KHARKOV NATIONAL UNIVERSITY OF RADIOELECTRONICS

Proceedings of IEEE East-West Design & Test Symposium (EWDTS'09)

SPONSORED BY

IEEE Computer Society Test Technology Technical Council

Moscow, Russia, September 18 – 21, 2009

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The main target of the **IEEE East-West Design & Test Symposium** (EWDTS) is to exchange experiences between scientists and technologies of 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 circuits and systems. The symposium is typically held in countries around the Black Sea, the Baltic Sea and Central Asia region. We cordially invite you to participate and submit your contribution(s) to EWDTS'09 which covers (but is not limited to) the following topics:

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The symposium is organized by Kharkov National University of Radio Electronics, in cooperation with Tallinn University of Technology, Institute for System Programming of RAS, and Moscow Institute of Electronics and Mathematics. It is sponsored by the IEEE Computer Society Test Technology Technical Council (TTTC) and financially supported by Cadence, JTAG Technologies, Kaspersky Lab, Synopsys, Mentor Graphics, Tallinn Technical University, Donetsk Institute of Road Transport, Moscow Institute of Electronics and Mathematics, Virage Logic, Echostar, Aldec, Teprocomp, DataArt Lab.

CONTENTS

Technology of Cascade Structural Decoding

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Abstract

The necessity of increase of operationability of renewal of information is grounded without errors in the systems of digital diagnostics. Proof of theorem is conducted about decoding of code-number of cascade structural number. As a result of the well-proven theorem correlations are built providing renewal of elements of binary cascade structural number for the set official information without bringing of errors. The basic stages of process are expounded renewals of binary information on the basis of the cascade structural decoding, plugging in itself the system of expressions for recurrent determination of value of initial gravimetric coefficient of column of cascade structural number. Technology of rapid renewal of elements of cascade structural number is built without implementation of decodings actions.

Keywords – cascade structural numbers, of coda-number of column of binary array.

1. Introduction

For the increase of operationability of communication of data in the informatively-telecommunication systems it is necessary to carry out their compact presentation [1, 2]. It results in diminishing of digital volumes of information, and consequently, and to diminishing of amount of packages of information. Important requirements to the methods of compression it is been: increase of degree of compression; providing of control of the errors given without bringing; decline of time of treatment. Thus in a number of practical applications, in that numbers in the process of diagnostics of digital charts, it is especially important to carry out rapid renewal of information. For existent approaches in organization of compression and renewal of binary information the additional increase of coefficient of compression is or with the loss of information or with the increase of temporal expenses on treatment [1 - 4]. From here ***the scientifically-applied task*** is a decline of time of renewal of information at the maintenance of the required level of authenticity of information.

The method of compact presentation of binary information is in-process [5] developed with arbitrary statistical descriptions. It is rotined that approach, based on forming of cascade structural code combinations, allows to promote the degree of compression. In also time for the use of this method in the handling systems of data it is required to carry out their timely renewal without bringing of errors. Means ***the purpose of researches*** is in developments of method of rapid renewal of cascade structural numbers (CSN) without bringing of error.

2. Development of method of decoding of cascade structural code constructions

We will consider sending for the decline of amount of operations to renewal of binary information without bringing of error. We will rosin at the beginning, that by value koda-number $C_{\psi}^{(2)}$ and for the known official information it is possible without bringing of error to recover an initial cascade structural number G.

For this purpose we will formulate and will prove a next theorem.

Theorem about renewal of cascade structural numbers. Binary sequence $G=\{g_{k\ell}\}$, $k=\overline{1,n}$, $\ell=\overline{1,n}$, satisfying limitations:

$$G^{(\ell)}=\{g_{k\ell}\}_{k=\overline{1,n}} \to \eta_{\ell};$$

$$C_{\ell}<F(\eta,\lambda)_{\ell}=\min(V_{\ell,\nu,\eta};\lambda_{\ell}),\ \ell=\overline{1,n},$$

