PRELIMINARY RESULTS ON THE GENERATION OF ARTIFICIAL HANDWRITING DATA USING A DECOMPOSITION-RECOMBINATION STRATEGY

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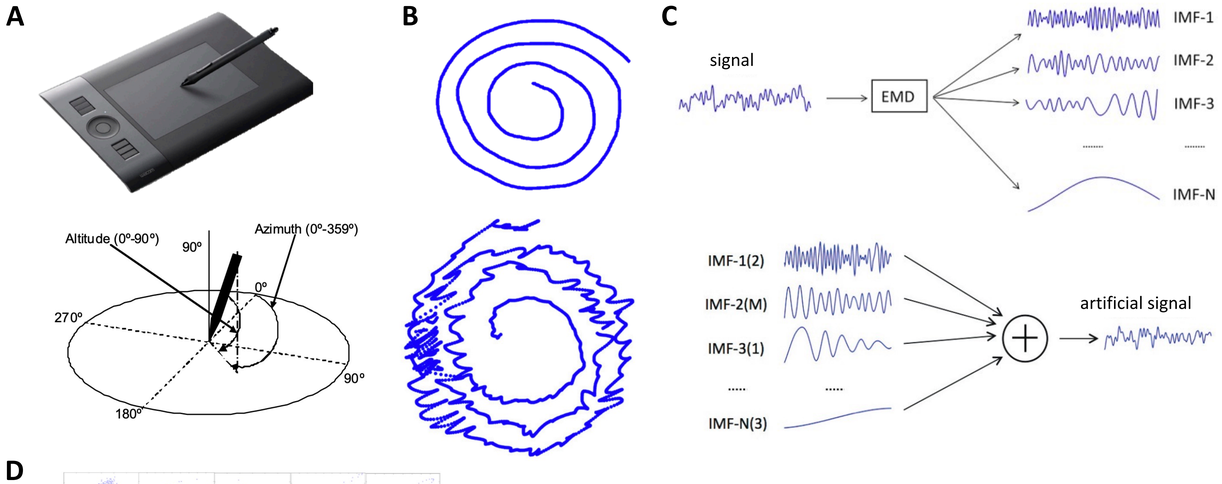
INTRODUCTION

- Essential tremor (ET) is a disorder of the nervous system that causes involuntary and rhythmic movements that generally appears in people 65 years of age, but it can appear earlier, from the age of 40. Although it can be reflected in any part of the body, this tremor appears most frequently in the hands, and especially when the subject performs simple everyday tasks, such as eating, drinking or tying shoelaces.
- Different studies have focused on the automatic analysis of handwritten data to determine the patterns that allow an accurate diagnosis of this disease. Habitually, few subjects are available to properly train ML/DL models. Therefore, artificial data is needed to obtain useful models.
- Traditional machine learning methods rely on the calculation of many features and using feature selection methods to obtain a classification model. These features can be: Time related features, Spatial related features, Pressure related features, Dynamic features, Frequency features, Nonlinear features such as Entropy, fractal dimension, etc. We will use a LSTM network to avoid this step.

METHODS



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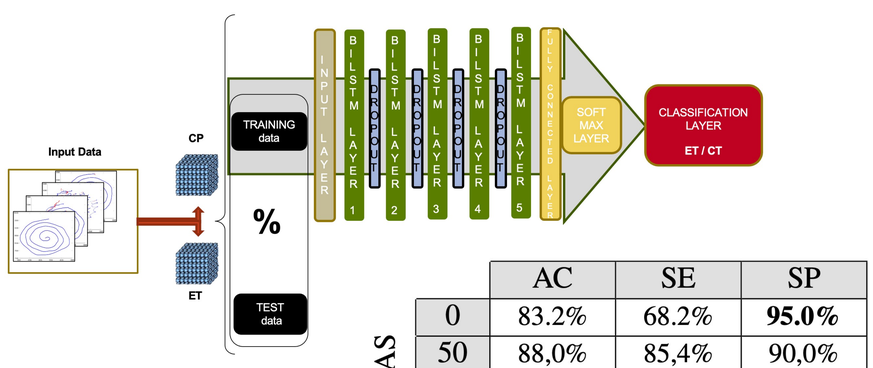
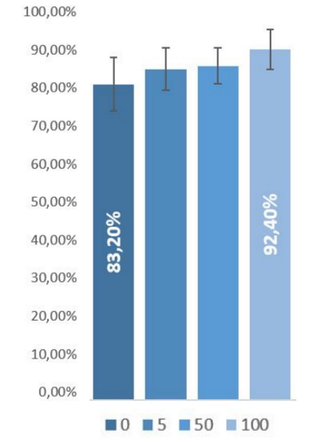
(A) A digitizing tablet is used to collect the handwriting data. Only X and Y coordinates will be used.
(B) Control subject (top) and essential tremor subject (bottom) examples of real Archimedes' spirals
(C) EMD allows to decompose a signal into IMFs (top). Then, we can combine IMFs from different signals to create artificial signals (bottom).
(D) mEMD is used to simultaneously decompose the X and Y coordinates, obtaining the IMFs (top). Then, IMFs of different subjects of the same group (control group or essential tremor group) are combined to create new artificial Archimedes' spirals (bottom).

RESULTS



AS	AC	SE	SP
0	83.2%	68.2%	**95.0%**
50	88,0%	85,4%	90,0%
100	**92,4%**	**93,6%**	91,4%



- We train the LSTM network with 50% of real samples and different number of artif. samples (AS).
- Artificial samples always allow for increased accuracy when training and testing the model.
- The best accuracy is obtained with 100 artificial samples per group, with an improvement in accuracy close to 10%.
- The sensitivity is also improved in these cases, from 68.18% to 93.64%.
- The specificity slightly decreases from 95% to 91.43%. However, sensitivity and specificity are more balanced when using artificial data.

CONCLUSIONS

- Our AC result of 92,4% is similar to previous reported results using 77 and 84 linear and non-linear features extracted from all the available variables generated by the digitizer tablet [1,2], but is lower than the 97.96% reported in [3], obtained after combining two different strategies and selecting the best features over a set of 35 pre-computed linear and non-linear features using all the available variables generated by the digitizer tablet.
- Our system is much simpler (only X and Y is used) and doesn't need feature selection, nor any kind of tuning.

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