Docket #: S17-416

Frequency-based multiplexing technique for high density recording of electrodes

Stanford researchers have designed a frequency-multiplexed neural probe architecture that enables massive scaling of electrophysiological recording from neurons.

Multiplexing of many electrodes for brain neuron sensing is extremely difficult due to the requirement of using very little physical space. An array of "oscillatrodes" (oscillator-under-electrodes) are distributed along a probe and the outputs are coupled and transmitted using a single wire to overcome the space limitation. One application is for brain machine interface (BMI) to help paralysis patients regain functionality for improved quality of life.

A 65-nm CMOS prototype including eight ring oscillators has been implemented for study and characterization.

Figure:

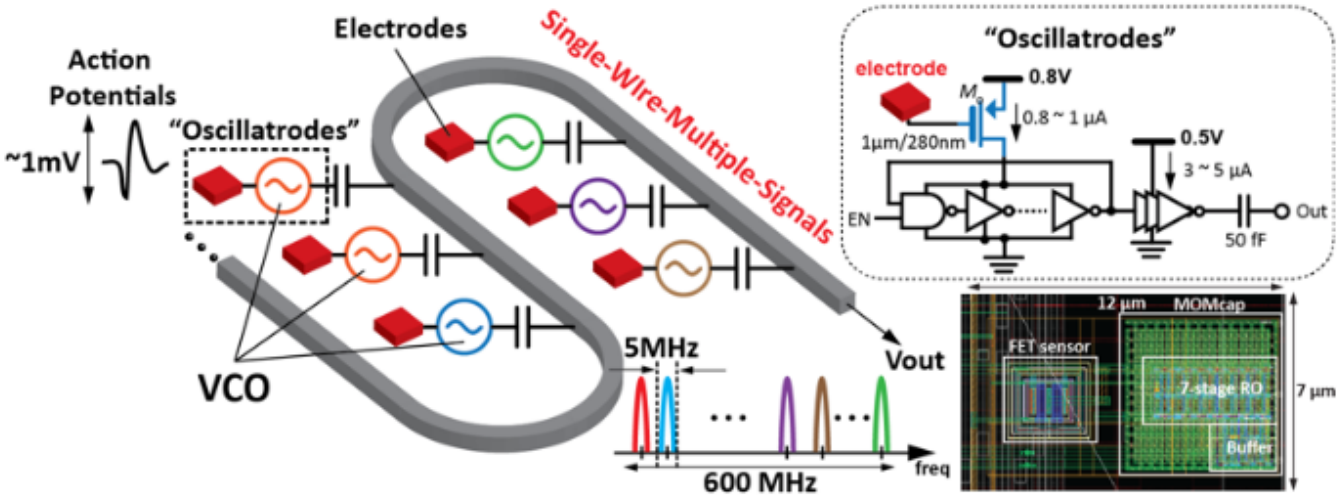

Figure Description: Frequency-multiplexed neural probe using oscillatrodes.

Stage of Development:

- **Testing second prototype** - A 65-nm CMOS prototype including eight ring oscillator

Applications

- **Brain Machine Interface (BMI)** - neural probes on brain cortex, surface electrodes on brain cortex
- **Therapeutic applications:**
  - Neurodegenerative diseases
  - Spinal cord injuries
  - Clinical research
- **Other applications include but are not limited to:** retina implant, cell-based assay for drug screening, Internet-of-Things (IoT), CMOS imager, 2D ultrasound transducer, MRI coil array detection, DNA microarrays, DNA sequencing arrays, high-energy physics experiments, and Large-scale IoT wireless sensor networks

Advantages

- **High-throughput** simultaneous recording at massive scale
- **Multiplexed onto a single wire** overcoming space limitations
- **High spatial and temporal resolution**
- **Other techniques cannot achieve all of the following five performance metrics simultaneously:** (1) high pixel density (2) reduced number in the interconnect counts (3) reduced shank width in neural probe platform (4) miniaturized implant size (5) scalable wireless connectivity

Publications

- IEEE EMBC NER Conference 2019 9th International IEEE/EMBS Conference on Neural Engineering (NER) March 20-23, 2019, San Francisco, CA, USA, Paper FrPO.190 "A Study of Frequency-Multiplexed "Oscillatrodes" for Ultra-High-Density Neural Probes"

Patents

- Published Application: WO2020124030
- Published Application: 20220052641
- Issued: 12,009,785 (USA)

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