

# Matrix Cofactorization for Joint Representation Learning and Supervised Classification – Application to Hyperspectral Image Analysis.

## Complementary results

Adrien Lagrange, Mathieu Fauvel, Stéphane May,

José Bioucas-Dias and Nicolas Dobigeon

E-mail : `adrien.lagrange@enseeiht.fr`, `mathieu.fauvel@inra.fr`, `stephane.may@cnes.fr`,  
`bioucas@lx.it.pt`, `nicolas.dobigeon@enseeiht.fr`

**TECHNICAL REPORT – 2019, October**

University of Toulouse, IRIT/INP-ENSEEIHT

2 rue Camichel, BP 7122, 31071 Toulouse cedex 7, France

### Abstract

This report provides additional results to the manuscript [1].

### I. HYPERPARAMETERS INFLUENCE STUDY

This section presents a set of experiments conducted to evaluate the influence of the hyperparameters of the model. Starting from the set of hyperparameters used in the experiment on synthetic image presented in the paper, the same experiment has been reproduced but several values are tested for each hyperparameter. It allows one to evaluate the influence of each parameters taken independently. Figures 1 and 2 show the obtained results in terms of F1-score and RMSE, i.e., quality of classification and spectral unmixing, respectively.

It is possible from these experiments that the results are very stable. Regarding classification, the two most critical parameters appears to be  $\lambda_1$  and  $\lambda_c$  which seems logical since the first weight the classification term and the latter the spatial regularization. An increase of the spatial regularization appears to be beneficial as expected but, more interestingly, increasing too much the weight of the classification term appears detrimental to the classification process. It is thus

important for the classification process to give sufficient importance to the spectral unmixing and clustering processes.

Regarding spectral unmixing, the most critical parameters are  $\lambda_0$  and  $\lambda_h$ . I was also expected since the first is weighting the unmixing term and the latter the sparsity penalty. The observed behaviors are the expected one, a too big penalization or a too low weight of fitting term are both detrimental.

Finally, the experiments showed that in this case the regularization of classifier parameters has no influence but, it might be explain by the fact that it seems difficult to observe some overfitting problem with this toy example. It also seems that the choice of the number of clusters is not critical which supports the idea that it is only necessary to consider enough clusters and that an overestimation of the number of clusters is not a critical issue.

## REFERENCES

- [1] A. Lagrange, M. Fauvel, S. May, J. Bioucas-Dias, and N. Dobigeon, "Matrix cofactorization for joint representation learning and supervised classification – Application to hyperspectral image analysis," submitted. [Online]. Available: <https://arxiv.org/abs/1902.02597/>

