Weighted Average of Human Motion Sequences for Improving Rehabilitation Assessment

Ali Ismail-Fawaz[1], Maxime Devanne[1], Stefano Berretti[2], Jonathan Weber[1], and Germain Forestier[13]

[1] *IRIMAS, Université de Haute-Alsace, France*

[2] *MICC, University of Florence, Italy*

[3] *DSAI, Monash University, Australia*

ali-el-hadi.ismail-fawaz@uha.fr

Abstract

Context :

- The specific task of assessing rehabilitation motion is difficult due to the lack of annotated data
- Traditional augmentation techniques often produce meaningless human motion sequences, particularly in the context of rehabilitation
- In rehabilitation assessment, labels are continuous values representing movement quality, making it difficult to assign labels to augmented data

Contribution :

- We investigate the use of ShapeDBA [4] for human skeleton sequences to generate average rehabilitation movements
- We extend the averaging method by a weighting strategy [3, 2] that allows generating more various but yet coherent sequences
- We leverage the weighting strategy for associating meaningful continuous labels to synthetic rehabilitation sequences
- We consider the proposed method for extending a small real-world rehabilitation dataset [1] and evaluate it on an extrinsic regression task

References

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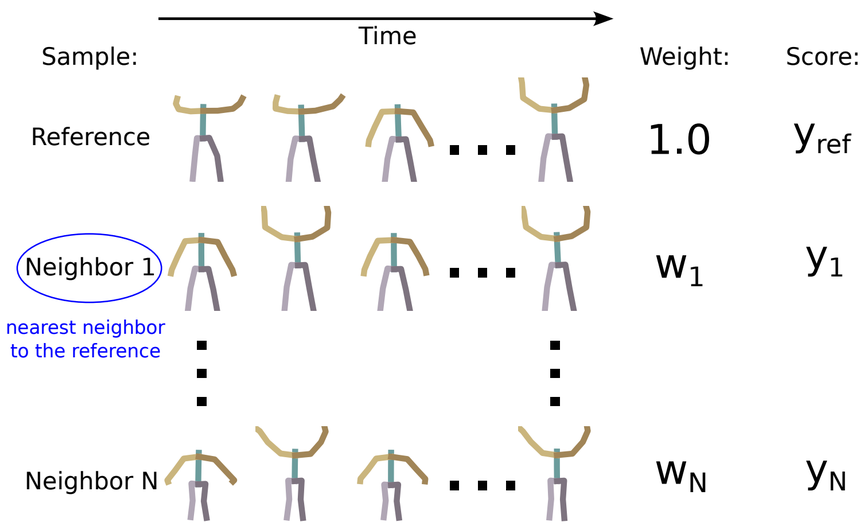
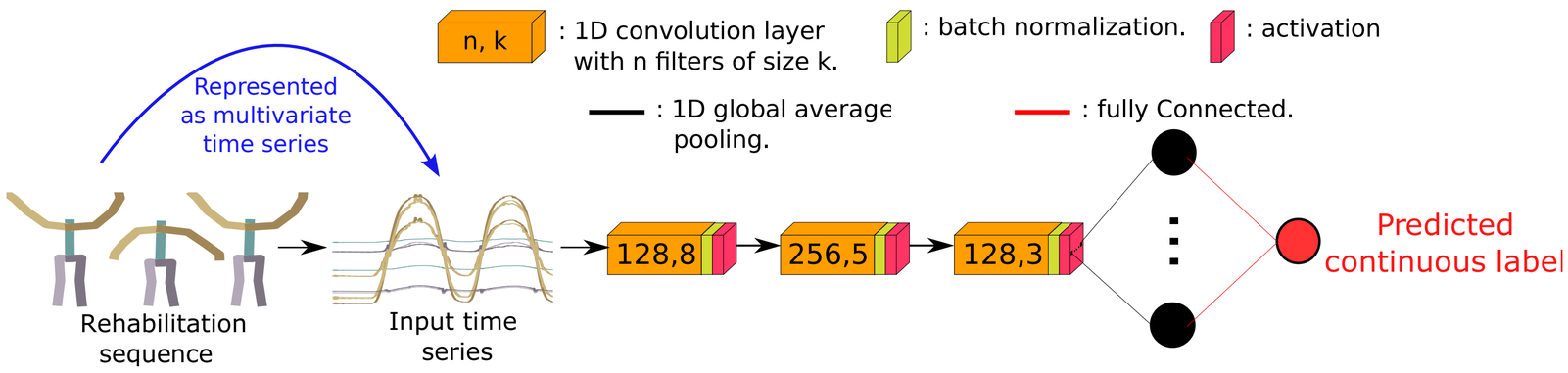
Article & Source Code

