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A Tensor-Train Dictionary Learning algorithm based on spectral proximal alternating linearized minimization.

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Dictionary Learning (DL) is one of the leading sparsity promoting techniques in the context of image classification, where the "dictionary" matrix D of images and the sparse matrix X are determined so as to represent a redundant image dataset Y. The resulting constrained optimization problem $\min_{D,X} \|Y - DX\|_F$ is nonconvex, non-smooth and NP-hard, providing several computational challenges for its solution (see e.g. [1]). To preserve multidimensional data features, various tensor DL formulations have been introduced, adding to the problem complexity (see e.g. [2]). Unfortunately all the tensor-based DL methods in the literature are not supported with theoretical convergence analysis. We propose a new tensor formulation of the DL problem using a Tensor-Train decomposition ([3]) of the multi-dimensional dictionary, together with a new alternating algorithm for its solution. The new method belongs to the Proximal Alternating Linearized Minimization (PALM) algorithmic family (see e.g. [4]), with the inclusion of second order information to enhance efficiency. We discuss a rigorous convergence analysis, and report on the new method performance on the image classification of several benchmark datasets.
This talk is based on [5].

References

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