(where C_{ℓ} - value of coda-number of column of binary array) it is possible will recover without bringing an error on the basis of values of coda-number $C_{\psi}^{(2)}$, taking into account the known values of sizes: length of binary columns, vector of limitations $F=\{F(\eta,\lambda)_\ell\}_{\ell=\overline{1,n}}$ on the ranges of codas of one-dimensional floating structural numbers and vector $\{\eta_1,...,\eta_\ell,...,\eta_n\}$ limits on the number of cereus of units in binary columns, by system of expressions:

$$g_{k\ell}^{(\psi)}=\text{sign}(1+\text{sign}(C(k-1;\ell)_{\psi}^{(2)}-\phi_{k\ell})),\ k=\overline{1,n},$$

$$\ell=\overline{1,n}\,; \tag{1}$$

$$\phi_{0\ell}=\frac{(n)!}{(2\eta)!(n-2\eta)!}\left(\prod_{\vartheta=\ell+1}^{n}F(\eta,\lambda)_\vartheta\right) \tag{2}$$

$$F(\eta,\lambda)_\ell=\begin{cases}\lambda_\ell, & \rightarrow \lambda_\ell < V_{\ell,\nu,\eta};\\ V_{\ell,\nu,\eta}, & \rightarrow \lambda_\ell \ge V_{\ell,\nu,\eta}.\end{cases} \tag{3}$$

- if $g_{k-2,\ell}=1$, and $g_{k-1,\ell}=0$, and also if $\left|g_{k-2,\ell}-g_{k-1,\ell}\right|=0$ and $(g_{k-2,\ell}-g_{k-1,\ell})=0$, то

$$\phi_{k\ell}=\phi_{k-1,\ell}\,(n-k+1-t_{k-1,\ell}+1)\,/\,(n-k+2)\,; \tag{4}$$

- if $g_{k-2,\ell}=0$, and $g_{k-1,\ell}=1$, to

$$\phi_{k\ell}=\frac{\phi_{k-1,\ell}\prod_{\gamma=1}^{2}(t_{k-1,\ell}+\gamma)}{(n-k+1-t_{k-1,\ell})(n-k+2)}, \tag{5}$$

where $g_{k\ell}^{(\psi)}$ - $(k;\ell)$ element ψ cascade structural number; $\phi_{k\ell}$ - amount of cascade binary structures $G_k^{(\ell)}$, at which $(k;\ell)$ an element is equal to the zero, I.e. $g_{k\ell}^{(\psi)}=0$; $t_{k-1,\ell}$ - a parameter reflecting dependence of amount of units, forming the number of cereus of units on the current stage of treatment. Calculated on basis recurrent correlations

$$t_{k,\ell}=t_{k-1,\ell}-\left|g_{k-1,\ell}^{(\psi)}-g_{k\ell}^{(\psi)}\right|+(g_{k-1,\ell}^{(\psi)}-g_{k\ell}^{(\psi)}),$$

$$t_{0,\ell}=2\eta_\ell\,; \tag{6}$$

$C(k-1;\ell)_{\psi}^{(2)}$ - remaining value of coda-number $C_{\psi}^{(2)}$, got for a binary structure $G_k^{(\ell)}$, consisting of $((n-k+1)+n(n-\ell))$ binary elements:

$$G_k^{(\ell)}=\{g_{k,\ell}^{(\psi)},...,g_{n,\ell}^{(\psi)},g_{1,\ell+1}^{(\psi)},...,g_{n,\ell+1}^{(\psi)},...,g_{1,n}^{(\psi)},...,g_{n,n}^{(\psi)}\}; \tag{7}$$

$$C(k;\ell)_{\psi}^{(2)}=C(k-1;\ell)_{\psi}^{(2)}-g_{k\ell}^{(\psi)}\phi_{k\ell},$$

$$C(0;1)_{\psi}^{(2)}=C_{\psi}^{(2)}\,; \tag{8}$$

$$C(1;\ell)_{\psi}^{(2)}=C(n;\ell-1)_{\psi}^{(2)}\,;$$

$C(1;\ell)_{\psi}^{(2)}$, $C(n;\ell-1)_{\psi}^{(2)}$ - remaining values of coda-number are accordingly for the first element ℓ column and last element $(\ell-1)$ column of CSN

Proof. Gravimetric coefficient of element $g_{k\ell}^{(\psi)}$ cascade structural number (CSN) consists of two factors and equal $p_{k\ell}^{(\psi)}\prod_{\phi=\ell+1}^{n}F(\eta,\lambda)_\phi$.

