We propose an algorithm for the characterization of carcinogenic microcalcifications by distribution and morphology descriptors BI-RAD 4. the algorithm is implemented by means of a two-phase algorithm; The first phase is the segmentation of images where suspicious microcalcifications are obtained, and the second phase these objects are classified for diagnosis using morphology descriptors BI-RAD 4.

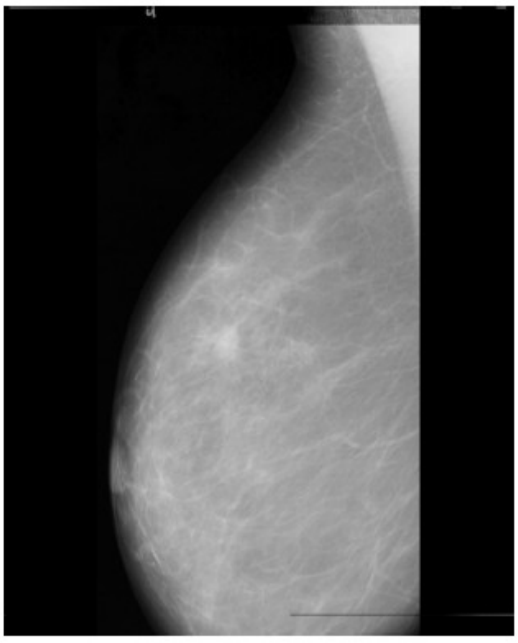
Phase 1: segmentation

An improved non-linear based filter using enhanced factor for image thresholding algorithm

The proposal:

Let $f(x, y)$ the source image, and $g(x, y) = \alpha$ output image, where α is the enhanced factor defined by:

$$\alpha \leftarrow t / (m - t) \quad (1)$$
$$\alpha \leftarrow m - (v * (1 + \alpha)) \quad (2)$$
$$\alpha \leftarrow \alpha - (\alpha * t) \quad (3)$$



f(x, y): source image

g(x, y) ← α: segemented image

in (1), $\boldsymbol{t}$ is the threshold value that minimizes the weighted within-class variance of $f(x,y)$, $m = \boldsymbol{max(f(x, y))}$ and $\boldsymbol{v = med \{ f (xi, yj), i, j \epsilon W \}}$, where W is $n \times n$ sub-matrix whit $n = 3$, Noise,

brightness and contrast level are automatic adjusted by (2) and (3) respectively, then each object is labeled

Phase 2: analysis

A propose algorithm for the characterization of carcinogenic microcalcifications by morphology and distribution descriptors BI-RAD 4. The first step is to reduce the number of false negatives, classifying them according to their morphologies

The proposal:

Let be A a $k \times m$ the matrix of morphological variable values for $\boldsymbol{k}$ suspicious object in $g(x,y)$, B a $n \times m$ the proposed matrix, m the set of variables and $n = 2^m$, posibles values depending:

$$b_{ij} = \begin{cases} 0 <=> li < v < = lc \\ 1 <=> lc < v <= ls \end{cases} \qquad (4)$$

where li, lc, ls are minimal, central and maximun posible variable value. Additionally each row of B is previously labeled with 0 benign 1 malignant in the L set. The k-$esime$ object in A, is classified Lk, if $Akm = = Bkm$

$$A = \begin{pmatrix} a_{11} & a_{12} & \dots & a_{1m} \\ . & . & & . \\ . & . & & . \\ . & . & & . \\ a_{k1} & a_{k2} & \dots & a_{km} \end{pmatrix}, \quad B = \begin{pmatrix} b_{11} & b_{12} & \dots & b_{1m} \\ . & . & & . \\ . & . & & . \\ . & . & & . \\ b_{n1} & b_{n2} & \dots & b_{nm} \end{pmatrix}, \quad L = \{ l_1, \dots, l_k \}$$

The second step, is to find groups of $\boldsymbol{q}$ $\boldsymbol{(q > 2)}$ or more microcalcifications grouped in an area less than or equal to maximal distance threshold $\boldsymbol{d_t}$. Using $\boldsymbol{C}$ a $\boldsymbol{m \times m}$ the matrix whit $\boldsymbol{d_{ij}}$ of distances between microcalcifications centroids. A new matrix $\boldsymbol{C}^*$ is generated, where the value $\boldsymbol{p_{ij}}$ coresponding:

$$p_{ij} = \begin{cases} 0 <=> d_{ij} > d_t \\ 1 <=> d_{ij} \leq d_t \end{cases} \qquad i \neq j \qquad (5)$$

$\boldsymbol{C_i}$ is candidate :

$$\boldsymbol{S_i} = \sum_{}^{\boldsymbol{n}} \boldsymbol{p_{ij}} \; > \; \boldsymbol{q}$$

$$j=1$$