Tensor Decomposition Learning for Compression of Multidimensional Signals

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ABSTRACT

Multidimensional signals like multispectral images and color videos are becoming ubiquitous in modern times, constantly introducing challenges in data storage and transfer, and therefore demanding efficient compression strategies. Such high dimensional observations can be naturally encoded as tensors, exhibiting significant redundancies across dimensions. This property is exploited by tensor decomposition techniques that are being increasingly used for compactly encoding large multidimensional arrays. While efficient, these methods are incapable of utilizing prior information present in training data. In this work, a novel tensor decomposition learning method is presented for the compression of high dimensional signals. Specifically, instead of extracting independent bases for each example, our method learns an appropriate basis for each dimension from a set of training samples by solving a constrained optimization problem. As such, each sample is quantized and encoded into a reduced-size core tensor of coefficients that corresponds to the multilinear combination of the learned basis matrices. Furthermore, the proposed method employs a symbol encoding dictionary for binarizing the decomposition outputs. Experimental results on synthetic data and real satellite multispectral image sequences demonstrate the efficacy of our method, surpassing competing compression methods while offering the flexibility to handle arbitrary high dimensional data structures.

REFERENCES

[1] Aidini, Anastasia, Grigorios Tsagkatakis, and Panagiotis Tsakalides. "Tensor Decomposition Learning for Compression of Multidimensional Signals." *IEEE Journal of Selected Topics in Signal Processing* 15.3 (2021): 476-490.