



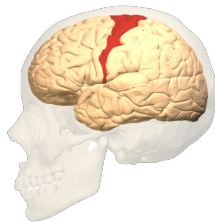
# COMPARAÇÃO DE TÉCNICAS DE APRENDIZAGEM DE MÁQUINA E PROCESSAMENTO DE SINAL PARA BCIs

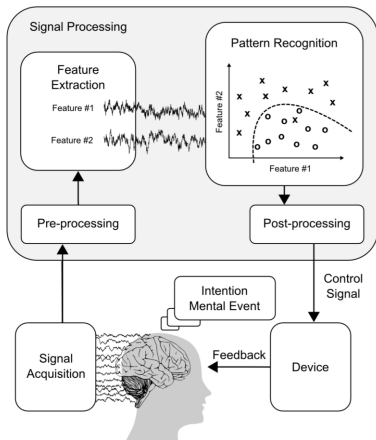
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ORIENTADOR: THIAGO DA SILVA CASTRO

INSTITUTO FEDERAL SUDESTE MG  
CAMPUS JUIZ DE FORA

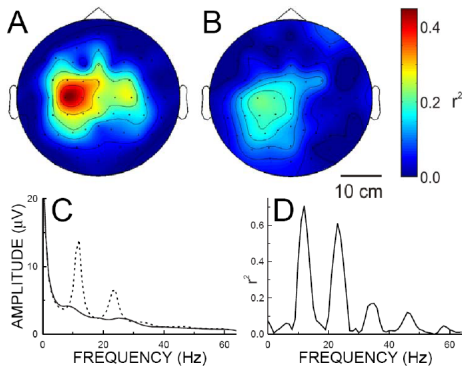
14 06 2020





**Figure: Etapas BCI[?]**

- Sinal: Ondas  $\mu$
- Extração de características: STFT, Espectro de Welch e Multitaper
- Reconhecimento de padrões: Redes Neurais, SVM e Vizinhos Proximos



- Componente principal 10Hz  
Amplitude  $10\mu - 20\mu$
- Presente na ausência de movimento

Figure: [?]

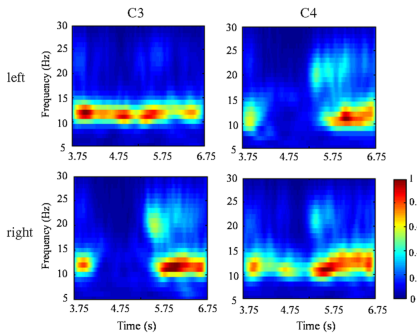
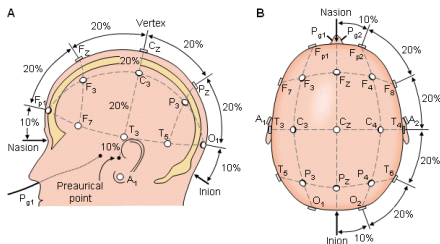
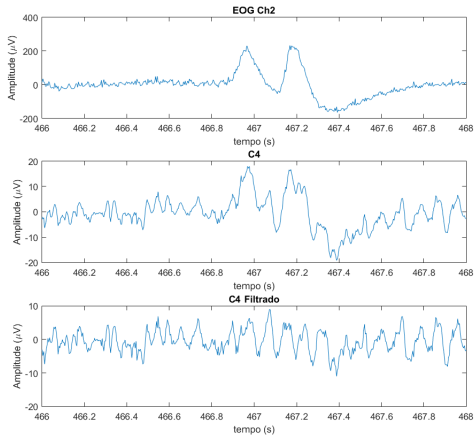


Figure: [?]