Proposed Generative Setup



Deep Learning for Regression Architecture



Qualitative & Quantitative Results

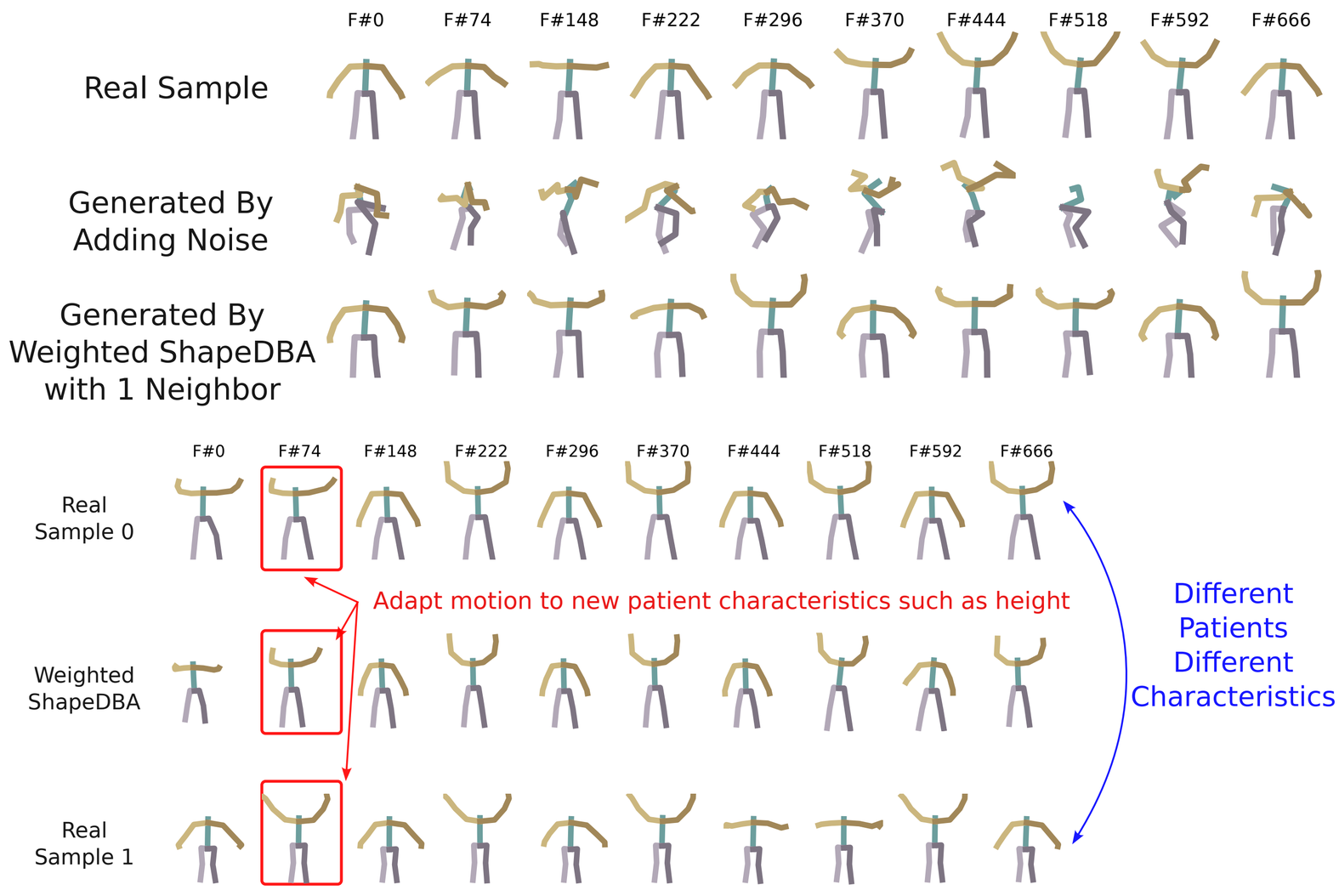


Table 1: MAE and RMSE errors obtained for all compared approaches on each exercise separately. Best values are emphasized in bold, while second best values are underlined.

Training Set	Exercise 1	Exercise 2	Exercise 3	Exercise 4	Exercise 5
			MAE		
Ref.	0.206 ± 0.069	0.202 ± 0.037	0.204 ± 0.055	0.184 ± 0.068	0.224 ± 0.058
Ref. + Noise	0.186 ± 0.065	**0.172 ± 0.040**	0.203 ± 0.045	0.185 ± 0.073	0.229 ± 0.069
Ref. + ShapeDBA NN1	**0.167 ± 0.070**	0.175 ± 0.030	**0.182 ± 0.051**	**0.141 ± 0.062**	**0.208 ± 0.079**
Ref. + ShapeDBA NN2	0.169 ± 0.057	0.177 ± 0.041	0.194 ± 0.041	0.168 ± 0.056	0.226 ± 0.066
Ref. + ShapeDBA NN3	0.173 ± 0.063	0.183 ± 0.047	0.199 ± 0.058	0.168 ± 0.083	0.225 ± 0.055
Ref. + ShapeDBA NN4	0.168 ± 0.059	0.179 ± 0.043	0.199 ± 0.043	0.180 ± 0.080	0.231 ± 0.060
Ref. + ShapeDBA NN5	**0.166 ± 0.067**	0.185 ± 0.043	0.201 ± 0.050	0.182 ± 0.089	0.226 ± 0.061
			RMSE		
Ref.	0.251 ± 0.083	0.247 ± 0.045	0.248 ± 0.065	0.230 ± 0.083	0.267 ± 0.073
Ref. + Noise	0.203 ± 0.078	0.226 ± 0.043	0.238 ± 0.046	0.227 ± 0.090	0.274 ± 0.092
Ref. + ShapeDBA NN1	0.199 ± 0.087	**0.226 ± 0.036**	**0.214 ± 0.054**	**0.178 ± 0.074**	**0.251 ± 0.094**
Ref. + ShapeDBA NN2	0.203 ± 0.075	0.232 ± 0.052	0.226 ± 0.044	0.210 ± 0.074	0.268 ± 0.083
Ref. + ShapeDBA NN3	0.205 ± 0.082	0.235 ± 0.050	0.240 ± 0.062	0.214 ± 0.105	0.268 ± 0.066
Ref. + ShapeDBA NN4	**0.198 ± 0.071**	0.235 ± 0.050	0.234 ± 0.048	0.230 ± 0.105	0.279 ± 0.070
Ref. + ShapeDBA NN5	0.202 ± 0.079	0.230 ± 0.049	0.244 ± 0.057	0.231 ± 0.109	0.280 ± 0.080