Mini-Project (ML for Time Series) - MVA 2023/2024

Time warp invariant kSVD:
Sparse coding and dictionary learning for time series under time warp

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1 Introduction and contributions

[1]

2 Method

2.1 Sparse coding

2.1.1 Orthogonal Matching Pursuit

2.1.2 Time Warp Invariant Orthogonal Matching Pursuit

2.2 Dictionnary Learning

2.2.1 kSVD

2.2.2 Time Warp Invariant kSVD

2.3 Evaluation metrics

3 Data

3.1 BME Dataset

3.2 DIGITS Dataset

4 Results

4.1 BME Dataset

4.2 DIGITS Dataset

Sparsity/Models	kSVD	TWI-kSVD
2	0.25551	0.17313
5	0.19873	0.12301
10	**0.15060**	**0.08559**

Table 1: Reconstruction L_2 errors on the BME dataset (lower is better)

Sparsity/Models	kSVD	TWI-kSVD
2	**0.22**	0.58
5	0.30	0.58
10	0.45	**0.47**

Table 2: Original classification strategy

Sparsity/Models	kSVD	TWI-kSVD
2	**0.07**	**0.53**
5	0.08	**0.53**
10	0.10	0.62

Table 3: Our classification strategy

Table 4: Classification error rates on the BME dataset (lower is better)

Sparsity/Models	kSVD	TWI-kSVD
2	0.50133	0.53786
5	0.30436	0.32883
10	**0.20911**	**0.21764**

Table 5: Reconstruction L_2 errors on the DIGITS dataset (lower is better)

References

[1] SAEED, V. Y., AND DOUZAL-CHOUAKRIAA, A. Time warp invariant ksvd: Sparse coding and dictionary learning for time series under time warp.

Sparsity/Models	kSVD	TWI-kSVD
2	**0.27**	0.73
5	0.53	**0.66**
10	0.63	0.92

Table 6: Original classification strategy

Sparsity/Models	kSVD	TWI-kSVD
2	**0.14**	0.81
5	0.27	**0.76**
10	0.29	0.88

Table 7: Our classification strategy

Table 8: Classification error rates on the DIGITS dataset (lower is better)

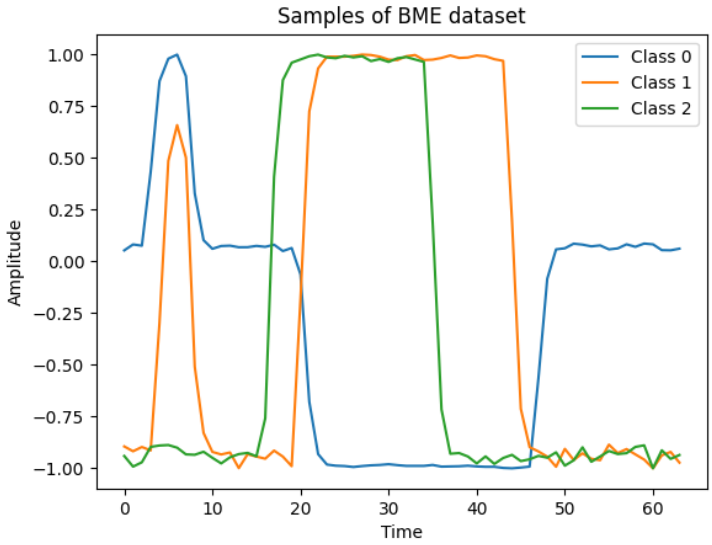
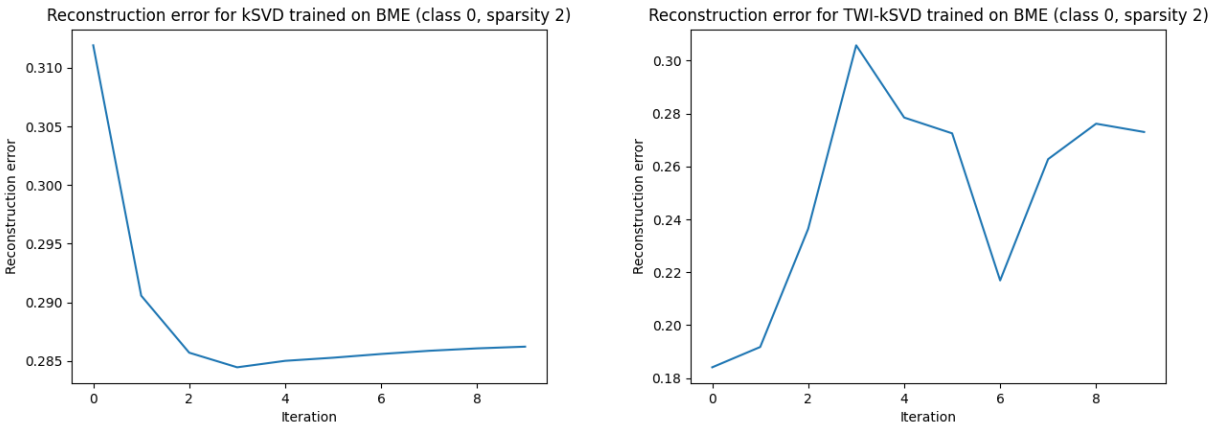


