

Results of the

BCI Competition 2005

for

data set IIIa and IIIb

Alois Schlögl
alois.schloegl@tugraz.at

Institute for Human-Computer Interfaces – BCI Lab
University of Technology Graz, Austria.

Version 1.30

June 20th, 2005

Submissions: IIIa

- A. Hill & Schröder (Tübingen)
resampling 100Hz, detrending, Infomax ICA, Amplitude spectra (Welch), linear PCA, and SVM, scores are constant for each trial
- B. Guan, Zhang & Li (Singapore)
Fisher ratios of channel-frequency-time bins, feature selection, designing mu- and beta passband, multiclass CSP, SVM
- C. Gao (head), Wu & Wei (Tsinghua, China)
surface laplacian, 8-30Hz filter, CSP (one-vs-rest), SVM+kNN+LDA, „bagging“

Table 1: Properties of the submitted results.

Submission	Continuous in Time	Continuous in magnitude	Causality	Software
A	Y (*)	Y	-	N
B	Y	2 discrete values	-	N
C	(10Hz, triggered: t = 0 .. 7s)	2 discrete values	-	N

(*) Result has same length as input data but does not change within trials.

Evaluation result:

Table 2: Maximum Kappa for $t \leq 7s$.

(rank)	K3	K6	L1	Mean
A (3)	0.9481	0.4111	0.5222	0.6272
B (1)	0.8222	0.7556	0.8000	0.7926
C (2)	0.9037	0.4333	0.7111	0.6872

Table 3: Maximum Accuracy for $t \leq 7s$.

[%]	K3	K6	L1	Mean
A	96.11	55.83	64.17	72.04
B	86.67	81.67	85.00	84.44
C	92.78	57.50	78.33	76.20

