Super multi-channel recording system for BMI

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Abstract—To improve the accuracy of estimating motion intention in ECoG-based BMI systems, a super multi-channel recording system was developed in which 1024 channels of recorded ECoG signal can be amplified and transmitted to outside the body by using a UWB wireless system. Also, a high density, flexible Parylene electrode array was developed that is composed of units of 32-ch recording arrays. We are now evaluating the system with a body phantom system and animals.

I. INTRODUCTION

The electrocorticogram (ECoG) has recently attracted attention as a source signal for clinical Brain-Machine Interface (BMI), because of its good balance of features. It is less invasive than penetrating electrode methods and has a higher spatial resolution than the normal EEG. We have been developing a fully implantable human ECoG-BMI system that has 64 - 128 channels for clinical applications [1]. To achieve more precise control of a multi-joint prosthetic arm, it is necessary to increase the number of recording channels; however, there are several barriers, especially in the electrode array, amplifier, and wireless transmitting. In this paper, we report a novel super multi-channel recording system for BMI in which 1024 channels of ECoG signals are recorded, amplified, and transmitted wirelessly by UWB(Ultra Wide Band) (Fig. 1).

II. ELECTRODE ARRAY

Fig. 2(a) shows the fabrication process of our high density, flexible electrode array. A gold layer is sandwiched between two Parylene-C layers (10 μm × 2). Fig. 2(b) shows a unit array of 32 ch. Our standard inter-electrode distance is 1-2.5mm (the minimum is 20 μm). By combining these units together, a 32 - 1024-ch electrode array can be composed. Fig. 2(c) shows an example of the electrode array, which has 128-ch recording sites for use in monkey experiments. In the experiment the ECoG signals are recorded stably for 15 months (using another wired system), and a part of the array can be inserted into the sulcus safely [2].

III. AMPLIFIER, ADC AND UWB

Recorded signals are amplified and converted to digital (maximum sampling rate of the ADC is 1kHz per channel) by using a LSI chip [3], which has 64-ch low-noise amplifiers and ADCs. Then, the signals from 16 chips (1024-ch) are multiplexed by MUX units and transmitted wirelessly to the control unit located outside of the body by an UWB unit that is designed to use a frequency band (7.9GHz ±0.625GHz) that can be used internationally. The transmitting rate of the unit in the air is 133 Mbps. Evaluation experiments of the system with a body phantom system and animals are undergoing.

REFERENCES