Diyala Journal of Engineering Sciences

ISSN 1999-8716
Printed in Iraq

Second Engineering Scientific Conference
College of Engineering –University of Diyala
16-17 December. 2015, pp. 546-556

# SEGMENTATION AND COMPACT MULTISCALE REPRESENTATION OF THE IMAGES BASED ON PROGRESSIVE BACKWARD CLUSTERING

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**ABSTRACT: -** Developed a method of segmentation and compact multiscale representation of images based on the progressive backward clustering. The method provides an accurate segmentation, multiscale representation and compression of the segmented images, adaptation to a limitation on the time of segmentation.

**Keywords**: image segmentation, multiscale image representation, compact representation of images, progressive backward clustering.

## 1. INTRODUCTION

Image segmentation is widely applied in cartography, video surveillance, recognition and other fields. In some cases, such as combination of images, requires accurate segmentation, multiscale representation and compression of the segmented image, an adaptation to the restriction (limitation) on the time of segmentation. Are known segmentation methods, based on the formation of regions with watershed [1, 2], the quantization by histogram [3, 4], split and merge fields with Quadra-tree [5], Region growing [6].

However, these methods do not satisfy the above requirements. Segmentation using the watershed does not provide allocation of structurally complex areas, and is effective for a narrow class of images, such as the medical. Segmentation based on the quantization histogram does not provide an accurate separation of areas due to assigning the same segment number with the same brightness. Methods based on the division and merging areas with Quadra-tree and based on the Region growing allows accurate image segmentation.

However, these methods do not provide the multiscale representation and compression of the segmented images, adaptation to a limitation on the time of segmentation. In this regard, actual task of developing a method of image segmentation, which takes into account these defects.

## 1. Method Of Segmentation And Compact Multiscale Representation Of Images On The Basis Of Progressive Backward Clustering

Proposed method of segmentation and compact multiscale representation of images on the basis of progressive backward clustering (Progressive Backward Clustering Segmentation and Compact Representation – PBCS&CR). The essence of the method lies in the tree clustering of homogeneous by brightness pixel area and forming a plurality of multiresolution clustering images of the original image (direct clustering); assigning numbers clustered homogeneous areas at all levels of multiresolution representation of the original image and the search for redundant boundaries of homogeneous areas (progressive backward clustering); combining adjacent homogeneous in brightness clustered areas (refinements to the boundaries of segments).As a result, Forward(direct) forming a hierarchical set of the matrices approximately (determined by the average brightness of the cluster) and the clustering (determine the homogeneity cluster members).

The matrix of each hierarchical level correspond to more than an cluster multi-scale represented of the original image. This allows to implement in the next step progressive segmentation, effusing (allocate) homogeneous area first for large-scale representation of the image, and then gradually refines the boundaries of homogeneous areas in the lower hierarchy of small-scale representation of the image. The scaling factor in the vertical and horizontal - two (chosen based on the size of the cluster).

During backward clustering, iteratively forming a hierarchical set of segmentation matrices, elements are given numbers corresponding segments as a result the forming of new and capacity of the existing homogeneous in brightness regions. In addition, Identifies neighboring homogeneous regions having the same average brightness, but different numbers of segments for subsequent merger. Backward clustering begins with the large-scale representation of the image and extends to some number of levels of multi-scale image representation, determine the admissibility of processing time and the required accuracy of segmentation. With each iteration of the of segmentation accuracy increases. In parallel, forming nested code, compactly describing the location of homogeneous in brightness areas. In results of refinement (clarifying) the boundaries of the segments formed by the resulting segmentation matrix, whose size is coincides with the size of the original image or a multiple of it. Each element of the resulting segmentation matrix represents some pixel of an image or its multi-scale representation and has as a value the number of the corresponding segment. Fig.(1)a diagram for main algorithms of operations for PBCS&CR method.

### 1.1 Forward clustering

Algorithm of forward Clustering consists of the following steps.

1) Forming a plurality of $\{A(l)\}_{(l=\overline{0,L})}$ matrix $A(l)=\left\|a^{(l)}(y,x)\right\|_{\left(y=\overline{0,Y/2^l-1},x=\overline{0,X/2^l-1}\right)}$ approximation and initialization of matrix A(0) approximation 0-s level according to the equation $a^{(0)}(y,x)\Leftarrow p(y,x)$ when $y=\overline{0,Y-1}$, $x=\overline{0,X-1}$, where $\Leftarrow$ – the assignment operation; $p(y,x)$ pixel of segmented image $P=\left\|p(y,x)\right\|_{\left(y=\overline{0,Y-1},\,x=\overline{0,X-1}\right)}$; $Y=2^{f_Y}$, $X=2^{f_X}$ – size of the segmented image P; $f_Y>0$, $f_X>0$ – Whole; $l=\overline{0,L}$ – the number of iterations (level) segmentation; $L=\min\left(f_Y,f_X\right)$ – The number of iterations, determined by the minimum of the values $f_Y$ and $f_X$. In results as approximation sample $A(0)$ using segmented image P.

