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Presentation Abstract

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Title:	Hermes-c: wireless low-power neural recording system for freely behaving primates
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Abstract:	Neural prosthetics research is currently conducted in highly controlled settings with restrained subjects in a limited visual environment. To determine if a physically active patient such as an amputee can effectively use a brain machine interface (BMI) in a complex environment, we seek to develop an animal model of freely moving humans. Therefore we have developed and tested HermesC, which can wirelessly record neural activity from individual electrodes on a 96-channel cortical array (Cyberkinetics) from a rhesus macaque during free behavior. The mechanical design is identical to HermesB, which spooled 2 channels of neural data to onboard flash memory (Santhanam et al, 2007). HermesC utilizes the integrated neural interface (INI) microchip, which is part of a larger development effort towards implantable devices for BMIs (NIH-NINDS). This chip includes an amplifier, an analog to digital converter, and a wireless link at ~900 MHz. One neural channel can be sampled at 15.7 ksps and 10 bit resolution. The chip also includes 96 programmable threshold-crossing circuits, which should become accessible in future packages with the same total power

consumption as the current system. While in this application the system includes a lithium ion battery pack and a separate clock chip, the INI chip can also receive power and a clock signal wirelessly over the range of a few mm (Harrison et al, SFN 2008). The electronics were packaged in an aluminum enclosure with a protruding 8mm stub antenna, and the enclosure was attached to the skull with titanium hardware. The complete system weighs 201 g. The device consumes 15.8 mA at 4V for a total power consumption of 63 mW, which is substantially lower than other similar systems. Using the available space inside the aluminum enclosure for a 2000 mA-hr battery pack, this device can run for 5.8 days continuously. A system for synchronous video collection was also implemented to allow for the correlation of neural activity and general behavioral states. Single unit neural data were obtained from one 6.9 kg freely behaving rhesus macaque. This macaque was implanted with a 96-channel array 2.5 yrs prior to this experiment, which still provided a substantial number of large neural units. Data were collected during active reaching, rhythmically moving, and non-moving periods. These data were consistent with previous recordings in the experimental rig. Possible applications may include overnight neural unit tracking between experiments, establishing characteristic rates of neural population changes across days, studying the firing properties of neurons over long time periods, and demonstrating long-term neural prosthetic applications.

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