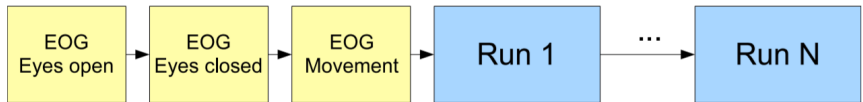






ID	Training	Evalutation
1	Bo101T, Bo102T, Bo103T	Bo101E, Bo102E
2	Bo201T, Bo202T, Bo203T	Bo201E, Bo202E
3	Bo301T, Bo302T, Bo303T	Bo301E, Bo302E
4	Bo401T, Bo402T, Bo403T	Bo401E, Bo402E
5	Bo501T, Bo502T, Bo503T	Bo501E, Bo502E
6	Bo601T, Bo602T, Bo603T	Bo601E, Bo602E
7	Bo701T, Bo702T, Bo703T	Bo701E, Bo702E
8	Bo801T, Bo802T, Bo803T	Bo801E, Bo802E
9	Bo901T, Bo902T, Bo903T	Bo901E, Bo902E

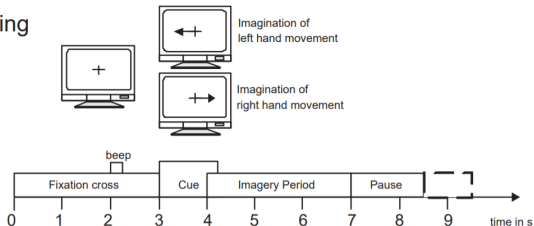
[?]



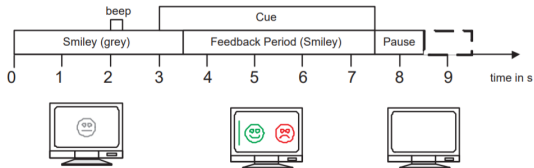
**Figure:** Segmento EOG nas sessões do graz-b [?]



## (a) Screening

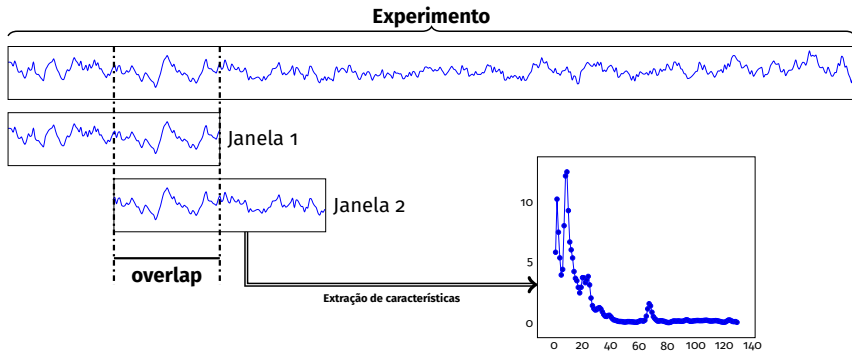


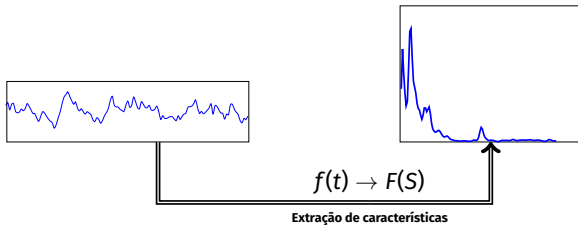
## (b) Smiley Feedback



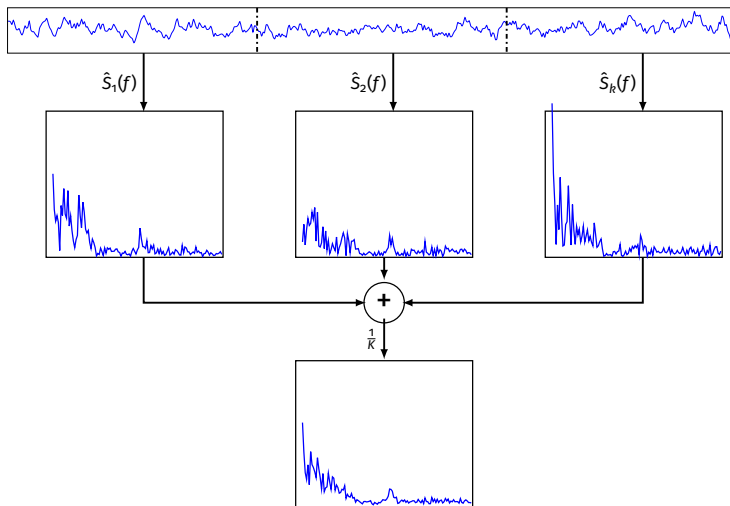
**Figure:** Os dois tipos de sessão em Graz-b [?].