On the basis of features the construction of possible great number of floating structural numbers flows out, that factor $p_{k\ell}^{(\psi)}$ possesses the followings properties:

- for the single value of element ($g_{k\ell}^{(\psi)}=1$) CSN size $p_{k\ell}^{(\psi)}$ equal to the amount of preceding the current number of possible OFPSN, at which on k positions are located zero elements;

- size $p_{k\ell}^{(\psi)}$ in supposition, that k an element is equal to the zero ($g_{k\ell}^{(\psi)}=0$) it is on a formula

$$p(g_{k\ell}^{(\psi)}=0)=(n-k+1)!/((t_{k-1,\ell})!(n-k+1-t_{k-1,\ell})!)\,; \tag{9}$$

- on condition of equality of refurbishable element 1, I.e. $g_{k\ell}^{(\psi)}=1$, equality is executed

$$p_{k\ell}^{(\psi)}\prod_{\phi=\ell+1}^{n}F(\eta,\lambda)_\phi=\phi_{k\ell}. \tag{10}$$

From here governed for renewal of elements of CSN it is suggested to build on the basis of the first two terms. If a refurbishable element will be equal to 1, $g_{k\ell}^{(\psi)}=1$, remaining value of coda-number $C(k-1;\ell)_{\psi}^{(2)}$ it will be anymore or equal amounts of possible OFPSN, preceding a current number, but value k element at which equal to the zero

$$C(k-1;\ell)_{\psi}^{(2)}\ge p(g_{k\ell}^{(\psi)}=0)\prod_{\phi=\ell+1}^{n}F(\eta,\lambda)_\phi \ \text{ for } g_{k\ell}^{(\psi)}=1. \tag{11}$$

In reverse case, when a refurbishable element is equal to the zero, $g_{k\ell}^{(\psi)}=0$, then remaining value of coda-number $C(k-1;\ell)_{\psi}^{(2)}$ there will be a less total amount of contiguous possible CSN, at which value k element at which equal to the zero

$$C(k-1;\ell)_{\psi}^{(2)} < p(g_{k\ell}^{(\psi)}=0)\prod_{\phi=\ell+1}^{n}F(\eta,\lambda)_{\phi} \text{ for } g_{k\ell}^{(\psi)}=0. \quad (12)$$

From the analysis of correlations (11) (12) follows, that:

- for the calculation of sizes $C(k-1;\ell)_{\psi}^{(2)}$ and $p(g_{k\ell}^{(\psi)}=0)$ it is not required to know a value k element of refurbishable element;

- result of comparison of sizes $C(k-1;\ell)_{\psi}^{(2)}$ and $p(g_{k\ell}^{(\psi)}=0)$ there is identical in relation to the value of refurbishable element.

Consequently, sizes $C(k-1;\ell)_{\psi}^{(2)}$ and can be utilized for determination of value of element $g_{k\ell}^{(\psi)}$. Governed for renewal of elements of CSN looks like

$$\begin{cases} g_{k\ell}^{(\psi)}=0, \rightarrow C(k-1;\ell)_{\psi}^{(2)} < p(g_{k\ell}^{(\psi)}=0)\prod_{\phi=\ell+1}^{n}F(\eta,\lambda)_{\phi}; \\ a_{izj}=1, \rightarrow C(k-1;\ell)_{\psi}^{(2)} \geq p(g_{k\ell}^{(\psi)}=0)\prod_{\phi=\ell+1}^{n}F(\eta,\lambda)_{\phi}. \end{cases} \quad (13)$$

Replacing a size in right parts of inequalities of the system (13) $p(g_{k\ell}^{(\psi)}=0)\prod_{\phi=\ell+1}^{n}F(\eta,\lambda)_{\phi}$ by expression (10), will get

$$\begin{cases} g_{k\ell}^{(\psi)}=0, \rightarrow C(k-1;\ell)_{\psi}^{(2)} < \phi_{k\ell}; \\ g_{k\ell}^{(\psi)}=1, \rightarrow C(k-1;\ell)_{\psi}^{(2)} \geq \phi_{k\ell}. \end{cases} \quad (14)$$

We will replace two operations of comparison of sizes $C(k-1;\ell)_{\psi}^{(2)}$ and $\phi_{k\ell}$ on the operation of verification of difference between these sizes. These actions are set an operator $\operatorname{sign}(u)$.

Taking into account this operator the set of inequalities (14) will assume an air of correlation (1).

Third property of gravimetric coefficient, set a formula (10) allows to count the remaining value of coda-number. Indeed, as on the value of coda-number the single elements of CSN influence only, at knowledge of their gravimetric coefficient the remaining value of coda-number will be determined on correlation (8). A theorem about renewal is well-proven.

