Fuzzy SHmath.MAbio-transform generalization and application to skin cancer imaging (distributed diseases)

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ABSTRACT

A number of techniques have been used to solve fuzzy differential and integral equations and corresponding fuzzy boundary (initial) value problems; fuzzy integral transforms are significant method for this purpose. In this research, we extend and use the formula of third- order fuzzy derivative of, Fuzzy *SHmath.MAbio*-transform to generalize the n^{th}-order fuzzy derivative of this integral transform. In fact, this process studies under strongly generalized Hukuhara differentiability. In fact, a drug distribution means the amount of drug in the body which is measured by the proportional of this drug to its amount in the plasma or blood, so corresponding to this issue, a drug concentration in an organ equation solves using this proposed, Fuzzy *SHmath.MAbio*-transform.

KEYWORDS: generalization of *SHmath.MAbio*-Transform, process image, image skin cancer

1 INTRODUCTION

To date, various methods have been developed and introduced to solve fuzzy initial and boundary value problems. Fuzzy transforms are one of the most common methods for solving these kind of differential equations as well as integral equations. Laplace transform[1,2] and Sumudu transform [3,7] are two examples of conventional transforms that have recently been converted to fuzzy transforms for the purpose of solving fuzzy differential equations[9].In this work, a generalization of Fuzzy SHmath.MAbio -transform technique (nth-order fuzzy derivative) is discussed with an illustrative example that related with drug concentration or the amount of drug in any organ in the body which can be measured by its level in the blood (plasma), urine, saliva and other sampled fluids.

2 BASIC CONCEPTS

Definition 1 [6]: Parametrically speaking, a fuzzy number is a set of two functions that meet the following criteria:

1. $\underline{\beta}(\phi)$ represents a left continuous function that is convex and does not decrease (0, 1], and consistent
2. $\overline{\beta}(\phi)$ is a left continuous function that is bounded and not rising in (0, 1], and consistent right at 0
3. $\underline{\beta}(\phi) \le \overline{\beta}(\phi)$, $0 \le \phi \le 1$.For $\beta = \underline{\beta}(\phi), \overline{\beta}(\phi)$ and $\alpha = \underline{\alpha}(\phi), \overline{\alpha}(\phi)$ and $\varphi > 0$ we define addition $\beta \oplus \alpha$ and subtraction $\beta \ominus \alpha$ and scalar multiplication by $\varphi > 0$ as follows :

(a) Addition: $\beta \oplus \alpha = \underline{\beta}(\phi) + \underline{\alpha}(\vartheta), \overline{\beta}(\phi) + \overline{\alpha}(\phi)$

(b) Subtraction: $\beta \ominus \alpha = \underline{\beta}(\phi) - \overline{\alpha}(\phi), \underline{\alpha}(\phi), \overline{\beta}(\phi) - \underline{\alpha}(\phi)$

(c) Scalar multiplication: $\varphi \odot \beta = \begin{cases} (\varphi\underline{\beta}, \varphi\overline{\beta}) & \varphi \geq 0 \\ (\varphi\overline{\beta}, \varphi\underline{\beta}) & \varphi < 0 \end{cases}$

Definition2.[9]: Assume $\beta, \alpha \in \mathrm{E}$ (E the set of all fuzzy number). If there exists $\eta \in \mathrm{E}$ such that $\beta + \alpha = \eta$ then η is called the Hukuhara – difference of β and α and it is denoted by $\beta \ominus \alpha$.

Note that" $\ominus$ " always stands for H– difference.

Definition 3. [4]

Let $\varphi(\sigma):(a,b) \to \mathrm{E}$; function with continuous fuzzy-values f is a robust generalization of the differential at σ0In the event that a certain feature does exist $\varphi^{\backslash}(\sigma_0) \in \mathrm{E}$ such that :

1- For all $\forall\ h > 0$ sufficiently small $\exists \varphi(\sigma_0 + h) \ominus \varphi(\varpi_0), \exists \varphi(\sigma_0) \ominus \varphi(\sigma_0 - h)$ and the limit is

$$\varphi^{\backslash}(\sigma_0) = \lim_{h \to 0^+} \frac{\kappa(\sigma_0 + h) \ominus \varphi(\sigma_0)}{h} = \lim_{h \to 0^+} \frac{\varphi(\sigma_0) \ominus \varphi(\sigma_0 - h)}{h} .$$

Or

2- For all $\forall\ h > 0$ sufficiently small $\exists \varphi(\sigma_0) \ominus \varphi(\sigma_0 + h), \exists \varphi(\sigma_0 - h) \ominus \varphi(\sigma_0)$ and the limit is

$$\varphi^{\backslash}(\sigma_0) = \lim_{h \to 0^+} \frac{\varphi(\sigma_0) \ominus \kappa(\sigma_0 + h)}{-h} = \lim_{h \to 0^+} \frac{\varphi(\sigma_0 - h) \ominus \varphi(\sigma_0)}{-h} .$$

