Abstract—Applications of electroencephalography (EEG), such as the detection of silent reading have attracted attention. Here, we propose a method of EEG analysis using empirical mode decomposition. The proposed method detects the time-frequency response of associated EEG.

I. INTRODUCTION

Recently, various types of brain-machine interface (BMI) applications have attracted research attention. Effort has been made to confirm the basis of electroencephalography (EEG) theory and the wide range of applications based on BMI. A wheel-chair could be driven automatically using an EEG signal, and robot hands could be operated arbitrarily by a human. These applications could be developed using mobile EEG detectors. Character selection on the computer instead of typing on a keyboard could be accomplished easily using EEG. Motor imagery and character imagery are useful methods for detecting signals using EEG; however, it is still unclear how to detect imagined characters during silent reading. We employed empirical mode decomposition (EMD) to detect the silent reading imagery signal using EEG. We then confirmed that the method is useful to detect character imagery.

II. EXPERIMENT AND ANALYSIS

An invasive method for detecting the electrocorticogram has been reported, and EEG based detection of silent reading of a single word has been developed. Here, the detection of a word using a non-invasive method was investigated, and results indicate that analyzing the character imagery using the non-invasive method is more difficult than that using the invasive method. In this experiment, three specified words (“rice,” “television,” “bed”) and an additional fifteen words were prepared, and one of these words was displayed on the screen. Subjects simultaneously associate the motion, especially for the case of specified words, and subjects must evoke “eat,” “see,” and “sleep” for “rice,” “television,” and “bed” respectively. The words were displayed for 200ms, with a 2800 ms delay between each presentation. The total period for a signal trial was 3000 ms. During each trial, the displayed word must be selected randomly, and ten words must be selected from among the fifteen words. The electrode arrangement for the EEG was based on the international 10-20 system. EEG signals were measured on C3 of the scalp. Measured signals were analyzed using EMD[1].

![Fig.1(a) EMD spectrum when no word is displayed](image1)

![Fig.1(b) EMD spectrum when specified word is displayed](image2)

III. RESULTS AND DISCUSSION

Figures. 1 (a) and (b) show the resultant. EEG signals when no word is displayed and when the specified word “see” is displayed, respectively. The α-wave from 0.5s to 0.6s is clearly different. These results confirm that EMD is useful for detecting evoked words.

IV. CONCLUSION

We proposed a detection method for evoked EEG signals based on EMD theory. The effectiveness of our proposed method was confirmed.

REFERENCES