As a result of the well-proven theorem correlations are built providing identical renewal of elements of binary cascade structural number for the set official information (a number of cereus of units is in the columns of CSN, limit on the values of codas-numbers of OFPSN).

For diminishing of amount of operations of the initial parameter expended on a calculation $\phi_{0\ell}$ it is suggested to conduct his calculation on the basis of size ϕ_{01} - found for the first column of cascade structural number. For this purpose it is required to set interdependence between sizes $\phi_{0\ell}$ and ϕ_{01}. Size ϕ_{01} for the known values of length of column n and numbers of cereus of units η_0 equal

$$\phi_{01} = (n)!/((2\eta_0)!\,(n-2\eta_0)!). \quad (15)$$

From other side size $\phi_{0\ell}$ for the known sizes n and η_ℓ it is on a formula

$$\phi_{0\ell} = (n)!/((2\eta_\ell)!\,(n-2\eta_\ell)!). \quad (16)$$

As expressions (15) and (16) differ denominators, the followings variants are possible:

- if between sizes η_0 and η_ℓ inequality is executed $\eta_0 < \eta_\ell$, то

$$\phi_{0\ell} = \phi_{01}\prod_{k=n-2\eta_\ell+1}^{n-2\eta_0}k! \Big/ \prod_{k=\eta_0+1}^{\eta_\ell}k!; \quad (17)$$

- otherwise for $\eta_0 > \eta_\ell$, it will be

$$\phi_{0\ell} = \phi_{01}\prod_{k=\eta_0+1}^{\eta_\ell}k! \Big/ \prod_{k=n-2\eta_\ell+1}^{n-2\eta_0}k!; \quad (18)$$

- for a condition $\eta_0 = \eta_\ell$ equality corresponds $\phi_{0\ell} = \phi_{01}$.

Correlations (17) and (18) allow to eliminate a necessity for the calculation of factorial expressions on the basis of the use of the known information about the initial parameter of process of renewal for the first column of cascade structural number.

For additional reduction of amount of operations it is suggested to take into account possibility of operative renewal of elements of cascade structural number.

Determination 1. Under operative renewal of elements of binary sequence possibility of determination of values of the got elements is understood without the leadthrough of decoding actions.

In this connection we will formulate and will prove next consequences.

Investigation 1. If on k step of decoding between by a size $t_{k,\ell}$ and by the amount of the unrecovered elements $(n-k+1)$ equality is executed

$$t_{k,\ell} = (n-k+1), \quad (19)$$

values of elements $g_{u\ell}^{(\psi)}$, where $u = \overline{k,n}$ will be equal:

- for $k=0$:

$$g_{2\xi,\ell}^{(\psi)} = 0,\ \xi = \overline{1,[n/2]};\quad g_{2\xi+1,\ell}^{(\psi)} = 1,\ \xi = \overline{0,[n/2]};\tag{20}$$

- for $k \geq 1$:

$$g_{k+2\xi,\ell}^{(\psi)} = 0,\ \xi = \overline{0,([n/2]-1)};$$

$$g_{k+2\xi+1,\ell}^{(\psi)} = 1,\ \xi = \overline{0,([n/2]-1)};\tag{21}$$

Proof. We will consider a variant, when index of refurbishable element more zero. It is necessary on the basis of expression (6), that size $t_{k,\ell}$ can take on only even values. Indeed between sizes $t_{k,\ell}$ and $t_{k-1,\ell}$ can be executed the followings correlations:

$$t_{k,\ell} = \begin{cases} t_{k-1,\ell}, & \rightarrow g_{k\ell}^{(\psi)} = 0\ \&(g_{k-1,\ell}^{(\psi)} = 1;\ g_{k\ell}^{(\psi)} = 1); \\ t_{k-1,\ell} - 2, & \rightarrow (g_{k-1,\ell}^{(\psi)} = 0; g_{k\ell}^{(\psi)} = 1). \end{cases}\tag{22}$$

As an initial value of size $t_{k,\ell}$ it is even (on determination of cascade structural numbers), on the basis of correlation (22) all subsequent values of sizes $t_{k,\ell}$ also will be even. A size means $t_{k,\ell}$ specifies on that how many whole cereus of units contained in $(n-k+1)$ not recovered elements. Consequently, if on k step of decoding a condition (19) is executed, and value of element $g_{k\ell}^{(\psi)} = 0$, : in $(n-k)$ elements there is a whole amount of cereus of units, equal $t_{k,\ell}$. But to make from $(n-k)$ elements number of cereus, equal $t_{k,\ell}$ there must be alternation of zeros and units, I.e. a condition must be executed (21).

