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## Presentation Abstract

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Title: Wireless neural signal acquisition with single low-power integrated circuit

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Abstract: Progress in modern systems neuroscience relies on the ability to monitor and record electrical signals produced by neurons in the brain or peripheral nervous system. The presence of a physical connection between electrodes and monitoring equipment limits the mobility of the subject under study and requires transcutaneous wires that present a risk of infection. To eliminate the need for this physical link, we have developed a completely wireless neural recording system using modern integrated circuit technology to achieve low volume, mass, and power (NIH-NINDS). We have fabricated a custom analog/digital integrated circuit that can be bonded directly to a 100-channel Utah Electrode Array (UEA). The chip, which was fabricated in a 0.6-micron commercially-available BiCMOS process measures 5.4 mm x 4.7 mm and contains 100 amplifiers, a 10-bit ADC, and a 902-928 MHz frequency shift keying (FSK) transmitter. The neural signal from a selected amplifier is sampled by the ADC at 15.7 kSps and telemetered over the FSK wireless data link. On-chip comparators perform data reduction on the remaining 99 channels by comparing amplified neural signals to

programmable thresholds, detecting action potentials. Power, clock, and command signals are sent to the chip wirelessly over a 2.765-MHz inductive (coil-to-coil) link. The chip is capable of operating with only two off-chip components: a power receive coil and a 100-nF capacitor. In the wireless mode of operation, the chip consumes as little as 8 mW of power. The use of an on-chip inductor with a high quality factor reduces the power consumption of the RF transmitter to 0.5 mW - a factor of ten improvement over previous designs. We validated the operation of the chip by recording and transmitting multi-unit neural activity from the motor cortex of an awake cat. We also conducted fully wireless powering and neural telemetry using a previously-implanted cortical electrode array (Cyberkinetics) in a rhesus macaque during reaching behavior. Recordings were performed more than 22 months after implantation. The power coils were spaced 3 cm apart, and the wireless telemetry signal was received from 5 cm away. Neural spikes recorded during reaching and non-reaching trials showed statistically significant variations in firing rate. An optional RF output stage on the chip allows for the driving of an external antenna. This extends the telemetry range at the expense of increased power consumption. A battery-powered system using this chip has been used to monitor neural activity in a freely moving rhesus macaque for extended periods of time (Chestek et al, SFN 2008).

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