



Functional Connectivity Analysis Using the Oddball Auditory Paradigm for Attention Tasks

Juana Valeria Hurtado-Rincón^{1(✉)}, Francia Restrepo², Jorge Ivan Padilla^{1,2,3},
Hector Fabio Torres³, and German Castellanos-Dominguez^{1,2,3}

¹ Signal Processing and Recognition Group,
Universidad Nacional de Colombia, Bogotá, Colombia
jvhurtador@unal.edu.co

² Universidad Autónoma de Manizales, Manizales, Colombia

³ Universidad de Caldas, Manizales, Colombia

Abstract. Nowadays, cognitive stimulus processing using Electroencephalographic (EEG) recordings is accomplished by analyzing individually the time-frequency information belonging to each EEG channel. Nevertheless, several studies have characterized cognitive functions as synchronized brain networks depending on the underlying neural interactions. As a result, connectivity analysis provides essential information for improving both the interpretation and interpretability of brain functionality under specific tasks. In this research, we perform functional connectivity analysis by measuring the stability of the phase difference between EEG channels, aiming to include synchronization patterns for studying the brain reaction to cognitive stimulus. Experiments are carried out in subjects responding to an oddball paradigm. Results show statistical differences between target and non-target labels, making the proposed methodology a suitable alternative to support cognitive neurophysiological applications.

Keywords: Brain connectivity · Phase synchronization
Electroencephalography · Oddball paradigm

1 Introduction

Studies of routine activities (like attention, perception, or decision-making) have been widely used in cognitive and clinical research of neurological diseases [12, 19]. Because of the provided high temporal resolution and low implementation cost, electroencephalography (EEG) is a very suitable tool to investigate the brain activity patterns, mainly, in applications regarding the oddball paradigm experiments, in which two different testing sensory stimuli (i.e., *rare* and *frequent*) are randomly presented to a subject under examination. The rare stimuli, labeled as a target, are produced with a higher recurrence than the frequent stimuli, or non-target. In the oddball task, an evaluated subject must

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