Electrode Cap for Simultaneous EEG and MEG Recordings

Juha Virtanen\textsuperscript{a,b}, Teemu Rinne\textsuperscript{a}, and Risto Näätänen\textsuperscript{a}
\textsuperscript{a}Cognitive Brain Research Unit, Department of Psychology
P.O. Box 11, FIN-00014 University of Helsinki, Finland
\textsuperscript{b}BioMag Laboratory, Medical Engineering Centre
Helsinki University Central Hospital, FIN-00290 Helsinki, Finland

Abstract: We describe an EEG electrode cap, which is designed to facilitate simultaneous multichannel EEG and MEG recordings. The special electrode design allows faster preparation times and more reliable contacts than commercially available solutions. The cap is magnetically compatible with MEG and the low-profile electrodes consume minimal space inside the magnetometer.

INTRODUCTION

Modern EEG-analysis methods benefit from the use of large number of electrodes [1,2]. The typical number of electrodes used for brain-source localisation varies from 32 to 128. Fixing so many electrodes takes several hours. To reduce this time, for example Electro-Cap International, Inc. (Eaton, OH.) and Electrical Geodesics, Inc. (Eugene, OR.) provide commercial solutions. Simultaneous MEG and EEG recordings potentially provide complementary information [3], but are seldom performed because of the special requirements for the EEG instrumentation and because of the long preparation times needed for fixing the electrodes.

We have designed an EEG electrode cap which facilitates the application of multiple electrodes and is fully compatible with MEG instruments. All the materials in the electrode cap are non-magnetic and the flat electrode design consumes minimal space inside the magnetometer.

METHOD

The electrode cap is made of elastic fabric. The flexible cap adapts to the head shape so that most of the adult population can be measured using only two different cap sizes. An illustration of the electrode cap is shown in Fig. 1.

A cross-section view of the round electrode is shown in Fig. 2. The electrode is made of a 0.5 mm thick purified silver plate. We have used both gold and Ag/AgCl coatings on the electrodes. The electrode wire is 0.22 mm\textsuperscript{2} tinned stranded copper and it is soldered to the electrode with ordinary 60/40 % tin/lead alloy. The soldered joint is sealed with adhesive heat shrink tube.

The electrode snaps into a plastic frame, so that the elastic fabric is tightly compressed between the frame and the electrode. The frame is only 3 mm thick.

Figure 2.
There is a 6 mm diameter opening in the electrode, through which the skin can be prepared using a wooden stick. The tip of the stick is dipped into electrode gel (Christian Nissen/Berner Oy, Helsinki, Finland) so that the skin under the hair is moistened. After skin preparation hardening paste (EC2, Grass Instruments Company, Quincy, MA) is injected into the opening, where it forms a bridge between skin and electrode.

RESULTS

We have measured 10 subjects using 32 channel caps with gold plated electrodes and 2 subjects using 64 channel caps with Ag/AgCl coated electrodes. The preparation time for 32 channels was about 20 minutes and for 64 channels about 30 minutes. We found no problem achieving impedances lower than 20 k\textohm, a low enough value in our well shielded environment.

The open electrode design makes skin preparation easy and the contact between electrode and skin is mechanically stable because of the hardening paste. The same electrode cap suits well for multichannel EEG alone.

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REFERENCES