

Lossless and Lossy Compression of DNA Microarray Images

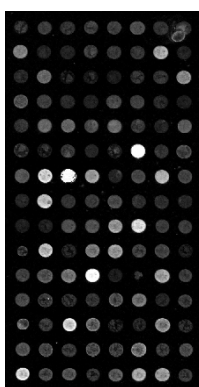
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A DNA microarray is a matrix of thousands or even more single stranded DNA fragments, arranged on a glass or nylon slide. If a solution of an unknown DNA, dyed with fluorescent molecules is washed over the slide, hybridization takes place. Hybridized spots can be detected by laser scanning of the microarray (Fig. 1a).

A new approach for lossless compression of DNA microarray images is proposed. First spots are automatically detected and extracted. Then a new scanning technique, spiral path, is employed to transform the 2D spot to a 1D sequence. Linear interpolation is used in the prediction coding of the achieved sequence. Finally the prediction residual sequence is divided into spot and background parts and is adaptive Huffman coded. Two stages of local optimization result in excellent compression ratios. Fig. 1b compares compression ratios achieved by our method with some others.

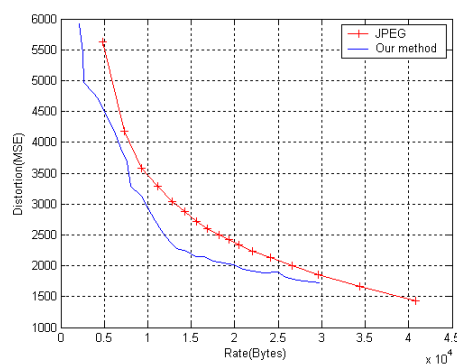
We have also designed and implemented an algorithm for lossy compression of microarray images. First, spots are automatically extracted into spot sub-images. Then a circle is matched to each spot via spatial optimization techniques. After that the new circle to square transform, C2S, is applied to each spot sub-image. Square shaped images are then put together and coded by means of DCT transform, quantization, and entropy coding. Fig. 1c compares the rate distortion curves obtained with JPEG and our method.



(a)

Method	Image a	Image b	Image c
ZIP	1.67:1	1.31:1	1.15:1
GIF	1.54:1	1.13:1	0.98:1
TIFF	1.53:1	1.13:1	0.95:1
JPEG-2000	1.74:1	1.43:1	1.34:1
Lossless-1	1.73:1	1.31:1	1.30:1
Lossless-2	1.71:1	1.32:1	1.31:1
Lossless-3	1.65:1	1.23:1	1.24:1
Lossless-4	1.60:1	1.34:1	1.29:1
Lossless-5	1.70:1	1.36:1	1.32:1
Lossless-6	1.69:1	1.36:1	1.32:1
Lossless-7	1.70:1	1.36:1	1.35:1
JPEG-LS	2.03:1	1.58:1	1.45:1
Our	2.14:1	1.64:1	1.50:1

(b)



(c)

Figure 1: (a) A sample microarray image. Our results for (b) lossless and (c) lossy compression of microarray images compared to some conventional techniques.