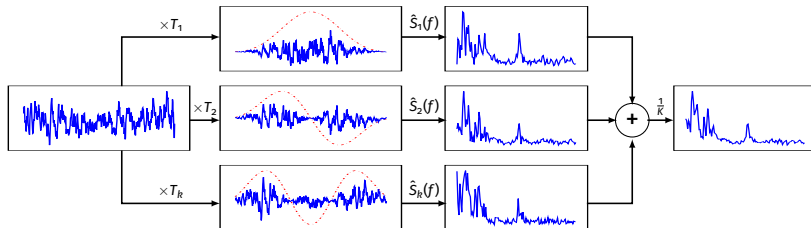


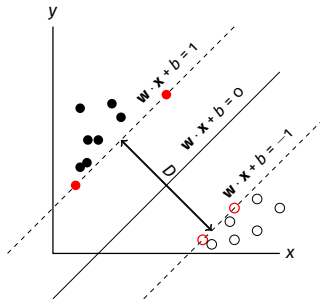
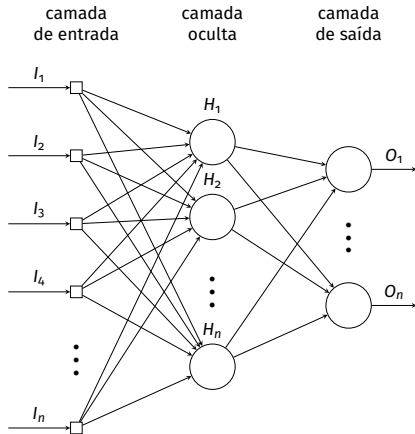


