Semi-Discrete Matrix Transforms (SDD) for Image and Video Compression

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A wide variety of matrix transforms have been used for compression of image and video data. Transforms have also been used for motion estimation and quantization. One such transform is the singular-value decomposition (SVD) that relies on low rank approximations of the matrix for computational and storage efficiency. In this study, we describe the use of a variant of SVD in image and video compression. This variant, first proposed by Peleg and O’Leary, called semi-discrete decomposition (SDD), restricts the elements of the outer product vectors to 0/1/-1. Thus approximations of much higher rank can be stored for the same amount of storage. We demonstrate the superiority of SDD over SVD for a variety of compression schemes. We also show that DCT-based compression is still superior to SDD-based compression (see Figure 1). We also demonstrate that SDD facilitates fast and accurate pattern matching and motion estimation; thus presenting excellent opportunities for improved compression.

Figure 1: Comparison of techniques: SVD (1st row), SDD (2nd row), and DCT (3rd row). The first column corresponds to images at 2bpp (except for DCT), the second at 1bpp, and the third at 0.5 bpp.

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