2) Forming a plurality of $\{C(l)\}_{(l=\overline{0,L})}$ matrix $C(l)=\left\|c^{(l)}(y,x)\right\|_{\left(y=\overline{0,Y/2^l-1},\,x=\overline{0,X/2^l-1}\right)}$ clustering and initialization Elements of matrix $c^{(0)}(y,x)$ of matrices $C(0)$ clustering 0-s level according to the equation $c^{(0)}(y,x)\Leftarrow 0$ when $y=\overline{0,Y-1}$, $x=\overline{0,X-1}$. In results of matrix $C(0)$ clustering zero level determines by zero.

3) Initialization counter l cycle according to the equation $l\Leftarrow 1$.

4) Start cycle of clustering. The formation of matrices $C(l)$ clustering $l$ level, elements which computing according to the equation

$$\forall\left(j=\overline{0,1}\right)\forall\left(i=\overline{0,1}\right)\left(a^{(l-1)}(2y+j,2x+i)=a^{(l)}(y,x)\right)\wedge\left(c^{(l-1)}(2y+j,2x+i)=0\right)\rightarrow\left(c^{(l)}(y,x)\Leftarrow 0\right), \quad (1)$$

$$\exists\left(j=\overline{0,1}\right)\exists\left(i=\overline{0,1}\right)\left(a^{(l-1)}(2y+j,2x+i)\neq a^{(l)}(y,x)\right)\vee\left(c^{(l-1)}(2y+j,2x+i)=1\right)\rightarrow\left(c^{(l)}(y,x)\Leftarrow 1\right) \quad (2)$$

when $y=\overline{0,Y/2^l-1}$, $x=\overline{0,X/2^l-1}$,

where $a^{(l)}(y,x)=\frac{1}{4}\sum_{j=0}^{1}\sum_{i=0}^{1}a^{(l-1)}(2y+j,2x+i)$ - average arithmetical elements of cluster with coordinates $(2y,2x)$ in matrix $A(l-1)$ Approximation lower $(l-1)$ level.

In result zero's cluster $\{c^{(l-1)}(2y+j,2x+i)\}_{(j=\overline{0,1},i=\overline{0,1})}$ matrices $C(l-1)$ clustering $(l-1)$ level and corresponding their homogeneous in values of the clusters $\{a^{(l-1)}(2y+j,2x+i)\}_{(j=\overline{0,1},i=\overline{0,1})}$ of matrix $A(l-1)$ Approximation $(l-1)$ level are put in association with zeros elements $c^{(l)}(y,x)$ matrices $C(l)$. Non zeros clusters $\{c^{(l-1)}(2y+j,2x+i)\}_{(j=\overline{0,1},i=\overline{0,1})}$ of matrix $C(l-1)$; also zeros clusters $\{c^{(l-1)}(2y+j,2x+i)\}_{(j=\overline{0,1},i=\overline{0,1})}$ of matrix $C(l-1)$, having a non-homogeneous by values of the corresponding clusters $\{a^{(l-1)}(2y+j,2x+i)\}_{(j=\overline{0,1},i=\overline{0,1})}$ of matrix $A(l-1)$ approximation, are put in a corresponding with one's elements $c^{(l)}(y,x)$ of matrix $C(l)$. Forming such sample for $L$ cycle $L$- levels zero-tree describe the location of the clusters of homogeneous regions in the set $\{A(l)\}_{(l=\overline{0,L})}$.

5) Increasing counter of the cycle according to the equation $l \Leftarrow l+1$.

6) End the cycle of clustering. Check the condition $l \le L$. If it's satisfy – then go to step 4, else – out of cycle and completion of the algorithm.

### 1.2 Progressive backward clustering

Algorithm of progressive backward Clustering consists of the following steps.

1) Forming a plurality of $\{S(l)\}_{(l=\overline{0,L})}$ of matrix $S(l)=\left\|s^{(l)}(y,x)\right\|_{\left(y=\overline{0,Y/2^l-1},\,x=\overline{0,X/2^l-1}\right)}$ segmentation and a set $\{E(l)\}_{(l=\overline{0,L})}$ of matrix $E(l)=\left\|e^{(l)}(y,x)\right\|_{\left(y=\overline{0,Y/2^l-1},\,x=\overline{0,X/2^l-1}\right)}$ borders of homogeneous regions (areas). Initialization matrix of elements $S(l)$ segmentation and $E(l)$ borders of homogeneous regions level $\overline{0,L}$ according to the equation $s^{(l)}(y,x)\Leftarrow 0$ and $e^{(l)}(y,x)\Leftarrow 1$ when $\overline{l=0,L}$, $y=\overline{0,Y/2^l-1}$, $x=\overline{0,X/2^l-1}$. As a result implementation of the current step matrices $S(l)$ of segmentation and $E(l)$ boundaries of homogeneous regions level $\overline{0,L}$ determined the zero's and one's association.

2) Initial a counter $N_A$ homogeneous areas according to the expression $N_A \Leftarrow 1$.

3) Initialization of matrices $S(L)=\left\|s^{(L)}(y,x)\right\|_{(y=0,x=0)}$ of segmentation and $E(L)=\left\|e^{(L)}(y,x)\right\|_{(y=0,\,x=0)}$ boundaries of homogeneous regions level $L$-level. Values of only elements which (tree tops) are calculating using expressions

$$\left(c^{(L)}(0,0)=0\right)\rightarrow\left(s^{(L)}(0,0)\Leftarrow N_A,\,N_A\Leftarrow N_A+1\right). \qquad (3)$$

From equation (3) follow, that for homogeneous image $s^{(L)}(0,0)=1$, and for non-homogeneous image $s^{(L)}(0,0)=0$. For both variants $e^{(L)}(0,0)=1$.