Variant when index $k=0$ corresponds a case when the volume of possible great number of CSN is equal to 1. In this case the first element of refurbishable sequence will be equal to the zero. Investigation 1 it is well-proven.

Investigation 2. In case if gravimetric coefficient $\phi_{k\ell}$ element $g_{k\ell}^{(\psi)}$ equal to the zero, I.e. $\phi_{k\ell} = 0$, all the subsequent not recovered elements will be equal to 1, I.e. $g_{u\ell}^{(\psi)} = 1$, where $u = \overline{k,n}$.

Proof. As a gravimetric coefficient of element $g_{k\ell}^{(\psi)}$ to the zero, on the basis of expressions (5) and (6) will be equal to the zero coefficients of all of the not recovered elements, I.e. $\phi_{u\ell} = 0$, where $u = \overline{k,n}$. It is necessary from here, that for any value of remaining coda-number $C(k-1;\ell)_{\psi}^{(2)}$ inequality will be executed $C(k-1;\ell)_{\psi}^{(2)} \geq \phi_{u\ell} = 0$, where $u = \overline{k,n}$. In also on the basis of correlation (1) get time $g_{u\ell}^{(\psi)} = 1$, where $u = \overline{k,n}$. *Investigation 2 it is well-proven.*

Means it is possible to do the followings conclusions:

1) identical renewal of cascade structural binary numbers is developed without the use of additional official information. The built decoding is based on the consistently-recurrent receipt of gravimetric coefficients of elements of CSN;

2) for the decline of amount of operations on renewal of binary elements technology of operative renewal of binary elements is created without implementation of decoding actions. This technology plugs in itself the systems of terms, taking into account dependences of parameters of process of decoding from maintenance of the not recovered elements and feature of forming of possible great number for the maximal values of number of cereus of units. It allows:

- to pre-ordain the values of all of the not recovered elements of CSN;
- exceptions are an amount of operations of increase and division, gravimetric coefficients of value of which required on a calculation 0 is scienter equal;
- exceptions are an amount of operations of increases and division, elements of CSN, the values of which are scienter equal to 1., taken on determination

3. Conclusion

Methodological bases are developed renewals of diagnostic information on the basis of the cascade structural decoding, pluggings in itself:

1. Proof of theorem about decoding of coda-number of cascade structural number. As a result of the well-proven theorem correlations are built providing non error renewal of elements of binary cascade structural number for the set official information (a number of cereus of units is in the columns of CSN, limit on the values of codas-numbers of OPSN).

2. Method of operative renewal of elements of cascade structural number without implementation of decoding actions. This method plugs in itself the systems of terms, taking into account dependences of parameters of process of decoding from maintenance of the not recovered elements and feature of forming of possible great number for the maximal values of number of cereus of units. It allows: to pre-ordain the

values of all of the not recovered elements of CSN; exceptions are an amount of operations of increase and division, gravimetric coefficients of value of which required on a calculation 0 is scanter equal; exceptions are an amount of operations of increases and division, elements of CSN, the values of which are scanter equal to 1., taken on determination.

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Camera-ready was prepared in Kharkov National University of Radio Electronics
by Dr. Svetlana Chumachenko
Lenin ave, 14, KNURE, Kharkov, 61166, Ukraine

Approved for publication: 31.08.2009. Format 60×841/8.
Relative printer's sheets: . Circulation: 150 copies.
Published by SPD FL Stepanov V.V.
Ukraine, 61168, Kharkov, Ak. Pavlova st., 311

Матеріали симпозіуму «Схід-Захід Проектування та Діагностування – 2009»
Макет підготовлено у Харківському національному університеті радіоелектроніки
Редактори: Володимир Хаханов, Світлана Чумаченко
Пр. Леніна, 14, ХНУРЕ, Харків, 61166, Україна

Підписано до публікації: 31.08.2009. Формат $60 \times 84^{1}/_{8}$.
Умов. друк. арк. . Тираж: 150 прим.
Видано: СПД ФЛ Степанов В.В.
Вул. Ак. Павлова, 311, Харків, 61168, Україна