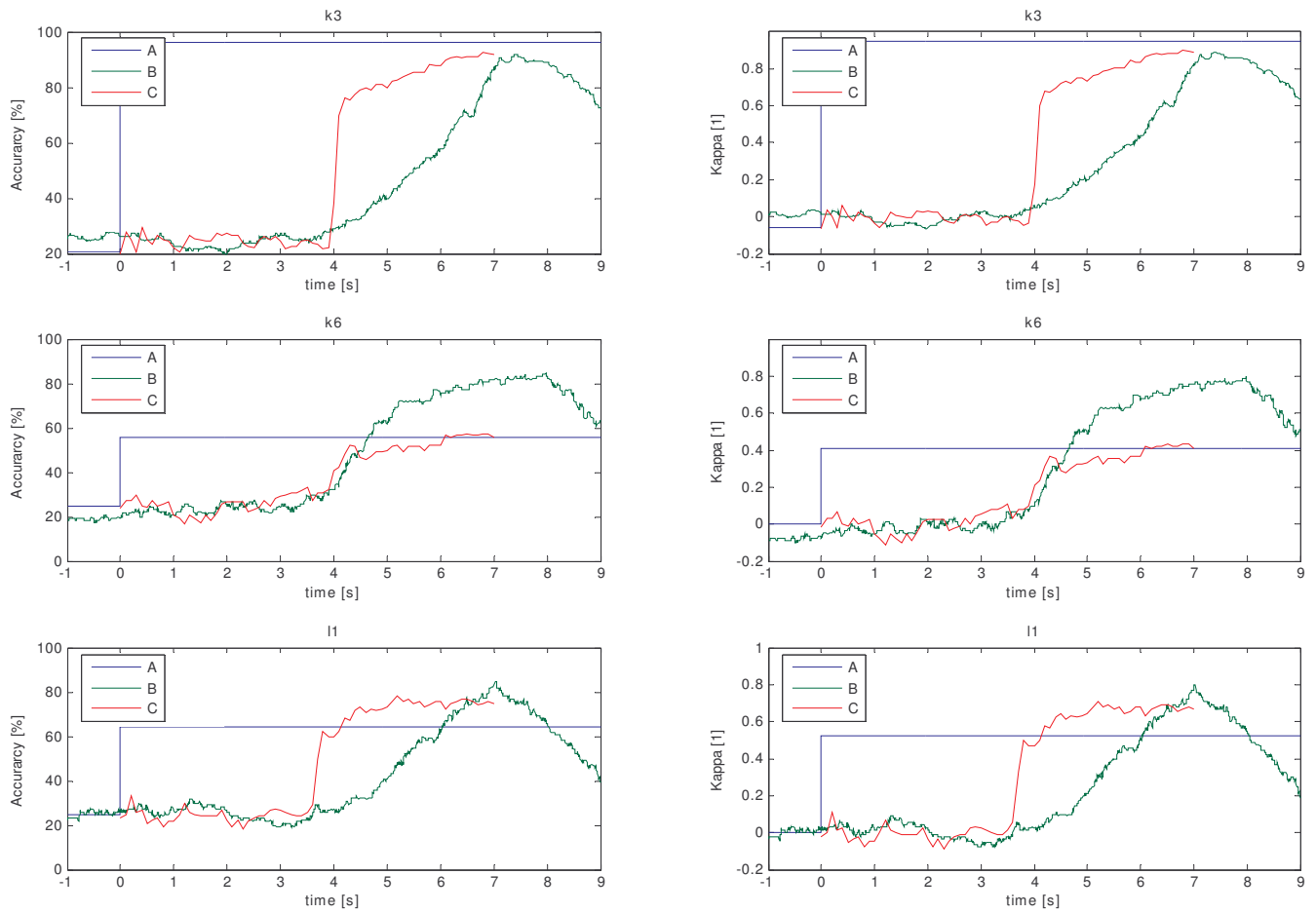


Figure 1: Time course of Accuracy (left) and Kappa (right) for subjects K3 (top), K6 (middle), and L1 (bottom).

Submissions: IIIb:

- A Authors: O.Burmeister, M.Reischl, R. Mikut
Affiliation: Forschungszentrum Karlsruhe, Germany
Bandpower (BP), ratios and differences of BP; MANOVA for feature selection;
SVM and linear combiner
- B Authors: D. Coyle, G. Prasad, M. McGinnity,
Affiliation: University of Ulster, Northern Ireland
Preprocessing with Prediction Neural Networks (pNN); Short-Time-Fourier-
Transform (STFT); Linear Discriminant Analysis;
- C Authors: S. Lemm
Affiliation: Fraunhofer (FIRST) IDA, Berlin Germany
Method: ERP and ERD (MU and BETA), probabilistic classification model,
accumulative classifier
- D Authors: S. Parini, L. Piccini, L. Maggi, G. Panfili, G. Andreoni
Affiliation: Politecnico di Milano, Italy
Method: optimization of frequency bands (using Cauer Elliptic Filter and
Bandpower using LDA) and time-interval (using amplitude modulation envelope)
using LDA; Classification with AR(4) parameters (Burg) and PSD from 1s-
window with boosted regularized LDA;
- E Authors: K. Tavakolian, S. Rezaei
Affiliation: University of Northern British Columbia, Canada
Method: AAR(6) parameters from 1s-segments; Bayesian Network classifier
- F Authors: : Dezhong Yao, Yu Yin ,Xiang Liao
Affiliation: University of Electronic Science and Technology of China (UESTC)
Chengdu, China
Method: Scales of Morlet-Wavelet optimized by statistical method; wavelet-based
bandpower, Support-Vector-Machines, normalized weighted summation for
accumulative classification result.
- G Authors: Xiaomei Pei, Guangyu Bin
Affiliation: Institute of Biomedical Engineering of Xi'an Jiaotong University,
Xi'an, China
Method: FFT with Hanning window of 1s-segments; Fisher Discriminant
Analysis

Results IIIb:

Table 4: Properties of submitted results

Submission	Time-continuous	Continuous magnitude	Causality	Software included
A	Y	Y	OK (*)	Y
B	(triggered)	Y	OK (*)	Y
C	(triggered)	Y	OK (*)	Y
D	(triggered)	Y	OK (*)	Y
E	(triggered)	Y	OK (*)	Y
F	(triggered)	Y	50 samples (0.4s) delay added (*)	Y
G	(triggered)	Y	OK (*)	Y

(*) Causality was checked through visual inspection of the submitted software.

Table 5: Minimum error rate [%]. (+) incorrect sign – classes are swapped.

	O3(*)	S4	X11	Mean
A	14.47	22.96	22.22	19.88
B	11.95	21.48	18.70	17.38
C	10.69	11.48	16.67	12.95
D	23.90	24.44	24.07	24.14
E	34.28	38.52	28.70	33.83
F	10.69	13.52	25.19	16.47
G	13.21	17.59	16.48	15.76

Table 6: Maximum Mutual information [bit]

	O3(*)	S4	X11	Mean
A	0.4470	0.2316	0.3074	0.3287
B	0.4319	0.3497	0.3854	0.3890
C	0.6027	0.6079	0.4861	0.5656
D	0.2177	0.2387	0.2173	0.2246
E	0.0431	0.0464	0.1571	0.0822
F	0.5975	0.5668	0.2437	0.4693
G	0.5509	0.3752	0.4675	0.4645

Table 7: Maximum Steepness (with $t_0=3s$) of the Mutual information [bits/s].

