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EEG Classification: The Warping Window Size Does Not Matter That Much

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1 Summary

EEG classification is the common theoretical background of various EEG-related recognition tasks, such as the recognition of symptoms of diseases. We consider these tasks as time series classification tasks for which models based on dynamic time warping (DTW) are popular and effective.

According to Dau et al. (2018), setting the appropriate warping window size (WWS) is crucial for the accuracy in various applications [1].

We examined whether the WWS is crucial in case of EEG classification. We considered two DTW-based methods, nearest neighbor (NN) and PROCESS [2]. We performed disease recognition experiments on a publicly-available dataset [3] according to patient-based 10-fold cross-validation and measured the area under receiver operator characteristic curve (AUC) for both models with various WWS.

A reasonably high accuracy is achieved in a relatively wide rage of WWS, although WWS should not be set to zero. The AUC of the best examined model was around 0.9 which we achieved with relatively low WWS corresponding to approximately 125 milliseconds.

Our observations indicate that in case of EEG classification, the examined classifiers are much less sensitive to the WWS than suggested by Dau et al.

2 Background

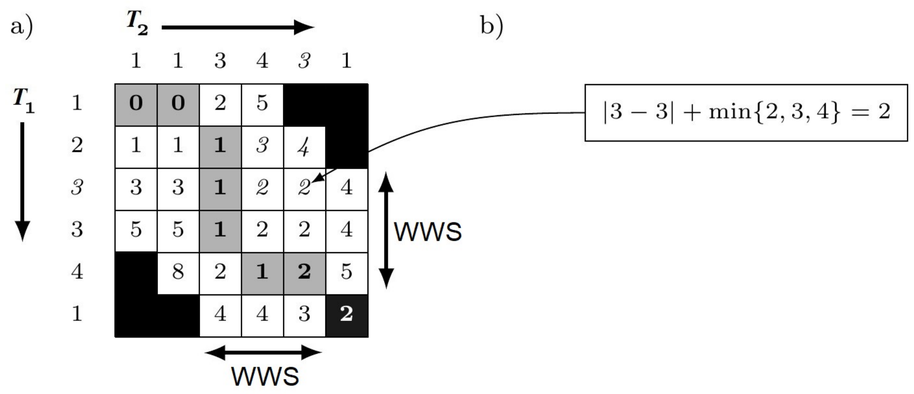

Fig. 1. Dynamic time warping

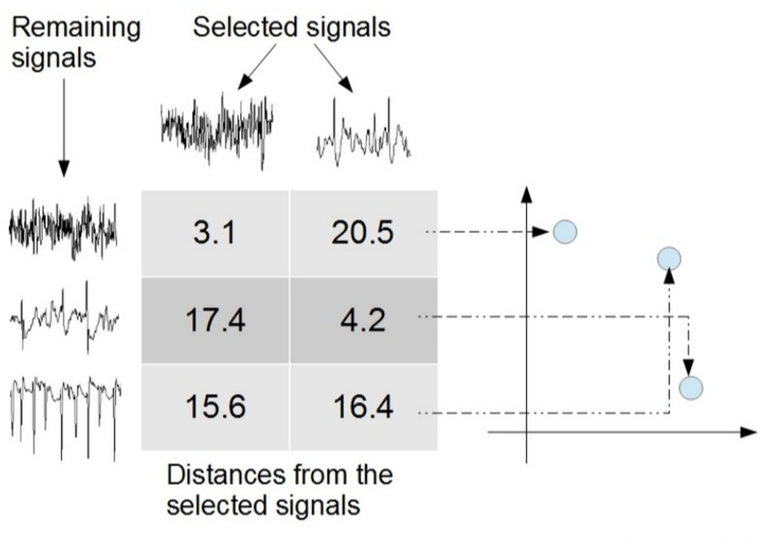

Fig. 2. Projection of signals (PROCESS)

