Dataset IIIb: Non-stationary 2-class BCI data

Short description:

cued motor imagery with online feedback (non-stationary classifier)
with 2 classes, and 3 - 4 sessions from 3 subjects.
(EEG, 2 bipolar channels)

Aim:

Non-stationary (i.e. time-varying) BCI data should be classified. It can be expected that time-varying classifier performs better than a stationary (static) classifier. Moreover, the response time of each method will be evaluated.

EEG recording:

EEG-data from three different subjects during a BCI experiment. The experiment consists of 3 sessions for each subject. Each session consists of 4 to 9 runs. The data of all runs was concatenated and converted into the GDF format [1]. The recordings were made with a bipolar EEG amplifier from g.tec. The EEG was sampled with 125 Hz, it was filtered between 0.5 and 30Hz with Notchfilter on.

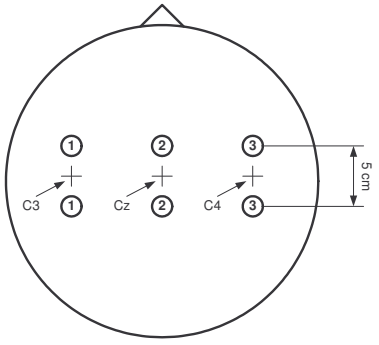

Figure 1: Electrode positions. Channel C3 and C4 are included in the EEG data.

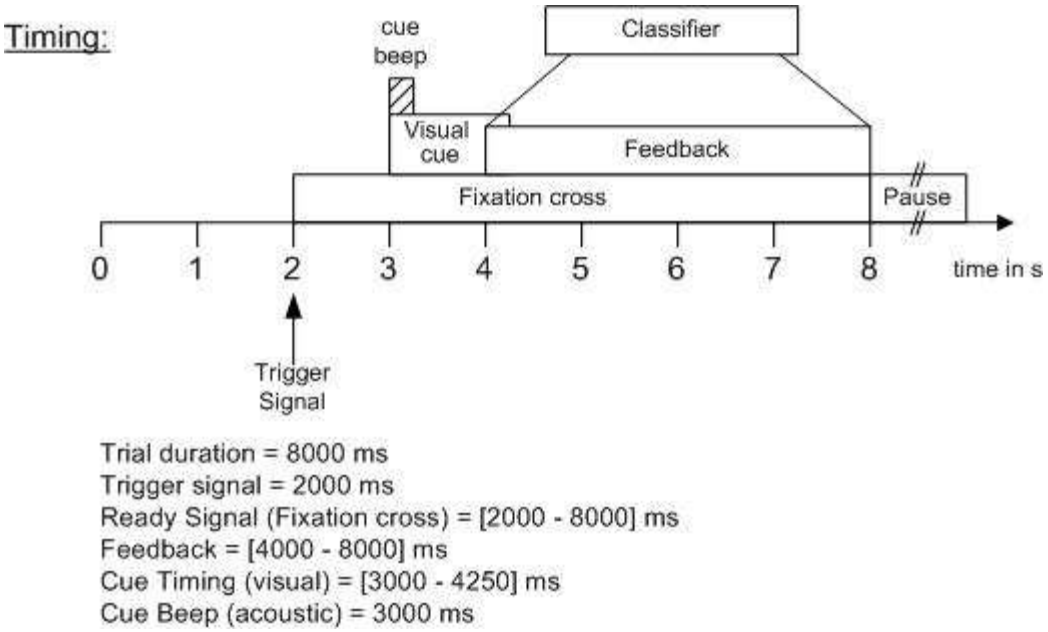

Figure 2: Paradigm of the Virtual reality experiment used for O3. A comparible experiment is described in [2]

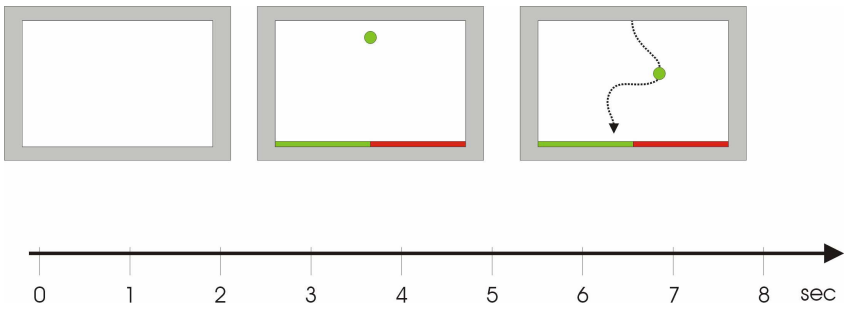

Figure 3: Basket paradigm used for S4 and X11 [3].

