

Efficient tensor completion for color image and video recovery: Low-rank tensor train

Abstract

This paper proposes a novel approach to tensor completion, which recovers missing entries of data represented by tensors. The approach is based on the tensor train (TT) rank, which is able to capture hidden information from tensors thanks to its definition from a well-balanced matricization scheme. Accordingly, new optimization formulations for tensor completion are proposed as well as two new algorithms for their solution. The first one called simple low-rank tensor completion via tensor train (SiLRTC-TT) is intimately related to minimizing a nuclear norm based on TT rank. The second one is from a multilinear matrix factorization model to approximate the TT rank of a tensor, and is called tensor completion by parallel matrix factorization via tensor train (TMac-TT). A tensor augmentation scheme of transforming a low-order tensor to higher-orders is also proposed to enhance the effectiveness of SiLRTC-TT and TMac-TT. Simulation results for color image and video recovery show the clear advantage of our method over all other methods.

Index Terms—Color image recovery, video recovery, tensor completion, tensor train decomposition, tensor train rank, tensor train nuclear norm, Tucker decomposition.