3 Results

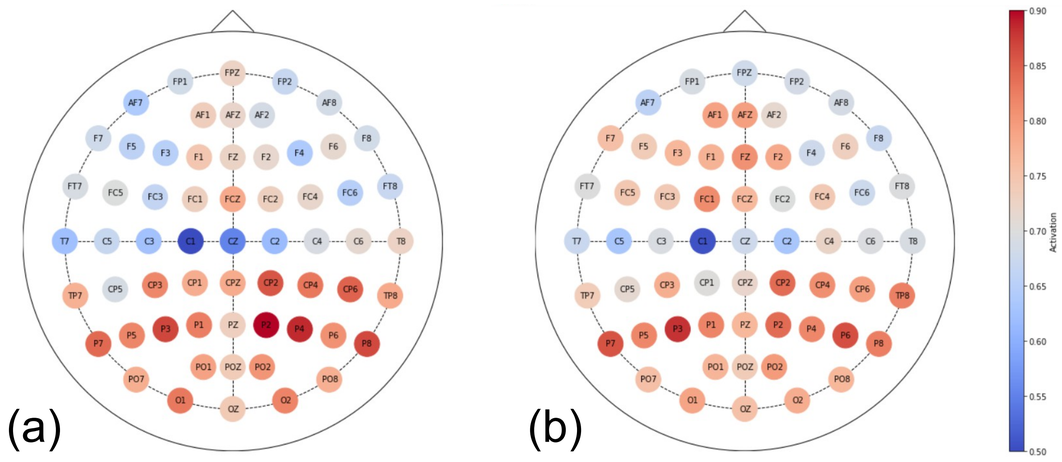

Fig. 3. AUC of 1-NN for various channels with (a) warping window size of 5 time slots (≈78 ms), and (b) without warping window

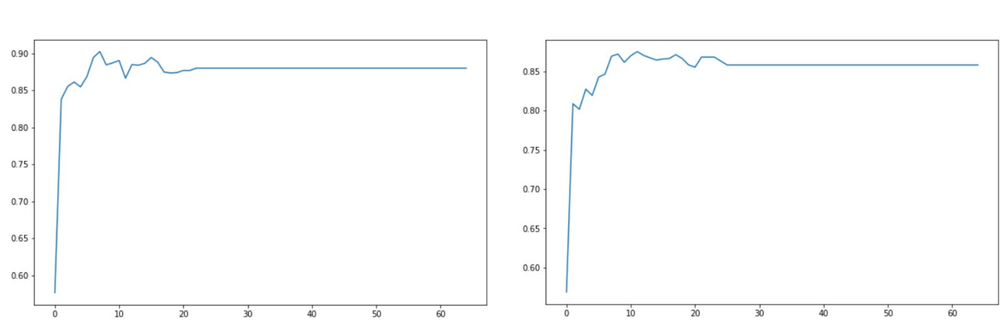

Fig. 4. AUC of 1-NN as function of the warping window size (in time slots) for channels P3 (left) and P7 (right)

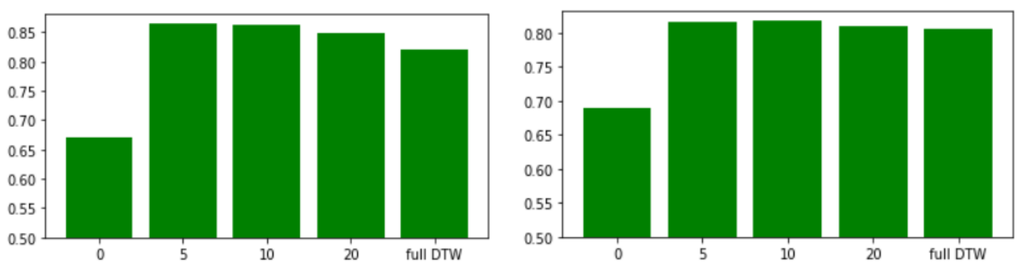

Fig. 5. AUC for averaging 100 projection-based predictions, each one using 100 selected (reference) signals in case of channels P3 (left) and P7 (right)

References

[1] Dau et al.: Optimizing dynamic time warping's window width for time series data mining applications. Data Mining and Knowledge Discovery (2018): 1-47.
[2] Buza et al.: PROCESS: Projection-based classification of electroencephalograph signals. International Conference on Artificial Intelligence and Soft Computing (2015): 91-100.
[3] UCI Machine Learning Repository, EEG Database https://archive.ics.uci.edu/ml/datasets/eeg+database

Acknowledgement

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