	Feedback	Feedback presentation	Channels	# of Trials	Classes
O3	Virtual reality [2]	4-8s	C3, C4	640	Left-Right
S4	Basket, adaptive classifier [3]	4-7s	C3, C4	1080	Left-Right
X11	Basket, adaptive classifier [3]	4-7s	C3, C4	1080	Left-Right

Format of the data

The data is stored in the GDF format [1] and can be loaded into Matlab or Octave with Biosig-toolbox [5] (version 0.81 or higher) using the command `[s,HDR] = sload(filename)`. The data s can contain NaN's; these NaN's indicate the breaks in between the runs or saturation of the analog-to-digital converter.

All events are stored according to the Table of eventcodes [6]. The beginning of each trial (t = 0s according to Fig. 1) can be obtained from `HDR.TRIG`; the classlabels are stored in `HDR.Classlabel`. `HDR.Classlabel` can contain the values '1','2' or 'NaN'. Values '1' and '2' indicate the labels of the training set, NaN indicates the trials of the test set.

Evaluation:

Valid submissions must fulfill two requirements:

(1) it must be demonstrated that the used algorithms are causal, at time t no sample from time k>t must be used (zero-phase filtering using forward-backward filters are not allowed). In order to demonstrate the causality, the source code of the algorithm must be submitted.
(2) a continuous classification output (continuous in time as well as magnitude) must be submitted. The classifier output should provide a value<0 for class 1, a value > 0 for class 2, and value=0 is non-decisive.

The output will be validated using the time course of the mutual information [4]. The method with the maximum increase of the mutual information (maximum steepness calculated as MI(t)/(t-3s) for t>3.5s) will be used for validation. On order to avoid a stimulus-response-mechanism, time >3.5s will be evaluated. The "steepness" of the mutual information quantifies the response time. The evaluation algorithm is provided in BIOSIG (see /biosig/t490/criteria2005IIIb.m) [5].

Remark:

Optional, the algorithm can be submitted for inclusion into BIOSIG. Each algorithm which performs better than the standard classification algorithm [5] is eligible to be included in BIOSIG.

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References:

[1] A. Schlögl, O. Filz, H. Ramoser, G. Pfurtscheller,
GDF - A general dataformat for biosignals, Technical Report, 2004.
available online at: http://www.dpmi.tu-graz.ac.at/~schloegl/matlab/eeg/gdf4/TR_GDF.pdf.

[2] R. Leeb, R. Scherer, F. Lee, H. Bischof, G. Pfurtscheller: Navigation in Virtual Environments through Motor Imagery, 9th Computer Vision Winter Workshop, CVWW'04, 4-6 February 2004, Piran, Slovenia; Proceedings of the CVWW'04, pp.99-108, Slovenian Pattern Recognition Society, Ljubljana, 2004.

[3] C. Vidaurre, A. Schlögl, R. Cabeza and G. Pfurtscheller, "A fully on-line adaptive Brain Computer Interface", Biomed. Tech. Band 49, Special issue 2, pp. 760-761, 2004.

[4] A. Schlögl, C. Neuper, G. Pfurtscheller: Estimating the mutual information of an EEG-based Brain-Computer-Interface, *Biomedizinische Technik* 47(1-2): 3-8, 2002.

[5] A. Schlögl, BIOSIG - an open source software library for biomedical signal processing. 2003-2004. available online: http://BIOSIG.SF.NET

[6] available online:
http://cvs.sourceforge.net/viewcvs.py/biosig/biosig/t200/eventcodes.txt