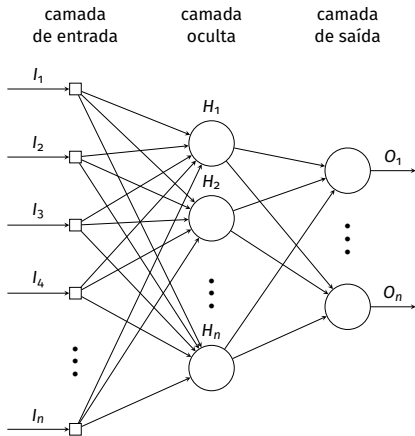


# ESPECTRO DE WELCH

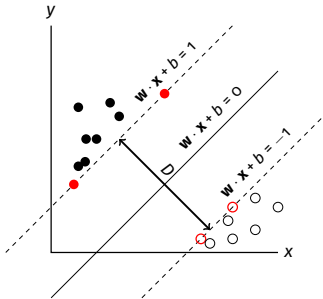




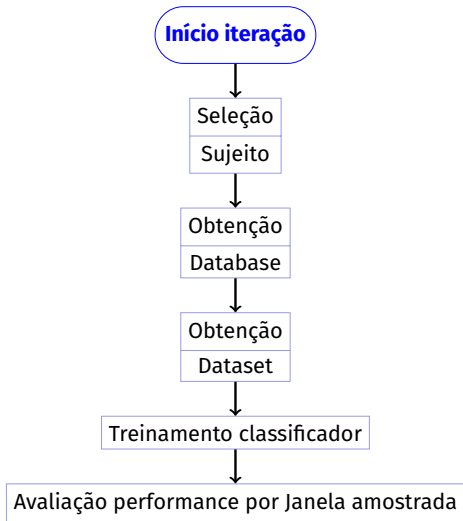




- Camadas Ocultas com 20 Neuronios



- Kernel Gaussian ("Fino", "Grosso")
- Kernel Linear

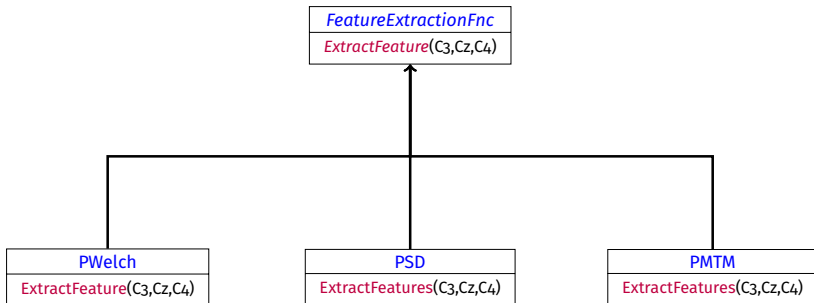


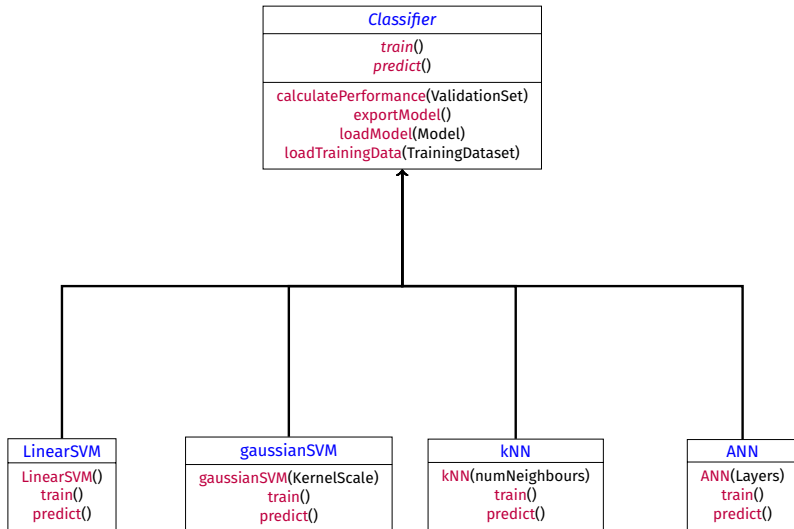




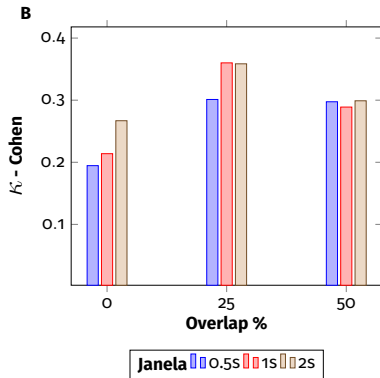
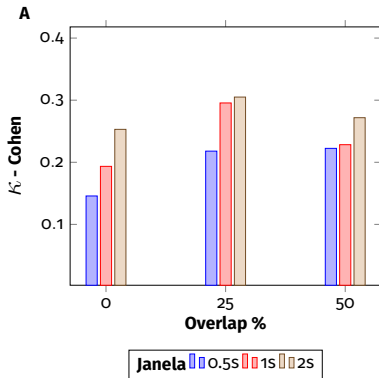
## Database

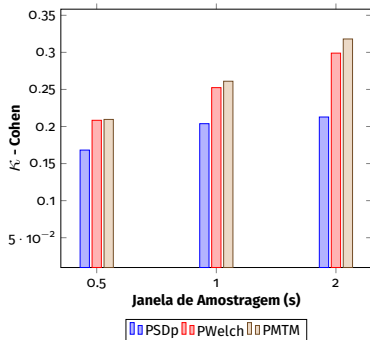
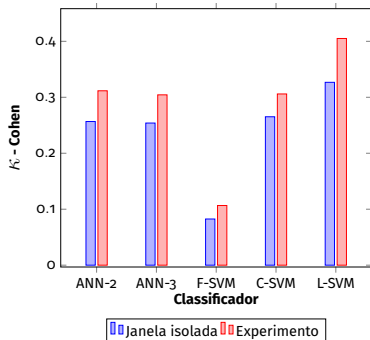
```
Database(overlap,windowLength,Trials)
    getSampleCountPerLabel()
generateDatasetIndex(numSamples)
generateDataset(TrainingDataset)
    getSample(Range)
    getSampleCount()
setFeatureExtractionFcn(FEFunction)
```





