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11th IEEE EAST-WEST DESIGN & TEST SYMPOSIUM (EWDTS 2013)

Rostov-on-Don, Russia, September 27-30, 2013

The main target of the **East-West Design & Test Symposium** (EWDTS) is to exchange experiences between the scientists and technologies of the Eastern and Western Europe, as well as North America and other parts of the world, in the field of design, design automation and test of electronic systems. The symposium aims at attracting scientists especially from countries around the Black Sea, the Baltic states and Central Asia. We cordially invite you to participate and submit your contribution(s) to EWDTS'13 which covers (but is not limited to) the following topics:

- Analog, Mixed-Signal and RF Test
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- ATPG and High-Level TPG
- Built-In Self Test
- Debug and Diagnosis
- Defect/Fault Tolerance and Reliability
- Design for Testability
- Design Verification and Validation
- EDA Tools for Design and Test
- Embedded Software Performance
- Failure Analysis, Defect and Fault
- FPGA Test
- HDL in test and test languages
- High-level Synthesis
- High-Performance Networks and Systems on a Chip
- Low-power Design
- Memory and Processor Test
- Modeling & Fault Simulation
- Network-on-Chip Design & Test
- Modeling and Synthesis of Embedded Systems
- Object-Oriented System Specification and Design
- On-Line Test
- Power Issues in Testing
- Real Time Embedded Systems
- Reliability of Digital Systems
- Scan-Based Techniques

- Self-Repair and Reconfigurable Architectures
- Signal and Information Processing in Radio and Communication Engineering
- System Level Modeling, Simulation & Test Generation
- Using UML for Embedded System Specification

CAD Session:

- CAD and EDA Tools, Methods and Algorithms
- Design and Process Engineering
- Logic, Schematic and System Synthesis
- Place and Route
- Thermal, Timing and Electrostatic Analysis of SoCs and Systems on Board
- Wireless Systems Synthesis
- Digital Satellite Television

The Symposium will take place in Rostov-on-Don, Russia, one of the biggest scientific and industrial center. Venue of EWDTS 2013 is Don State Technical University – the biggest dynamically developing centre of science, education and culture.

The symposium is organized by Kharkov National University of Radio Electronics and Science Academy of Applied Radio Electronics http://anpre.org.ua/ in cooperation with Don State Technical University and Tallinn University of Technology. It is technically co-sponsored by the IEEE Computer Society Test Technology Technical Council (TTTC) and financially supported by Aldec, Synopsys, DataArt Lab, Tallinn Technical University, Aldec Inc.

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CONTENTS

Method of Coding Bitmap Transformant to Improve Image Compression while Maintaining a Predetermined Quality Image to be Transmitted in Infocommunication Real Time Systems

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Abstract

The substantiation of the compression technology transforms the binary description of non-equilibrium position within the coding one-dimensional run lengths binary fields sequence. Showing respect to the possibility of reducing the transformants presentation volume from the identification of spatial constraints on the run lengths binary elements sequences.

Sets out the conditions for the formation of the effective use of non-equilibrium position-encoding for array processing of run lengths binary elements transforms the binary description.

Provides the rationale the shortcomings of non-equilibrium position-encoding: the reconstruction of the run lengths binary elements array columns without information loss is provided for known quantities of non-equilibrium position of code bases and the vector OP number length, during the encoding used internally delays for a preliminary calculation of weights.

Construct a modified non-equilibrium position coding, based on code generation from the younger elements and implementation of cross-order correspondence between the OP number elements and array elements column of the run lengths binary elements.

Creates a method of decoding the modified non-equilibrium position in the direction of the senior members on the basis of considering the possibility of forming weights, beginning with the junior members.

1. Introduction

The current market situation with provision of info communication services is characterized the overload of telecom networks. On the one hand this is caused by the fact that the volume of video information traffic (according to the company Cisco in 2013) rose to 70% of the total traffic. On the other hand the intensity of video stream increases greatly. At the same time, the characteristics of existing info communication technologies are significantly below required.

To reduce the intensity of video stream in the info communication systems integrates the compression technology. The main characteristic of compression technology is the speed of video information stream which is directly dependent on the compression coefficient. The compression coefficient, in turn, depends mainly on the level of introduced distortion, quantitative characteristic of which is the peak signal to noise ratio. The existing degrees of compression with an acceptable quality of video images do not provide the required bit rates. Thus, reducing the bit rate of the compressed video data is an actual scientific and applied task (to improve the quality of service with the use of telecommunications).

The solution of problem is to improve the compression technology. Modern video compression systems are mainly based on the use of JPEG-oriented technologies.

For coding transformants into JPEG technology uses two basic approaches. The first approach is based on the processing component structure transformant. A second approach performs coding bit structure of transformant.

The disadvantages of the first approach are the following: when processing highly saturated images in the train the uneven distribution of zero component chains increases the bit rate, which can exceed the speed of feed stream of uncompressed video; inadequacy of the statistical model leads to an increase

in the information part of the code and as a result to increase the bit rate of compressed stream.

