Piecewise Aggregate Approximation and Symbolic Aggregate Approximation applied to manual gestures analysis

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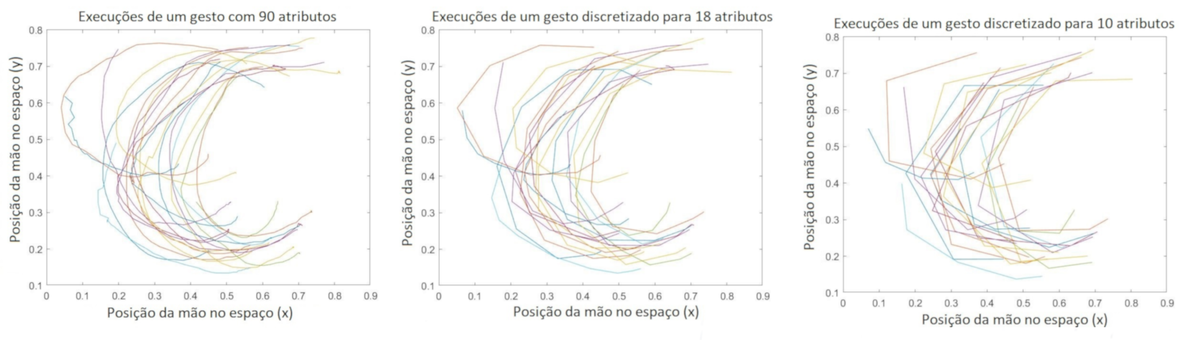
INTRODUCTION: In the gesture analysis field, a large amount of data is needed to produce information about the meaning of the gestures. Thus, the reduction of this volume with minimal loss of information is useful to optimize the studies developed in this field. In this work, the effect of time series discretization techniques, Piecewise Aggregate Approximation (PAA) and Symbolic Aggregate Approximation (SAX) [2] was explored according to a predictive model, the K-Nearest Neighbors (KNN), applied on gestures data. The quality of KNN classification allowed a quantitative evaluation of the loss of information

METHODS: The dataset is composed by specific movements, which are represented by hand positioning over 45 frames of video. In total, there are 15 movement classes, with 24 instances in each class, composing 360 instances of movements (datapoints). Each datapoint is represented by 90 descriptive attributes (two spatial coordinates per frame).

The KNN with $1 \leq K \leq 10$ was applied to the dataset with and without discratization. The number of attributes to build the discretized series needs to be informed as input for both methods, PAA and SAX. The SAX also receives the size of the alphabet used in the symbolic representation of the series.

The PAA tests were done in series with 30, 18, 10 and 6 attributes and in SAX tests, only 18 and 10 attributes. For both, the alphabet size varied from 3 to 10. The classification was evaluated in terms of accuracy and under the leave-one-out test strategy.



RESULTS AND DISCUSSION: For PAA, the best results were obtained with K = 1 and time series with 10 and 18 attributes. Such results achieved 85.56% and 86.67% of accuracy, respectively. In SAX, the best performance was obtained using 18 attributes, K = 1 and alphabet size set to 10, achieving 76.39% of accuracy. By using 10 attributes, with K = 4 and alphabet size set to 10, the best result achieved 69.99%

Accuracy Rate (AR)				Best Mean Accuracy Rates		
Attributes	K	Alphabet	AR	Attributes (N)/K/alphabet	Mean	Standard Deviation
10	1	-	85.56%	N = 10	73.39%	5.39%
10	2	-	76.11%	N = 18	75.33%	5.14%
10	4	9	70.00%	K = 1	83.54%	5.13%
10	5	10	69.72%	K = 2	73.68%	4.53%
18	1	-	86.67%	Alphabet = 9 && N = 5	67.69%	1.84%
18	2	-	76.39%	Alphabet = 10 && N = 5	66.14%	2.62%
18	1	9	75.83%	Alphabet = 9 && N = 9	71.08%	3.33%
18	1	10	76.39%	Alphabet = 10 && N = 9	72.22%	3.50%
				Original dataset	1 -	87.22%
					2 -	76.67%

CONCLUSION: The best accuracy rates were obtained with lower K, probably due to the low volume of data and the high similarity between certain classes of movements. For the PAA, many results were satisfactory, and the loss of precision (less than one percentage point) was considered particularly low due to the reduction of 80% of the attributes in the best result. The SAX performed poorly, in comparison, due to the over discretization of the values, increasing the similarity between the series.

REFERÊNCIAS

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