# OVERLAP E JANELAS DE AMOSTRAGEM







**Table:** Melhores performances na métrica do experimento

Pos	$\kappa_1$	ACC <sub>1</sub>	$\kappa_2$	ACC <sub>2</sub>	Janela	Overlap	Função	Classificador
1 <sup>o</sup>	0.422	71.14%	0.526	76.32%	2s	25%	PWelch	L-SVM
2 <sup>o</sup>	0.426	71.35%	0.512	75.62%	2s	25%	PMTM	L-SVM
3 <sup>o</sup>	0.421	71.06%	0.491	74.58%	2s	25%	PMTM	ANN-3
4 <sup>o</sup>	0.407	70.36%	0.490	74.51%	1s	25%	PMTM	L-SVM
5 <sup>o</sup>	0.402	70.11%	0.484	74.23%	1s	25%	PMTM	ANN-2



**Table:** Melhores performances por Janela de amostragem de até 2s

Pos	$\kappa_1$	ACC <sub>1</sub>	$\kappa_2$	ACC <sub>2</sub>	Janela	Overlap	Função	Classificador
1 <sup>o</sup>	0.426	71.35%	0.512	75.62%	2s	25%	PMTM	L-SVM
2 <sup>o</sup>	0.422	71.14%	0.526	76.32%	2s	25%	PWelch	L-SVM
3 <sup>o</sup>	0.421	71.07%	0.452	72.61%	2s	0%	PMTM	L-SVM
4 <sup>o</sup>	0.421	71.06%	0.491	74.58%	2s	25%	PMTM	ANN-3
5 <sup>o</sup>	0.418	70.95%	0.466	73.33%	2s	50%	PMTM	L-SVM



**Table:** Melhores performances por Janela de amostragem de até 0.5s

Pos	$\kappa_1$	ACC <sub>1</sub>	$\kappa_2$	ACC <sub>2</sub>	Janela	Overlap	Função	Classificador
1 <sup>o</sup>	0.293	64.69%	0.401	70.09%	0.5s	50%	PMTM	L-SVM
2 <sup>o</sup>	0.286	64.31%	0.388	69.45%	0.5s	50%	PWelch	L-SVM
3 <sup>o</sup>	0.284	64,21%	0.399	69.98%	0.5s	25%	PMTM	L-SVM
4 <sup>o</sup>	0.280	64,01%	0.397	69.88%	0.5s	25%	PWelch	L-SVM
5 <sup>o</sup>	0.275	63.78%	0.391	69.57%	0.5s	25%	PMTM	ANN-2





**Table:** Resultados da competição BCI-IV 2008

Pos	contributor	$K$	1	2	3	4	5	6	7	8	9
1 <sup>o</sup>	Z. Y. Chin	<b>0.60</b>	0.40	0.21	0.22	0.95	0.86	0.61	0.56	0.85	0.74
2 <sup>o</sup>	H. Gan	<b>0.58</b>	0.42	0.21	0.14	0.94	0.71	0.62	0.61	0.84	0.78
3 <sup>o</sup>	D. Coyle	<b>0.46</b>	0.19	0.12	0.12	0.77	0.57	0.49	0.38	0.85	0.61
4 <sup>o</sup>	S. Lodder	<b>0.43</b>	0.23	0.31	0.07	0.91	0.24	0.42	0.41	0.74	0.53
5 <sup>o</sup>	J. F. D. Saa	<b>0.37</b>	0.20	0.16	0.16	0.73	0.21	0.19	0.39	0.86	0.44
6 <sup>o</sup>	Y. Ping	<b>0.25</b>	0.02	0.09	0.07	0.43	0.25	0.00	0.14	0.76	0.47
-	L-SVM PMTM	<b>0.51</b>	0.41	0	0.09	0.92	0.58	0.63	0.4	0.83	0.71

# REFERENCIAS



# AGRADECIMENTOS