Therefore, to reduce the bit rate of the compressed stream is proposed to use the second approach. The advantages coding technology of bit view transformant is as follows: opportunity to carry out a soft reduction technology of psycho-visual redundancy; availability zero elements zones independent of the degree of image saturation; the use of less powerful algorithms to detect the regularities of binary nature; high degree of noise stability; binary data processing to simplify the hardware implementation of coders.

At the same time, the disadvantage of transformant bit processing is the need to spend an additional amount of operations on the binarization of each transformant component and accordingly it makes additional time delays in steps of binarization and forming bit planes arrays.

We can conclude that the coding technology of transformant bit view has the potential to reduce the bit stream ant transformant processing time in the conditions given quality of image reconstruction for different degrees of small objects saturation.

Therefore, the aim of research is to develop coding methods of the transformed image binary view to reduce their bit-rate with the specified quality reconstruction and using telecommunications. This requires a system $F_{comp}([Y_{m,n}]_2; d)$ of code generators expressions $C(Y) = F_{comp}([Y_{m,n}]_2; d)$ which provides bit rate minimization with given complexity of the algorithm $q_c + q_r \le \text{argument}(t(q_c + q_r))$, where $t(q_c + q_r) \le q_p / t$; and the quality of reconstructed images $\delta = \max\{\delta ax\{u)\} \ge \delta'$.

$C(Y)$ - the code of transformant $Y_{m,n}$ bit view; $[Y_{m,n}]_2$ - the transformant binary formant; $V(C)$ - the bit volume of code $C(Y)$.

2. The development of compression method of transformed image based on the bit planes coding

Transformants compression process is based on three components. The transformant binarization held as the binary cube on the basis of discrete values of basic functions coefficients. In the second stage, the formation of structured description of transformant bit view is proposed to organize identification of the linear dimensions of binary objects series. The binary series array is formed as a result of all bit planes processing. In the third step serves to code received arrays based on formation polyadic codes,

$$C_p = \ell_{1,p} \prod_{\xi=2}^{S} g_\xi + \ldots + \ell_{s,p} \prod_{\xi=s+1}^{S} g_\xi + \ldots + \ell_{S-1,p}\, g_S + \ell_{S,p} = \sum_{s=1}^{S} \ell_{s,p} \prod_{\gamma=s+1}^{S} g_\gamma$$

$$g_\xi \ne g_\gamma, \text{ where } \xi \ne \gamma,\ \xi, \gamma = \overline{1, \Theta}.$$

The size of binary areas taken into account the identification of binary series long (for such a view). The areas positions determined based on the weighting coefficients of series lengths depending on their position in the bit view. Therefore, this coding may be interpreted as position structural weight coding.

The place of position non-equilibrium view in processing system binary data is shown in figure 1.

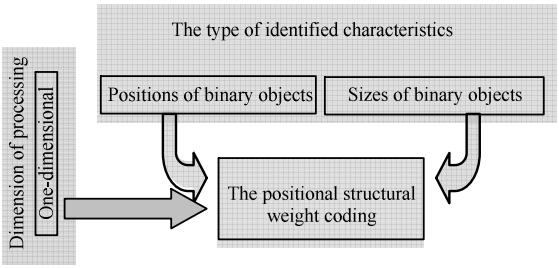

Figure 1. The place of position non-equilibrium view in the system of classification methods of bit processing

However, the proposed coding approach has several disadvantages affecting the availability of redundancy which leads to higher bit rate of transformant compressed view.

The first drawback is the limitation of the maximum-allowable length codeword. In this case, a substantial amount of equable codes formed for the numbers of uniform and limited lengths $S = \text{const} \to \min$. The same number of columns in the binary series lengths arrays increases $P \to \max$. As a result, the structural redundancy is reduced incompletely $R_V = V(v)'_C - v V_C$. The solution of this problem is possible due to formation of a unified code for the extended positional structural weight number.

This will reduce the bit rate (an average of 20-50% depending on the degree of saturation and made distortion levels) of compact view segment of image.

The second disadvantage stems from the fact that: identification of binary series restricted to the individual bit planes.

This leads to the presence of structural redundancy. To solve this problem is necessary to abandon the

principle of positional number building of uniform length.

The third disadvantage is due to the formation of the codeword (length of codeword does not exceed the maximum number of digits). However, for application areas there is a need to form a code word having a predetermined length. The key is to establish a mechanism for increasing the code length, at the expense of increasing the length of position number. The unified code to be generated for non-uniform (along the length) positional numbers.

A fourth disadvantage is that codeword length and codeword number determined based on the vector of positional numbers elements, and it is not known in advance at the receiving side. From which we can conclude that the correct (error-free) definition of the code constructions boundaries of segments compressed view depends on the infallibility of identifying the sizes and initial positions of code constructions of all the preceding segments.

$$\varphi(\tau)_0 = 1 + \sum_{\xi=1}^{\tau-1} v(\xi)_c$$

where $\sum_{\xi=1}^{\tau-1} v(\xi)_C$ - the total amount of code constructions of all segments compressed view preceding segment τ.