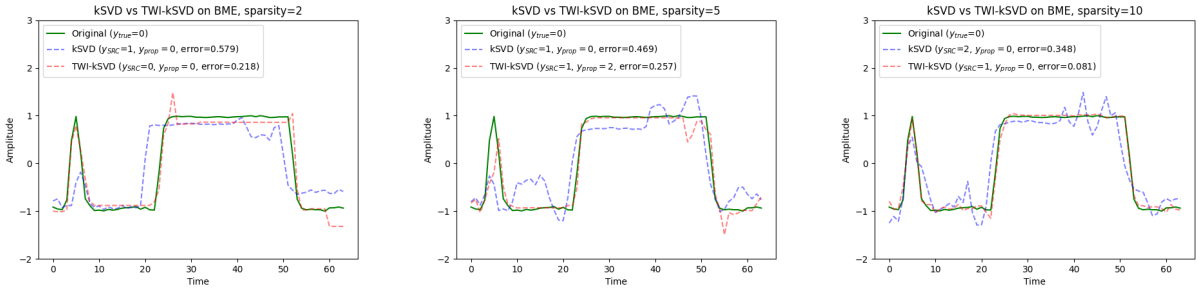
Figure 1: Samples of each class of the BME dataset



(a) kSVD

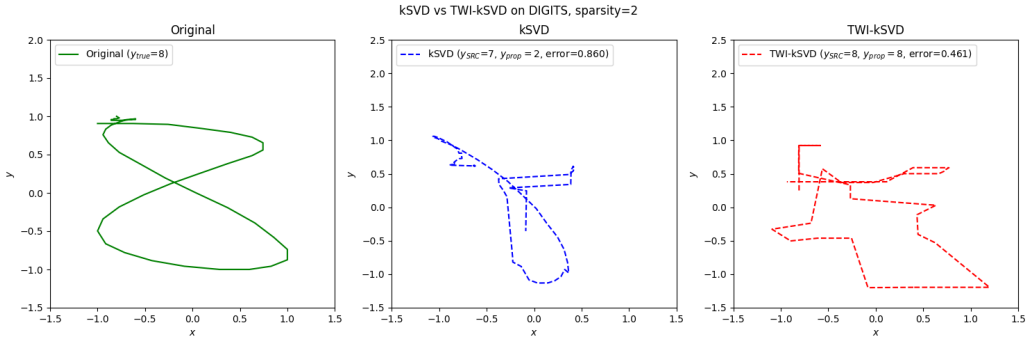
(b) TWI-kSVD

Figure 2: Evolution of reconstruction loss during training (BME dataset)

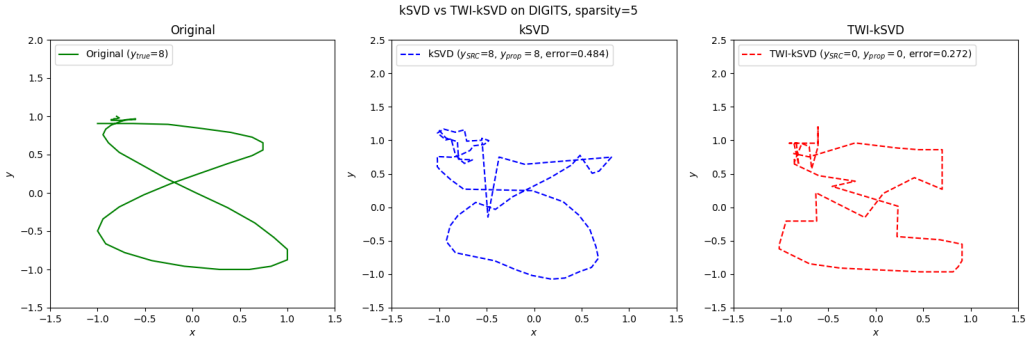


(a) Sparsity = 2 (b) Sparsity = 5 (c) Sparsity = 10

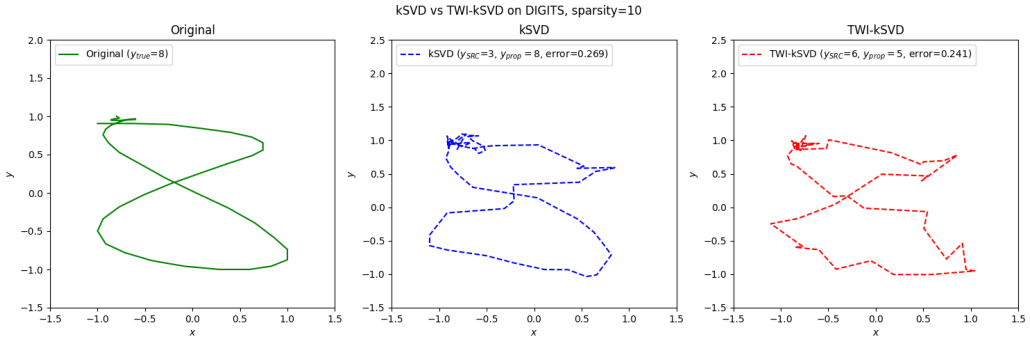
Figure 3: Example of reconstructions (BME dataset) with different sparsity levels



(a) Sparsity = 2



(b) Sparsity = 5



(c) Sparsity = 10

Figure 4: Example of reconstructions (DIGITS dataset) with different sparsity levels