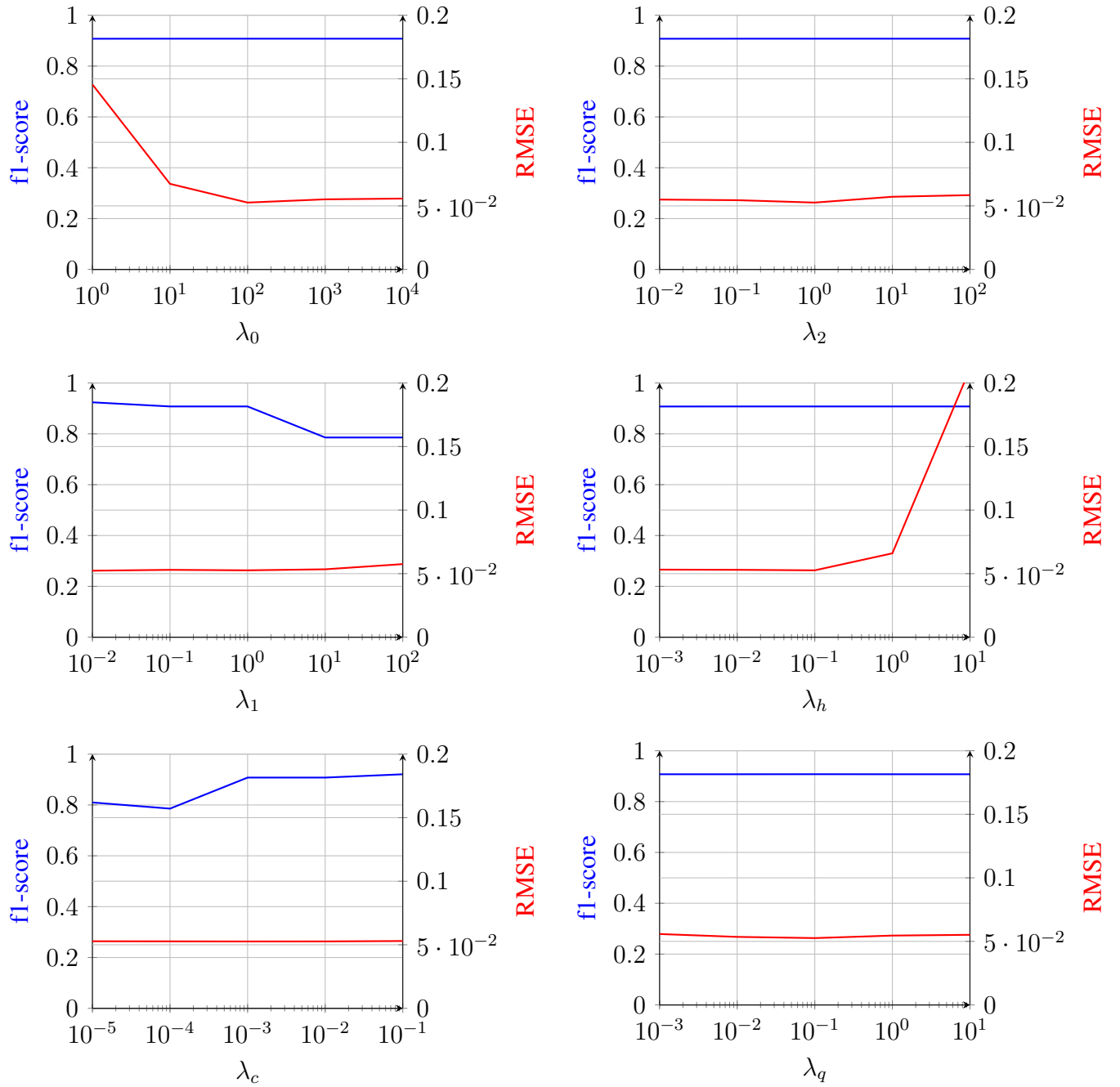


Figure 1. Performance of classification and spectral unmixing as a function of the parameters, evaluated with F1-score and RMSE averaged over 5 trials.

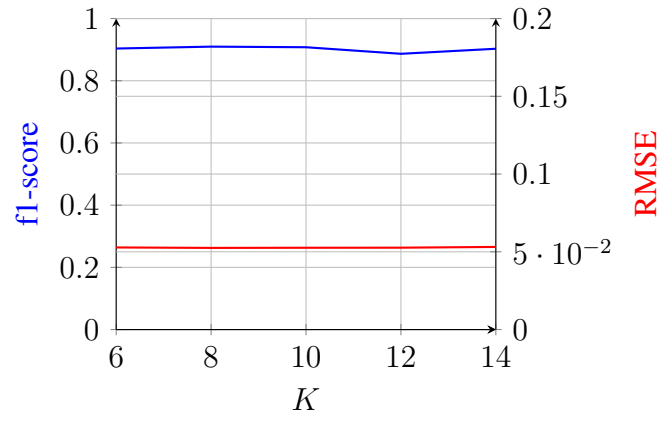


Figure 2. Performance of classification and spectral unmixing as a function of the number of clusters  $K$ , evaluated with F1-score and RMSE averaged over 5 trials.