4) Initialization counter l cycle according for the equation $l=L$.

5) Start cycle of progressive segmentation. The formation of values of the elements of matrices $S(l-1)$ of segmentation $(l-1)$-level. according to the equation (scaling of areas)

$$\left(c^{(l)}(y,x)=0\right)\rightarrow\left(s^{(l-1)}(2y+j,2x+i)\Leftarrow s^{(l)}(y,x)\right). \quad (4)$$

When $y=\overline{0,Y/2^l-1}, x=\overline{0,X/2^l-1}, j=\overline{0,1}, i=\overline{0,1}$.

As a results of forming $(l-1)$-level for clustered zero-trees.

In the general case there are four possible combinations corresponding values of clustering matrices in $l$–м and $(l-1)$–levels. For every of these assumed the following processing on $(l-1)$-level: (0,0) – scaling of region (cluster $(l-1)$-level inherits the segment number of the corresponding element $l$–level); (1,0) – forming new segment (the element $(l-1)$–level getting new number of segment) or joining to the existing adjacent segments (element $(l-1)$–level getting number of neighbor element $(l-1)$–level); (1,1) – not processed; (0,1) – an impossible combination.

6) The formation of new regions (separation of the regions) according to the expression

$$\begin{gathered}\left(c^{(l)}(y,x)=1\right)\wedge\left(c^{(l-1)}(2y+j,2x+i)=0\right)\wedge\\ \wedge\neg\exists(k\in[-1,1])\neg\exists(m\in[-1,1])\begin{pmatrix}a^{(l-1)}(2y+j,2x+i)=a^{(l-1)}(2y+j+k,2x+i+m)\wedge\\ \wedge s^{(l-1)}(2y+j+k,2x+i+m)\neq 0\end{pmatrix}\rightarrow\\ \rightarrow\left(s^{(l-1)}(2y+j,2x+i)\Leftarrow N_A, N_A\Leftarrow N_A+1\right)\end{gathered} \quad (5)$$

when $y=\overline{0,Y/2^l-1}, x=\overline{0,X/2^l-1}, j=\overline{0,1}, i=\overline{0,1}, k=\overline{-1,1}, m=\overline{-1,1}, |k|+|m|\neq 0$.

7) Build-up regions by their accession to existing homogeneous regions according to the expression

$$\begin{gathered}\left(c^{(l)}(y,x)=1\right)\wedge\left(c^{(l-1)}(2y+j,2x+i)=0\right)\wedge\left(s^{(l-1)}(2y+j,2x+i)=0\right)\wedge\\ \wedge\exists(k\in[-1,1])\exists(l\in[-1,1])\begin{pmatrix}a^{(l-1)}(2y+j,2x+i)=a^{(l-1)}(2y+j+k,2x+i+m)\wedge\\ \wedge s^{(l-1)}(2y+j+k,2x+i+m)\neq 0\end{pmatrix}\rightarrow\\ \rightarrow\left(s^{(l-1)}(2y+j,2x+i)\Leftarrow s^{(l-1)}(2y+j+k,2x+i+m)\right)\end{gathered} \quad (6)$$

when $y=\overline{0,Y/2^l-1}, x=\overline{0,X/2^l-1}, j=\overline{0,1}, i=\overline{0,1}, k=\overline{-1,1}, m=\overline{-1,1}, |k|+|m|\neq 0$.

8) Spatially-oriented search of the right and the lower borders of homogeneous areas at level l in according to the expression

$$\left(c^{(l)}(y,x)=1\right)\wedge\left(c^{(l-1)}(2y+j,2x+i)=0\right)\rightarrow\left(e^{(l-1)}(2y+j,2x+i)\Leftarrow 4\right), \quad (7)$$

$$\left(e^{(l)}(y,x)=4\right)\rightarrow\begin{pmatrix}e^{(l-1)}(2y,2x)\Leftarrow 0, e^{(l-1)}(2y,2x+1)\Leftarrow 11,\\ e^{(l-1)}(2y+1,2x)\Leftarrow 22, e^{(l-1)}(2y+1,2x+1)\Leftarrow 3\end{pmatrix}, \quad (8)$$

$$\left(e^{(l)}(y,x)=0\right)\rightarrow\begin{pmatrix}e^{(l-1)}(2y,2x)\Leftarrow 0, e^{(l-1)}(2y,2x+1)\Leftarrow 0,\\ e^{(l-1)}(2y+1,2x)\Leftarrow 0, e^{(l-1)}(2y+1,2x+1)\Leftarrow 0\end{pmatrix}, \quad (9)$$

$$\left(e^{(l)}(y,x)=11\right)\rightarrow\begin{pmatrix}e^{(l-1)}(2y,2x)\Leftarrow 0, e^{(l-1)}(2y,2x+1)\Leftarrow 11,\\ e^{(l-1)}(2y+1,2x)\Leftarrow 0, e^{(l-1)}(2y+1,2x+1)\Leftarrow 11\end{pmatrix}, \quad (10)$$