To improve the noise immunity of code constructions of image segments compressed view without using additional error correcting codes, it needs to provide code education mode when the length of the code-words is uniform for all segments.

3. The creation of recurrence reverse coding of extended position structural weight numbers of variable length

To overcome the disadvantages are encouraged to use recursion reverse coding of extended position structural weight numbers of variable length. The essence of the coding is to add a senior element of positional number $A'^{(p)} = \{\ell'_{1,p}, ..., \ell'_{s,p}, ..., \ell'_{S,p}, \ell'_{S',p}\}$ if there is information on the number and bases only previously processed items.

If we assume that the last element of position number be the first (and each added element is treated as a younger element relatively rough elements), then this expression becomes:

$$C(S')_p = \ell'_{1,p} + \ell'_{2,p} g_1 + ... + \ell'_{s,p} \prod_{\xi=1}^{s-1} g_\xi + ... + \ell'_{S,p} \prod_{\xi=1}^{S-1} g_\xi + \ell'_{S',p} \prod_{\xi=1}^{S'-1} g_\xi =$$

$$= \ell_{1,p} + \ell_{2,p} g_1 + ... + \ell_{s,p} \prod_{\xi=1}^{s-1} g_\xi + ... + \ell_{S,p} \prod_{\xi=1}^{S-1} g_\xi + \ell'_{S+1,p} \prod_{\xi=1}^{S} g_\xi =$$

$$= \sum_{s=1}^{S} \ell_{s,p} \prod_{\gamma=1}^{s-1} g_\gamma + \ell'_{S+1,p} \prod_{\xi=1}^{S} g_\xi = C(S)_p + \ell'_{S+1,p} g_S W_S .$$

Reverse coding can be represented as in figure 2.

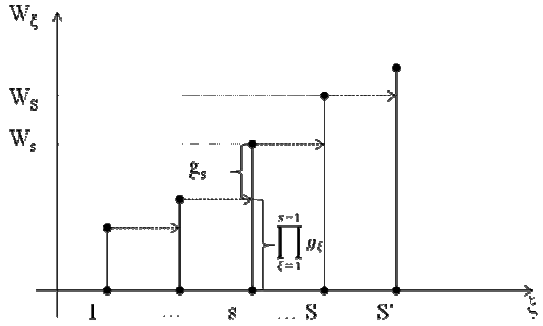

Figure 2. The chart of new coefficients reverse calculate of position structural weight number elements

The analysis of the chart shows that the calculation of the weighting coefficient (for the current element of position number) performed by multiplying the weight coefficient of prior element to its base,

$W_s = \prod_{\xi=1}^{s-1} g_\xi = g_{s-1} \prod_{\xi=1}^{s-2} g_\xi = g_{s-1} W_{s-1}$. This allows us to remove restrictions on the maximum length of binary series and generate code for the extended position number without a priori information on the length and values of the weighting coefficients of senior elements.

The position number length is selected, provided that the number of bits to the maximum possible value of its code views does not exceed the predetermined length of code-word $v(S')_{max} \le V_{ic}$. The condition for choosing the length of extended position number is avoidance of given length code word overflow

$S' = \arg\{\min(V_{ic} - [\sum_{s=1}^{S'} \ell og_2 g_s] + 1)\}$. At each step of processing required to check the condition on the admissibility of adding another element to the current positional number. This processing is to implement a system of expressions:

$$D = \begin{cases} D + 1, \rightarrow [\sum_{\xi=1}^{D} \ell og_2 g_\xi + \ell og_2 g_{s'}] + 1 \le V_{ic}; \\ D = S', \rightarrow [\sum_{\xi=1}^{D} \ell og_2 g_\xi + \ell og_2 g_{s'}] + 1 > V_{ic}, \end{cases}$$

Thus, we have developed the recurrence reverse extended position structural-weight coding ensuring the formation of a code value for the number of variable length in a context where the codeword length is given and codeword overflow be excluded. This saves bit rate by eliminating the code redundancy and excludes uncontrollable loss of information.

4. Conclusions

1) Modified by a non-equilibrium position coding, based on code generation from the younger elements and implementation of cross-order correspondence between the elements of OP number and column of the array elements of the run-length binary elements. This achieves a fundamental difference consisting in that:

- for calculating the weighting coefficients of the elements to the base need not know yet the treated cells;

- in the coding process is not required to carry out a preliminary calculation of weighting coefficients.

2) Time to market encryption technology to decline by an average of 20%.

3) First developed coding sequences of binary elements of runs on a modified presentation of the non-equilibrium position, which is in contrast to existing methods of forming a code value, beginning with the junior members. This allows the compression to eliminate the time delay prior to computation of weighting coefficients.

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