

# STUDY OF CEREBRAL HEMODYNAMIC RESPONSE FUNCTION IN PATIENTS WITH FOCAL EPILEPSY USING EEG/fMRI DATA

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## Introduction and Hypothesis:

Epilepsy is the most common neurological disorder, around 0.5 to 1% of the world population is affected. In half of the cases, a surgical intervention is an alternative to remove the brain tissue that generates the seizures or epileptogenic zone (ZE). ZE is spatially determined using several techniques and clinical evidences during the presurgical planning. These areas can be associated to ictal activity (abnormal activities in the crisis period) or interictal (abnormal activities outside of the crisis period) [1].

The functional magnetic resonance imaging (fMRI) is an important neuroimaging technique based on the BOLD (Blood Oxygenation Level Dependency) effect [2]. It allows the observation of the so-called cerebral hemodynamic response function (HRF), measured by the cerebral blood flow variation caused by the neural activity. In epilepsy studies, the simultaneous analysis of EEG-fMRI data is a useful tool to map BOLD response associated to interictal activity [3, 4].

In conventional fMRI studies a canonical HRF is used, however significant shape variation and beginning of the HRF were demonstrated in some individuals and brain regions. J.K. Kong. et al. had demonstrated that using a specific HRF for each patient is more efficient in the ZE localization [3]. HRF shape should be dependent on specific characteristics such as: brain attack region, age of the patient, type of epilepsy, among others [4].

## Objective:

Our main aim is to obtain a specific HRF for each patient using EEG and fMRI data from patients with clear defined ZE.

## Methods:

Three patients without manifestation of the epileptic crisis one year after the surgery will be selected. From EEG and fMRI data (already collected), a statistical map will be made using a canonical HRF. In a second step, time series of the BOLD signal from the ZE of the patients will be expressed in a Fourier series based on a previous method [3]. Essentially, we will convolute a series of functions impulse-spikes with a set of basic functions of sines and cosines. Afterwards, a linear regression of the fMRI signal with the points of interest versus the time series, previously obtained, will be executed. The procedure generates a coefficient set, to be used in the patient specific HRF. Once this HRF is obtained, it will be adjusted to two gamma functions, one for the positive lobe and another one for the negative lobe.

## Relevance:

The deconvolution of BOLD response of an epileptogenic region with the electric response is one of the methods considered for the identification of an accurate HRF. However, this procedure can be affected by various experimental factors that harm the result accuracy, such as the signal-to-noise ratio (RSR) of BOLD signal and the firing rate [3]. The correct mapping of ZE is extreme important for the patient outcome [1].

**References:** [1] Luders, H., et. al. *Epilepsy*, 39 (9), 1006-1013; [2] Ogawa S, et. al. *Proc Natl Acad Sci*. 1990; 87: 9868-72. [3] J.K. Kong. et al., *NeuroImage* 20 (2003) 1162-1170; [4] Bénar, Chistian-G et al., *NeuroImage* 17 (2002) 1182-192