$$\left(e^{(l)}(y,x)=22\right)\rightarrow\begin{pmatrix}e^{(l-1)}(2y,2x)\Leftarrow 0, e^{(l-1)}(2y,2x+1)\Leftarrow 0,\\ e^{(l-1)}(2y+1,2x)\Leftarrow 22, e^{(l-1)}(2y+1,2x+1)\Leftarrow 21\end{pmatrix}, \quad (11)$$

$$\left(e^{(l)}(y,x)=21\right)\rightarrow\begin{pmatrix}e^{(l-1)}(2y,2x)\Leftarrow 0, e^{(l-1)}(2y,2x+1)\Leftarrow 0,\\ e^{(l-1)}(2y+1,2x)\Leftarrow 21, e^{(l-1)}(2y+1,2x+1)\Leftarrow 21\end{pmatrix}, \quad (12)$$

$$\left(e^{(l)}(y,x)=3\right)\rightarrow\begin{pmatrix}e^{(l-1)}(2y,2x)\Leftarrow 0, e^{(l-1)}(2y,2x+1)\Leftarrow 11,\\ e^{(l-1)}(2y+1,2x)\Leftarrow 21, e^{(l-1)}(2y+1,2x+1)\Leftarrow 3\end{pmatrix}. \quad (13)$$

Equations (7) – (13) describe the procedure for spatially-oriented search boundaries of homogeneous areas. combinations of values $\left\{\left(c^{(l)}(y,x)=0\right),\left(c^{(l-1)}(2y+j,2x+i)=1\right)\right\}$ and $\left\{\left(e^{(l)}(y,x)=0\right),\left(e^{(l-1)}(2y+j,2x+i)=1\right)\right\}$ according for equations (7) – (13) presenting in Fig. 2. From equations (7) – (13) and Fig. 2 follows, that in results of execution procedures for determining borders of homogeneous areas pixels, belonging to the lower borders of the homogeneous regions, correspond to the elements of the matrix $E(0)$with values 22, 21 and 3; pixels, belonging to the right borders of the homogeneous regions, correspond to the elements of the matrix $E(0)$ with values 11 and 3; pixel in the right lower corner of the homogeneous region corresponds to an element of the matrix $E(0)$ with value 3; pixel in the left lower corner of the homogeneous region corresponds to an element of the matrix $E(0)$ with value 22; other pixels of the homogeneous region corresponds to an element of the matrix $E(0)$ with values 0.

9) Initial matrix $N_B=\left\|n_B(p,q)\right\|_{\left(p=\overline{0,N_A-1},q=\overline{0,M_A-1}\right)}$ numbers and quantity $V_B=\left\|v_B(p)\right\|_{\left(p=\overline{0,N_A-1}\right)}$ adjacent similar areas according to the expressions $n_B(p,q)\Leftarrow 0$, $v_B(p)\Leftarrow 0$ where $p=\overline{0,N_A-1}$, $q=\overline{0,M_A-1}$, where $M_A$ – the maximum number of adjacent similar areas.

10) Merging homogeneous regions according to the expression

$$\left(\left(e^{(l)}(y,x)=1\right)\vee\left(e^{(l)}(y,x)>1\right)\wedge\left(e^{(l-1)}(2y+j,2x+i)>0\right)\right)\wedge$$

$$\wedge\exists\left(k\in[0,1]\right)\exists\left(m\in[-1,1]\right)\begin{pmatrix}a^{(l-1)}(2y+j,2x+i)=a^{(l-1)}(2y+j+k,2x+i+m)\wedge\\ \wedge s^{(l-1)}(2y+j+k,2x+i+m)\neq 0\wedge\\ \wedge s^{(l-1)}(2y+j+k,2x+i+m)\neq s^{(l-1)}(2y+j,2x+i)\wedge\\ \wedge\neg\exists\left(q\in\left[0,v_B\left(s^{(l-1)}(2y+j,2x+i)\right)\right]\right)n_B\left(s^{(l-1)}(2y+j,2x+i),q\right)=\\ =s^{(l-1)}(2y+j+k,2x+i+m)\end{pmatrix}\rightarrow$$

$$\rightarrow\begin{pmatrix}n_B\left(s^{(l-1)}(2y+j,2x+i),v_B\left(s^{(l-1)}(2y+j,2x+i)\right)\right)\Leftarrow s^{(l-1)}(2y+j+k,2x+i+m),\\ v_B\left(s^{(l-1)}(2y+j,2x+i)\right)\Leftarrow v_B\left(s^{(l-1)}(2y+j,2x+i)\right)+1,\\ n_B\left(s^{(l-1)}(2y+j+k,2x+i+m),v_B\left(s^{(l-1)}(2y+j+k,2x+i+m)\right)\right)\Leftarrow s^{(l-1)}(2y+j,2x+i),\\ v_B\left(s^{(l-1)}(2y+j+k,2x+i+m)\right)\Leftarrow v_B\left(s^{(l-1)}(2y+j+k,2x+i+m)\right)+1\end{pmatrix} \quad (14)$$

