Compression of Silhouette-like Images
based on WFA *

Karel Culik II  Jarkko Kari  Vladimir Valenta
Dept. of Computer Science  Dept. of Computer Science  Dept. of Computer Science
Univ. of South Carolina  University of Iowa  Univ. of South Carolina
Columbia, SC 29208  Iowa City, IA 52242-1419  Columbia, SC 29208

Our objective is to design a lossy fractal compression method for silhouette-like bi-level images that would have an excellent quality to compression rate ratio. This is our second and better performing approach to this problem.

The first approach (DCC 96) was based on Generalized Finite Automata where the generalization means that we used rotations, flippings and negations when expressing subsquares of each state in the terms of the other states.

Our new approach is based on Weighted Finite Automata (WFA). WFA have been introduced as a way to specify real functions on \([0, 1]^n\), in particular for \(n = 2\), grayscale functions (grayscale images). Culik - Kari's recursive inference algorithm for WFA led to well performing compression software for grayscale and color images.

We reduce the problem of the encoding of a silhouette-like bi-level image to the encoding of two one-variable functions describing the boundary (-ies) of the black and white regions of the given image. Our method assumes that the given bi-level image consists of black and white regions separated by \(k\) closed curves \(c_1, \ldots, c_k\), for relatively small \(k\). Using the algorithm developed by Estes and Algazi we find \(k\) NESW (north-east-south-west) chain codes for the regions. We convert each chain code into two functions \(x_i(t), y_i(t)\) expressing \(c_i\) in parameterized form for \(i = 1, \ldots, k\). Now we combine the \(2k\) functions (tables) \(x_1, \ldots, x_k, y_1, \ldots, y_k\) into one function (longer table) \(z\) by concatenating the domains. Finally, we compress the function (table) \(z\) by the one-dimensional version of the recursive WFA algorithm and vector quantization for intervals of length 16.

Our new method extends to cartoon-like color images in the same way as for our GFA-method. An image with less than \(2^n\) color values is expressed by \(m\) bitplanes and then each bitplane is encoded as a bi-level image. A further advantage is that the automata encoding different bitplanes can share states.

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