

A hybrid CNN-SVM approach with dynamic time warping for time series classification

Kamil Książek^{1,2}, Krisztián Buza³

¹ Institute of Theoretical and Applied Informatics,
Polish Academy of Sciences, Gliwice, Poland

² Department of Data Sciences and Engineering,
Silesian University of Technology, Gliwice, Poland

³ Department of Mathematics-Informatics
Sapientia Hungarian University of Transylvania, Târgu Mureş, Romania
kksiazek@iitis.pl, kamil.ksiazek@polsl.pl, chrisbuza@yahoo.com

Recently, convolutional neural networks (CNNs) have been successfully applied in many fields, including time series classification. However, in earlier years an important role played methods based on a dynamic time warping (DTW) distance. Therefore some researchers tried to combine the advantages of CNNs and DTW and create hybrid methods. In this work, we demonstrate a new approach which consists of three main stages. In the initial phase, a conventional CNN is trained. Then, based on weights from the first convolutional layer of the learned network, DTW distances are calculated. Finally, such extracted features are used for the training of a traditional classifier like Support Vector Machine (SVM). The use of SVM instead of another neural network should reduce the whole calculation time and ensure the more explainable model. We present initial results of this method for selected datasets.

Acknowledgment

K.K. acknowledges funding from the European Union through the European Social Fund (grant POWR.03.02.00-00-I029).

References

- [1] K. Buza, M. Antal, *Convolutional neural networks with dynamic convolution for time series classification*, manuscript accepted to the ICCCI 2021 conference (International Conference on Computational Collective Intelligence).
- [2] M. Radovanović, A. Nanopoulos, M. Ivanović, *Time-Series Classification in Many Intrinsic Dimensions*, In: Proceedings of the 2010 SIAM International Conference on Data Mining, pp. 677–688.
- [3] B. K. Iwana, V. Frinken, S. Uchida, *DTW-NN: A novel neural network for time series recognition using dynamic alignment between inputs and weights*, Knowledge-Based Systems, Vol. 188, 2020.