2D Pattern Matching Image and Video Compression

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Abstract

We propose a lossy data compression framework based on an approximate two dimensional pattern matching (2D-PMC) extension of the Lempel-Ziv lossless scheme. This framework forms the basis upon which higher level schemes relying on differential coding, frequency domain techniques, prediction, and other methods can be built. We apply the pattern matching framework to image and video compression and report on theoretical and experimental results. Theoretically, we show that the fixed database model used for video compression leads to suboptimal but computationally efficient performance. The compression ratio of this model is shown to tend to the generalized entropy defined in this paper. For image compression we use a growing database model for which we provide an approximate analysis. The implementation of 2D-PMC is a challenging problem from the algorithmic point of view. We use a range of techniques and data structures such as k-d trees, generalized run length coding, adaptive arithmetic coding, and variable and adaptive maximum distortion level to achieve good compression ratios at high compression speeds. We demonstrate bit rates in the range of 0.25-0.5 bpp for high quality images and data rates in the range of 0.15-0.5 Mbps for a baseline video compression scheme that does not use any prediction or interpolation. We also show that this asymmetric compression scheme is capable of extremely fast decompression making it particularly suitable for networked multimedia applications.

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