	O3(*)	S4	X11	Mean
A	0.1626	0.4174	0.1719	0.2506
B	0.1039	0.1490	0.0948	0.1159
C	0.1698	0.4382	0.3489	0.3190
D	0.1153	0.1218	0.1181	0.1184
E	0.0704	0.0229	0.0489	0.0474
F	0.1184	0.1516	0.0612	0.1104
G	0.2030	0.0936	0.1173	0.1380

(*) only the test set of the trials 321-640 are used for validation.

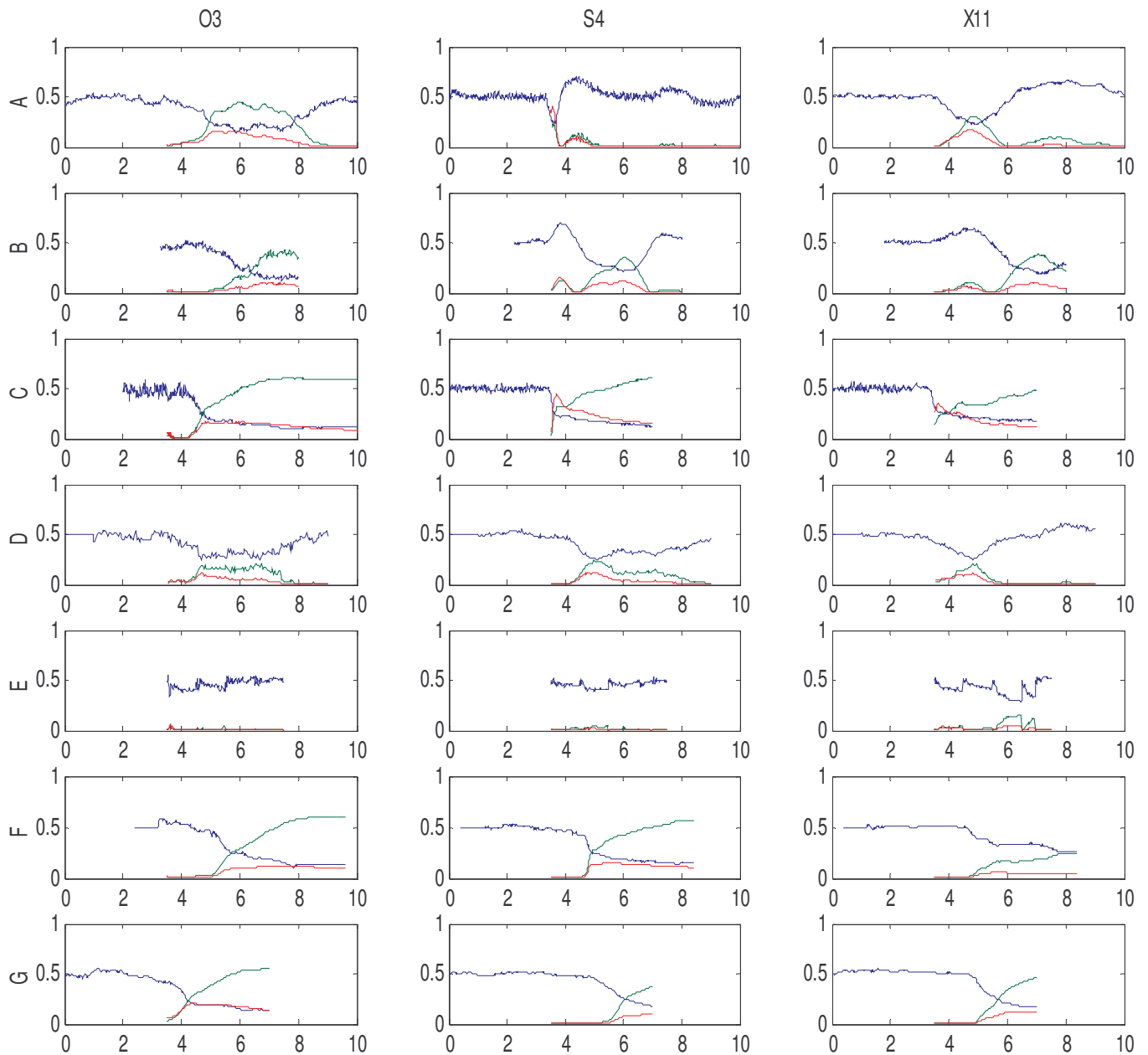


Figure 2: Time course of the Error rate (blue), the mutual information (green) and the steepness of the mutual information (red).

Table 8: Final ranking of IIIb.

Rank	Submission	[bits/s]
1	C	0.3190
2	A	0.2506
3	G	0.1380
4	D	0.1184
5	B	0.1159
6	F	0.1104
7	E	0.0474