. The first IC has four stimulation engines and can drive up to 32 stimulation cites and the second stimulator block includes eight engines that can be individually programmed for monopolar/differential stimulation.

PATENT STATUS

Country	Type	Number	Dated	Case

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INVENTORS

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OTHER INFORMATION

KEYWORDS

Electrode agnostic, universal agnostic electrode, supply variant stimulation engine, current mirror, integrated circuit, IC, neuromodulation, implantable neural stimulation, implants, neural recording, deep brain stimulation, epiretinal stimulation

CATEGORIZED AS

- **Biotechnology**
  - Other
- **Engineering**
  - Engineering
  - Other
- **Medical**
  - Devices
  - Other
- **Sensors & Instrumentation**
  - Biosensors
  - Medical

RELATED CASES

2017-511-0

United States Of America	Issued Patent	11,311,728	04/26/2022	2017-511

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Scalable Parameterized VLSI Architecture for Compressive Sensing Sparse Approximation
- Autonomous Thermoelectric Energy-Harvesting Platform for Biomedical Sensors
- A Simple, Area-Efficient Ripple-Rejection Technique for Chopped Bio-Signal Amplifiers
- Saturation-Tolerant Electrophysiological Recording Interface
- Load Adaptive, Reconfigurable Active Rectifier for Multiple Input Multple Output (MIMO) Implant Power Management
- A High Dynamic-Range Sensing Front-End For Neural Signal Recording Systems
- A Distance-Immune Low-Power Inductively-Coupled Bidirectional Data Link

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