摘要

图像数据因为其直观形象的特点而被广泛传播和使用，但是其占据了较大的空间。因此，在不影响图像的主观视觉效果的前提下，对图像进行有效的压缩能够减少对空间的占用和浪费。矩阵奇异值分解（SVD）可用于实现灰度图像的压缩，其本质为矩阵的低秩逼近。通过选取一定数量的数值较大的奇异值，来实现图像的压缩，这样不仅能够保留矩阵的主要特征，还能减少数据的存储空间。本文在此基础上，将该方法用于彩色图像的压缩，其基本做法是对彩色图像的 R、G、B 三个通道进行 SVD 分解，保留每个通道的主要信息。本文提出了基于张量 T-SVD 分解的图像压缩方法，利用块循环矩阵可对角化的性质，将图像数据分解为三个简单张量的 t-product 乘积，对奇异值进行截断，并重构图像。实验展示了选取不同数量奇异值时图像的压缩效果，从压缩比和结构相似性（SSIM）指数两个角度对原始图像和压缩图像做比较。通过数值实验验证了基于 T-SVD 的图像压缩方法是可行的，而且和矩阵 SVD 方法相比较，该方法实现的图像压缩效果更好。

关键词： SVD；T-SVD；图像压缩

Abstract

Image is widely disseminated and used because of its vivid and visual characteristics, but it occupies a large space. Therefore, the effective compression of the image can reduce the occupation and waste of space under the premise of not affecting the observation of the image. Matrix singular value decomposition (SVD) can be used to compress gray image. Its essence is low rank approximation of matrix. The image compression is realized by selecting a certain number of singular values with large values. It can not only retain the main features of the matrix, but also reduce the storing space of the data. On this basis, the method is applied to the compression of color image. The basic idea is SVD decomposition of R, G and B channels of color image, and then retain the main features of each channel. In this paper, a method is proposed to realize image compression based on tensor T-SVD decomposition. Based on the diagonalizable property of block circulant matrix, the image data is decomposed into 't-product' products of three simple tensors. Then we truncate the singular values and reconstruct this image. The paper display the image compression results when selecting different number of singular values, and compare the original image with the compressed image from the perspectives of compression ratio and structural similarity (SSIM) index. The numerical experiments verified that the method of image compression based on T-SVD is feasible, and the image compression results achieved by this method is better than matrix SVD.

Key Words: SVD; T-SVD; Image Compression

目录