When $y=\overline{0,Y/2^l-1}$, $x=\overline{0,X/2^l-1}$, $j=\overline{0,1}$, $i=\overline{0,1}$,

$$k = \begin{cases} \overline{0,1}\, when\ e^{(l-1)}(2y+j, 2x+i) = \{1,3,4\}, \\ 0\, when\ e^{(l-1)}(2y+j, 2x+i) = 11, \\ 1\, when\ e^{(l-1)}(2y+j, 2x+i) = \{21,22\} \end{cases},$$

$$m = \begin{cases} \overline{-1,1}\, when\ e^{(l-1)}(2y+j, 2x+i) = \{1,4\}, \\ \overline{-1,0}\, when\ e^{(l-1)}(2y+j, 2x+i) = 22, \\ 0\, when\ e^{(l-1)}(2y+j, 2x+i) = 21, \\ \overline{0,1}\, when\ e^{(l-1)}(2y+j, 2x+i) = 3, \\ 1\, when\ e^{(l-1)}(2y+j, 2x+i) = 11 \end{cases},$$

$$k + m \neq -1\, when\ e^{(l-1)}(2y+j, 2x+i) = \{1,4\},$$

$$|k| + |m| \neq 0\ when\ e^{(l-1)}(2y+j, 2x+i) = \{1,3,4\}.$$

Limitations, overlays on the indices k and m, provides configuration search space for values elements in the matrix $S(l-1)$, showing in Fig. 3.

11) Decrease cycle counter according to the expression $l \Leftarrow l-1$.

12) End the cycle of progressive segmentation. Checking the condition $l > 0$. If it's satisfying _ then go to step 5, else – out of the cycle and completion of algorithm.

### 1.3 Refinement borders of segments

Algorithm refinement borders of segments consists of the following steps.

1) Formation of matrix $N_X = \|n_X(p,q)\|_{(p=\overline{0,N_A-1},q=\overline{0,M_A-1})}$ numbers, $N_C = \|n_C(p)\|_{(p=\overline{0,N_A-1})}$ replacement numbers and $V_X = \|v_X(p)\|_{(p=\overline{0,N_A-1})}$ quantity merged regions.

2) Initialization counter of segments $N_S \Leftarrow 0$.

3) The formation of numbers of isolated homogeneous regions according to the expression

$$\exists(p \in [0, N_A])(v_B(p) = 0) \rightarrow ((n_X(N_S,0) \Leftarrow p), (n_C(p) \Leftarrow N_S), (N_S \Leftarrow N_S + 1)) \quad (15)$$

where $p = \overline{0,N_A-1}$.

4) Initialization counter cycle of merged regions. $p \Leftarrow 0$.

5) Start cycle of the combining areas. Checking the condition $(v_B(p) = 0)$. If the condition is satisfied, then go to step 12.

6) Definition number of first joint region according to the expression

$$(n_X(N_S,0) \Leftarrow p), (v_X(N_S) \Leftarrow 1), (n_C(p) \Leftarrow N_S). \quad (16)$$

7) Initialization stack pointer associated with numbers of regions (areas) $s \Leftarrow 0$.

8) Processing the stack according to the expression

$$\neg\exists(t \in [0, v_X(N_S)-1])(n_X(N_S,t) = n_B(n_X(N_S,s),q)) \rightarrow$$
$$\rightarrow \begin{pmatrix} n_X(N_S, v_X(N_S)+1) \Leftarrow n_B(n_X(N_S,s),q), (v_X(N_S) \Leftarrow v_X(N_S)+1), \\ n_C(n_B(n_X(N_S,s),q)) \Leftarrow N_S \end{pmatrix} \quad (17)$$

when $q=\overline{0, v_B(n_X(N_S,s))-1}$,

$$v_B(n_X(N_S,s)) \Leftarrow 0. \qquad (18)$$

9) Increment stack pointer associated with numbers of regions $s \Leftarrow s+1$.

10) Checking the condition end the processing of the stack $s < v_X(N_S)$. If the condition is satisfied – go to step 8. Else – go to next step.

11) Increment counter of the segments $N_S \Leftarrow N_S + 1$.

12) Increment counter of cycles of merged regions $p \Leftarrow p+1$.

13) Checking the condition ending of cycle of merged regions $p < N_A$. If the condition is satisfied – go to step 5, else – go to next step.

14) Formation of the resulting matrix $S_R = \|s_R(y,x)\|_{(y=\overline{0,Y-1},\, x=\overline{0,X-1})}$ Segmentation in result redefinition numbers of homogeneous regions according to the expression

$$s_R(y,x) \Leftarrow n_C\left(s^{(0)}(y,x)\right) \qquad (19)$$

when $y=\overline{0,Y-1}$, $x=\overline{0,X-1}$.

## 2. Evaluating The Effectiveness Of Methods For Image Segmentation

The suggested method PBCS&CR segmentation and compact multiscale representation of images based on the progressive backward clustering, like the method of RG Region growing provides a complete and accurate selection homogeneous regions, as well as a multi-scale representation of the segmented image for different levels (layers) as a results of suggested method of segmentation (Fig. 4), also below showing images resulted by implementation Region growing segmentation method on standard image for different sizes (Fig. 5).Unlike the method of RG method PBCS & CR provides a compact representation of the results of image segmentation and its multiscale representation. This is provided through the effective a nested coding locations of the homogeneous regions in the process of the backward clustering [7]. Fig. 6 shows an example of the formation of effective embedded code.

