

Learning Spatial and Temporal Filters for Single-Trial EEG Classification

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Abstract

There is a wide variety of electroencephalography (EEG) analysis methods. Most of them are based on averaging over multiple trials in order to increase signal-to-noise ratio. The method introduced in this article is a *single trial* method. Our approach is based on the assumption that the "real brain signal" of each task is smooth, and is contained in several sensor channels. We propose two stage preprocessing. At first, we use *spatial* filtering, by taking weighted linear combination of sensors. At the second step, we perform *time-domain* filtering. Both stages are performed *blindly*, by maximizing the between class discrimination and minimizing the total variation of result average or, alternatively, suppressing the signal at the windows, where it is known to be absent. No other information on signals of interest is assumed to be available.

1 Introduction

People have speculated that EEG might be used as alternative communication channel, which allows the brain to act bypassing peripheral nerves and muscles, since electroencephalography was first described by Hans Berger in 1929 [1]. First simple communication systems, that were driven by electrical activity recorded from the head, appeared about three decades ago [2]. In the past years, it has been shown that it is possible to recognize distinct mental processes from online EEG (see, for example [3, 4, 5, 6]). By associating certain EEG patterns to simple commands, it is possible to control a