Analysis of factors that influence the performance of biometric systems based on EEG signals

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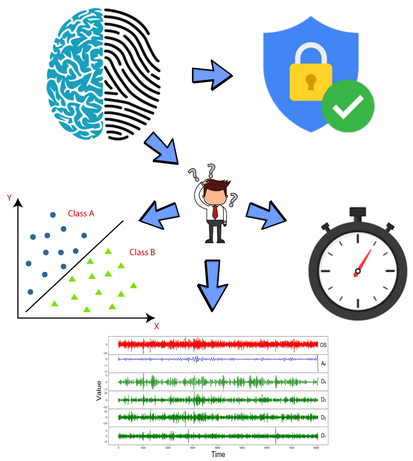
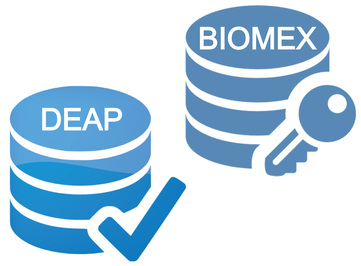
Introduction

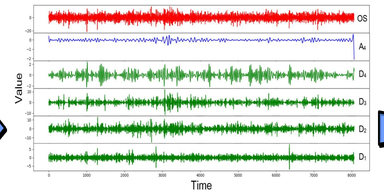
This work compares six different classifiers, provides a detailed analysis of the DWT, and investigates the impact of recording time on the classifier's performance for developing biometrics based on EEGs.



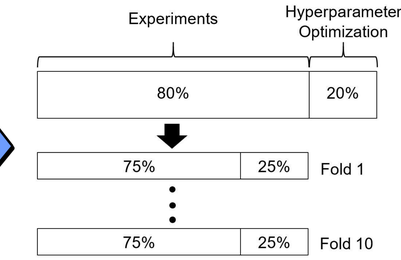
Methodology



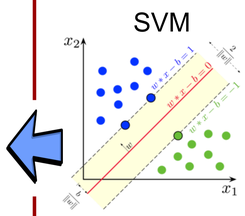
- 0.25 sec
- 0.50 sec
- 0.75 sec
- 1.00 sec
- 1.25 sec
- 1.50 sec
- 1.75 sec
- 2.00 sec
- 2.25 sec
- 2.50 sec

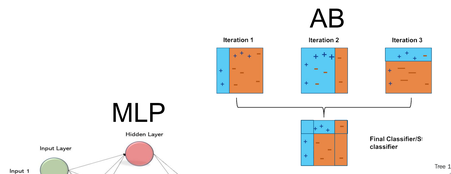


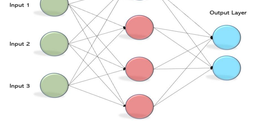
- 2-lvl DWT
- 3-lvl DWT
- 4-lvl DWT
- 5-lvl DWT

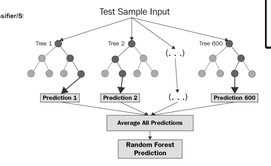


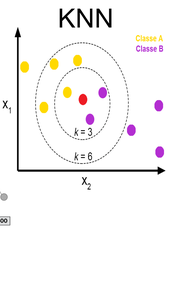
- Average Accuracy (*Acc*)
- Macro-averaging Sensitivity (*Se*)
- Macro-averaging Specificity (*Sp*)

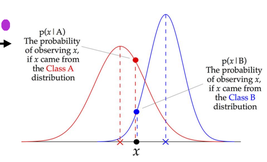




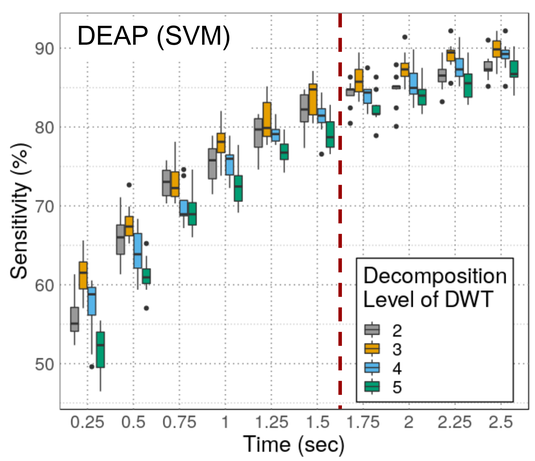


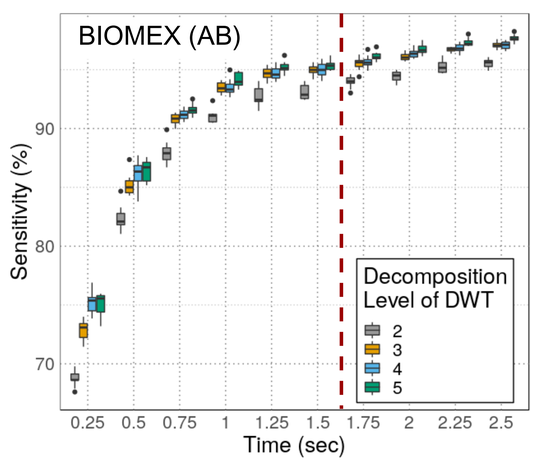






Results





DEAP

Decomposition Level	Two	Three	Four	Five
Time Segment (s)	p-value	p-value	p-value	p-value
0.25	2.2e−16	2.2e−16	2.2e−16	2.2e−16
0.5	2.2e−16	1.6e−15	2.2e−16	2.2e−16
0.75	6.7e−16	4.4e−13	4.4e−16	2.2e−16
1	5.5e−8	3.2e−6	5.7e−9	9.5e−14
1.25	1.1e−4	2.4e−3	4.6e−5	1,00E−04
1.5	5.2e−3	**0.14**	0.03	0.01
1.75	**0.29**	**0.22**	0.02	**0.26**
2	**0.46**	**0.68**	**0.31**	**0.35**
2.25	**0.65**	**0.99**	**0.87**	**0.94**

BIOMEX

Decomposition level	Two	Three	Four	Five
Time segment (s)	p-value	p-value	p-value	p-value
0.25	2.2e−16	2.2e−16	2.2e−16	2.2e−16
0.5	3.3e−11	2.8e−10	7.7e−10	4.8e−10
0.75	6.8e−6	8.8e−7	3.7e−6	4.7e−7
1	3.9e−4	1.2e−3	1.3e−3	8.8e−5
1.25	7.0e−3	0.02	0.02	8.4e−3
1.5	0.05	**0.07**	0.04	**0.08**
1.75	**0.18**	**0.21**	**0.23**	**0.31**
2	**0.38**	**0.41**	**0.36**	**0.57**
2.25	**0.92**	**0.89**	**0.71**	**0.96**

Conclusions

- Although the state-of-the-art recommends using five or four levels of decomposition of DWT, fewer levels can be used and obtain significantly similar results.
- The multivariate statistical analysis demonstrates that there is a point from which it does not matter if the available time increases, the performance of the system does not vary significantly.
- Using 1.75 seconds of EEG recording can be proposed as the recommendation for future studies because of the quality of results achieved with this time.
- An analysis by subject should be made to investigate further the factors that can influence the amount of EEG recording time needed to achieve good user identification.

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