Compactness multi-scale representation of the segmented images depends on the results of quantization of the original image. With increasing a quantization step (and increasing quantization errors) a compression ratio for the segmented images increases. Fig. 7 shows the dependence of the compression ratio of the mean square quantization errors for a number of standard test images.

From Fig. 7 it follows, that the method PBCS & CR provides compression of segmented images to 4.5 times depending on the image in comparison with the method of RG. Compression of segmented images in method PBCS & CR achieved by increasing the computational complexity, which leads to a reduction in the speed of segmentation. In Table. shown time of segmentation of multiscale representation of test images (level 4) methods PBCS & CR and RG, implemented in Matlab and executed on a computer (4 CPUs, 3.6 GHz, 4096 MB). From Table. Follows, the method PBCS & CR inferior in speed to the segmentation method of RG to 230 times.

## CONCLUSION

Proposed (Suggested) method of segmentation and compact multiscale representation of images on the basis of progressive backward clustering.

Method differs from the method of separation and merging areas on the basis of quadtree that it is having three stages of processing, in processing which carried out the clustering tree of homogeneous in brightness area of pixels and forming a plurality of multiresolution clustering imagery of the original image (forward clustering), assigning numbers for the clustered homogeneous areas at all levels of multiresolution representation of the original image and search for redundant boundaries of homogeneous areas (progressive backward clustering); combining the neighboring homogeneous brightness of clustered areas (refinements the boundaries of segments) that provides compression for the segmented image up to 2.2 times as compared with the method of region growing.

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**Table (1):** Time of segmentation for test images, s

| Segmentation methods | Test images | | |
|---|---|---|---|
| | Barbara | Lena | Mandrill |
| PBCS&CR | 5,1999 | 4,6640 | 5,1300 |
| RG | 0,0224 | 0,0235 | 0,0224 |

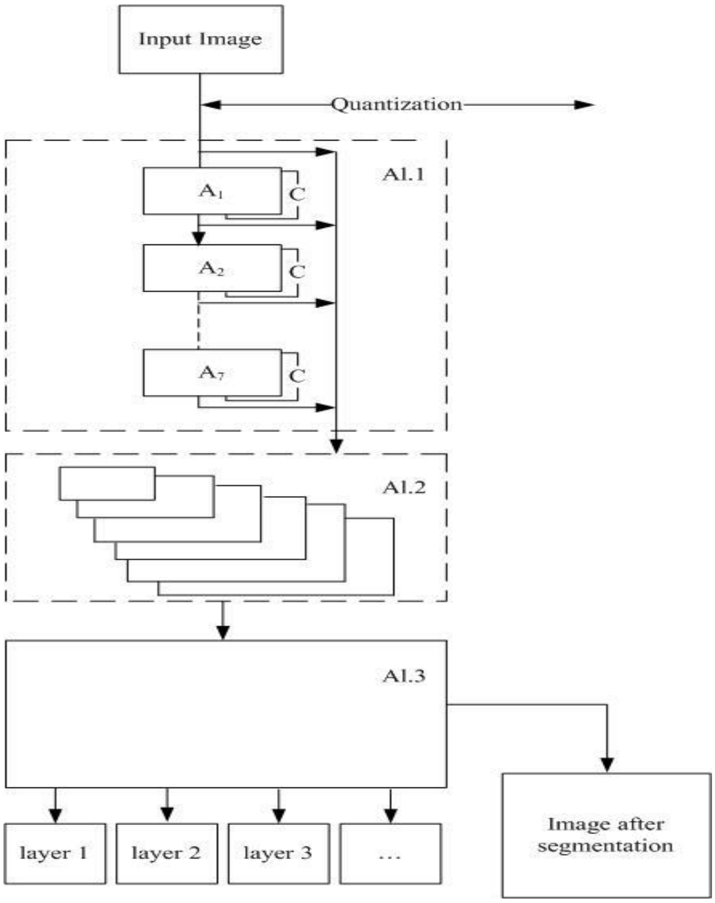


**Figure (1):** The main diagram for suggested method of segmentation

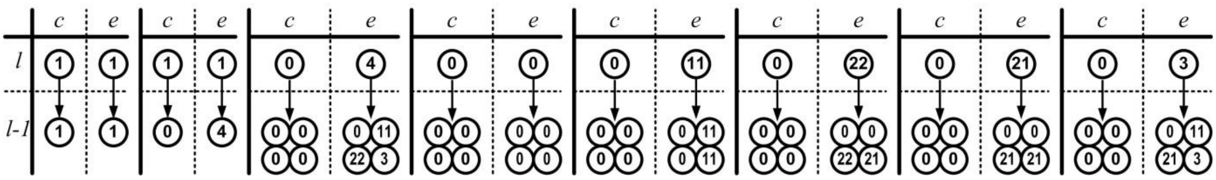

**Figure (2):** Combinations values of elements of clustering matrix and isolation the boundaries of regions

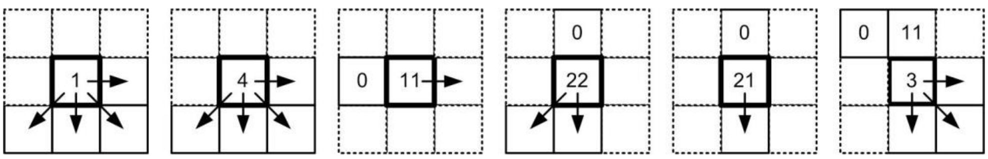

**Figure (3):** Configuration search space for values elements in the matrix $S(l-1)$

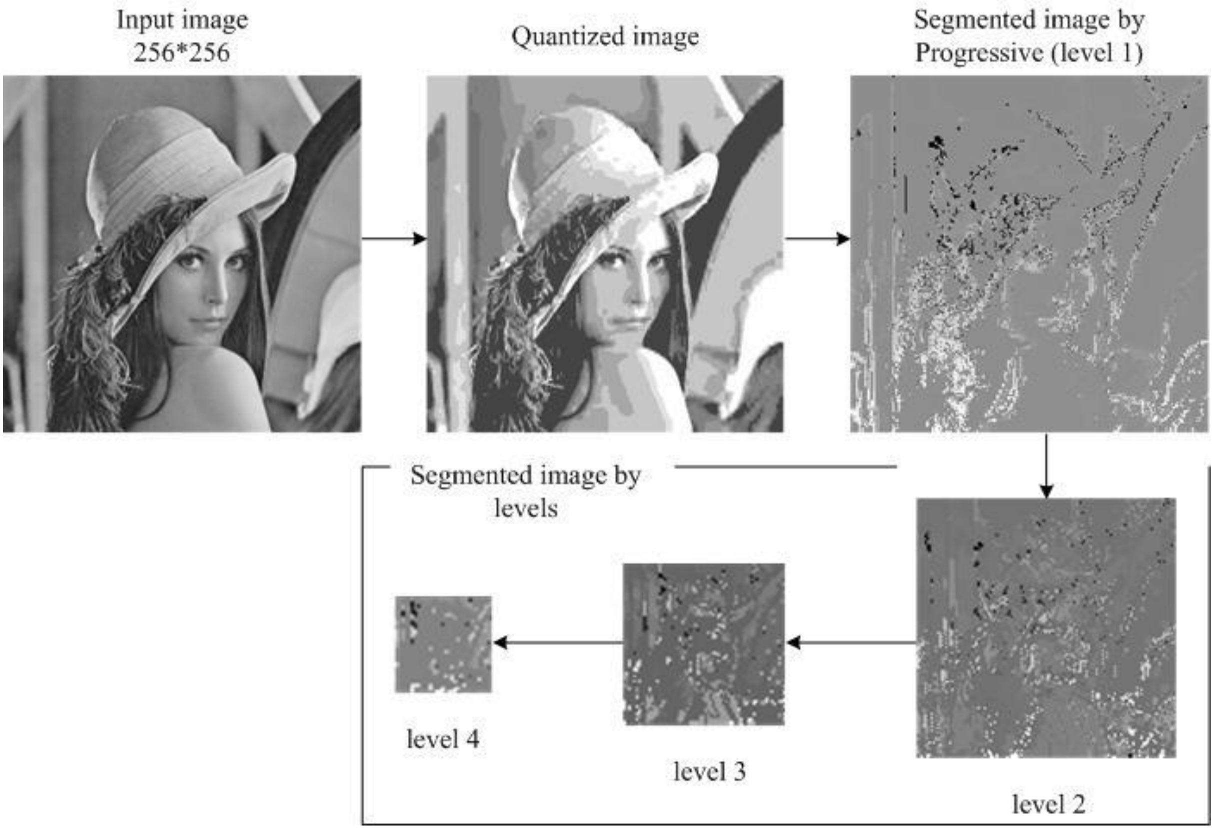


**Figure (4):** Multiscale representation of the segmented image

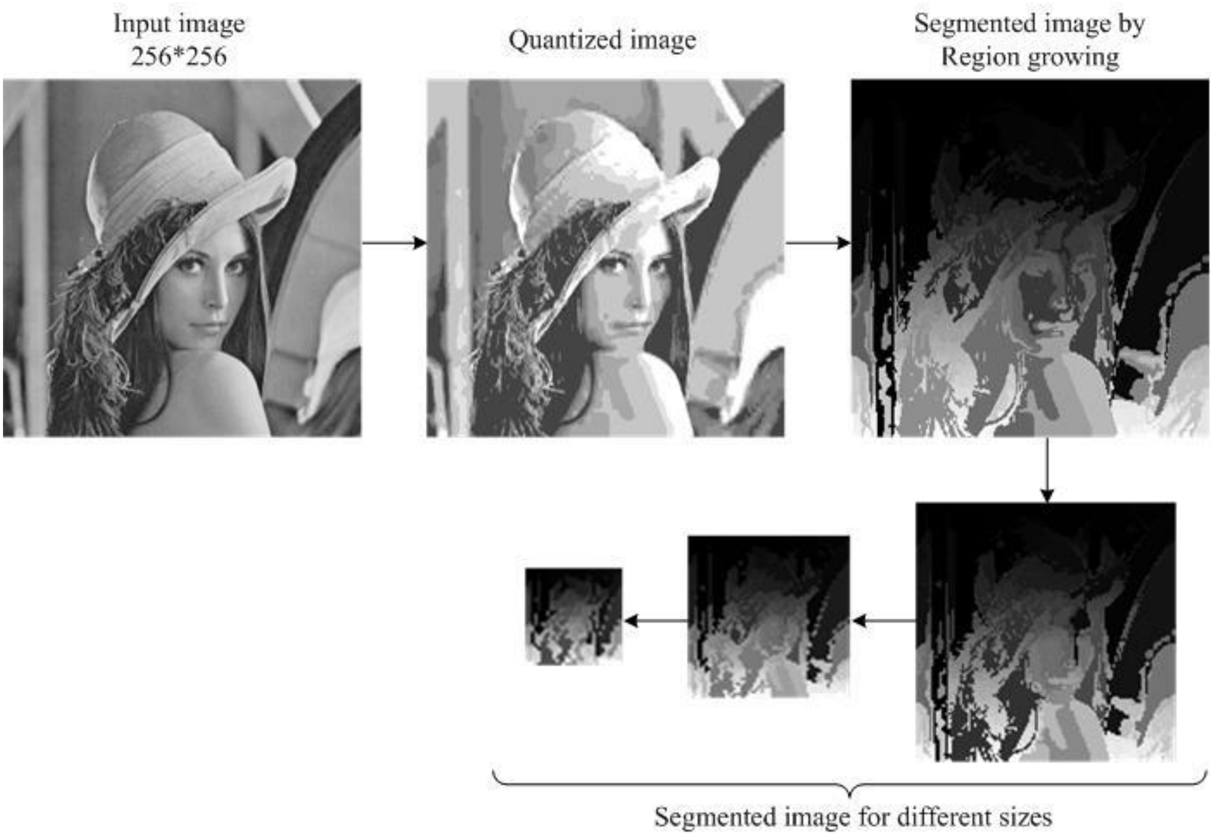


**Figure (5):** Result of segmentation by region growing method

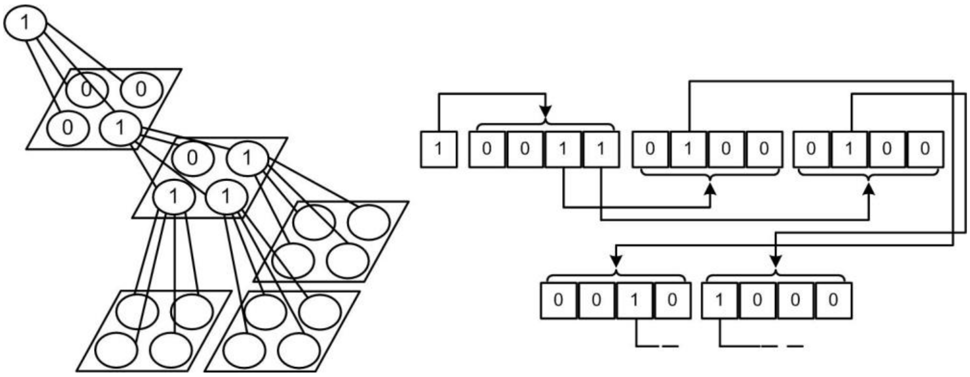

**Figure (6):** Effective nested coding of clustering tree

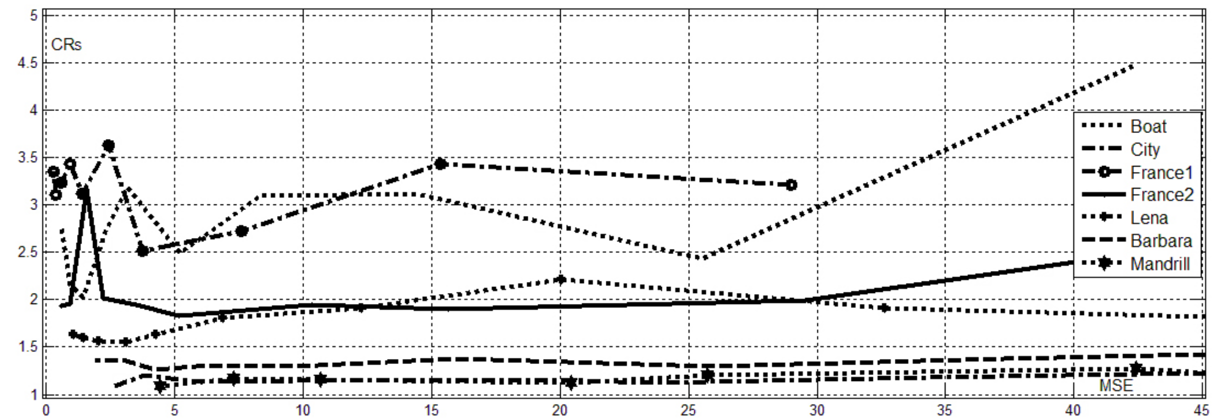


**Figure (7):** dependence of the compression coefficient of segmented images from the mean square errors of quantization of the original image