Or

3- For all $h > 0$ sufficiently small $\exists \varphi(\sigma_0 + h) \ominus \varphi(\sigma_0), \exists \varphi(\sigma_0 - h) \ominus \varphi(\sigma_0)$ and the limit is

$$\varphi^{\backslash}(\sigma_0) = \lim_{h \to 0^+} \frac{\varphi(\sigma_0 + h) \ominus \varphi(\sigma_0)}{h} = \lim_{h \to 0^+} \frac{\varphi(\sigma_0 - h) \ominus \varphi(\sigma_0)}{-h}$$

Or

4- For all $h > 0$ sufficiently small $\exists \varphi(\sigma_0) \ominus \varphi(\sigma_0 + h), \exists \varphi(\sigma_0 - h) \ominus \varphi(\sigma_0)$ and the limit is

$$\varphi^{\backslash}(\sigma_0) = \lim_{h \to 0^+} \frac{\varphi(\sigma_0) \ominus \varphi(\sigma_0 + h)}{-h} = \lim_{h \to 0^+} \frac{\varphi(\sigma_0 - h) \ominus \varphi(\sigma_0)}{h}$$

Theorem1 [5] :Let $\varphi : R \to \mathrm{E}$ be a function and denote $\varphi(\sigma) = \left(\overline{\varphi}(\varpi;\phi), \underline{\varphi}(\varpi;\phi)\right)$ for each $\phi \in [0,1]$,Then

1- If φ is the first form, then $\underline{\varphi}(\sigma;\phi)$ and $\overline{\varphi}(\sigma;\phi)$ are differentiable functions and $\varphi^{\backslash}(\sigma) = \underline{\varphi}(\sigma;\phi), \overline{\varphi}(\sigma;\phi)$.

2- If φ is the second form, then $\underline{\varphi}(\sigma;\phi)$ and $\overline{\varphi}(\sigma;\phi)$ are differentiable functions and $\varphi^{\backslash}(\sigma) = \overline{\varphi}(\sigma;\phi), \underline{\varphi}(\sigma;\phi)$.

Definition 4[8]: Let $\varphi(\sigma)$ be a continuous fuzzy-valued function Suppose that

$\cos n\varepsilon\int_0^\infty e^{-(\sin n\varepsilon+\varepsilon)\sigma}\varphi(\sigma)d\sigma$ is improper fuzzy Riemann-integrable on $[0,\infty)$, then

$\cos n\varepsilon\int_0^\infty e^{-(\sin n\varepsilon+\varepsilon)\sigma}\varphi(\sigma)d\sigma$ is called $SHmath.MAbio$ -transform and it denoted by:

$$SHmath.MAbio[\varphi(\sigma)] = SHmath.MAbio(\varepsilon) = \cos n\varepsilon(\sin n\varepsilon+\varepsilon)\int_0^\infty e^{-(\sin n\varepsilon+\varepsilon)\sigma}\varphi(\sigma)d\sigma$$

$$Sine\ from\ theorem\ 2\ to\ get: \mathrm{con}\, n\varepsilon\int_0^\infty e^{-(\sin n\varepsilon+\varepsilon)\sigma}\varphi(\sigma)d\sigma$$

$$= \cos n\varepsilon\int_0^\infty e^{-(\sin n\varepsilon+\varepsilon)\sigma}\underline{\varphi}(\sigma;\phi)d\sigma, \cos n\varepsilon\int_0^\infty e^{-(\sin n\varepsilon+\varepsilon)\sigma}\overline{\varphi}(\sigma;\phi)d\sigma$$

Using the definition of classic *SHmath.MAbio* -transform :

$$SHmath.\mathrm{MAbio}[\underline{\varphi}(\sigma;\phi)] = \cos n\varepsilon\int_0^\infty e^{-(\sin n\varepsilon+\varepsilon)\sigma}\underline{\varphi}(\sigma;\phi)d\sigma,$$

$$SHmath.\mathrm{MAbio}[\overline{\varphi}(\sigma;\phi)] = \cos n\varepsilon\int_0^\infty e^{-(\sin n\varepsilon+\varepsilon)\sigma}\overline{\varphi}(\sigma;\phi)d\sigma$$

So: $SHmath.\mathrm{MAbio}[\varphi(\sigma;\phi)] = SHmath.\mathrm{MAbio}[\underline{\varphi}(\sigma;\phi)], SHmath.\mathrm{MAbio}[\overline{\varphi}(\sigma;\phi)]$

.

Theorem2[8]. Duality Between Fuzzy Laplace – $SHmath.\mathrm{MAbio}$ **transforms**

If F(p) is fuzzy Laplace transform of $\varphi(\sigma)$ and $SHA(\varepsilon)$ is $SHmath.\mathrm{MAbio}$ -transform of $\varphi(\sigma)$ then

$SHmath.\mathrm{MAbio}(\varepsilon) = \cos n\varepsilon F(\sin n\varepsilon+\varepsilon)$.

Theorem 3: Let $\Im(\delta)$ by fuzzy function $\delta \geq 0, \eta(\varepsilon) = \cos n\varepsilon, \varepsilon \neq 0$ be positive real function and $\beta(\varepsilon) = e^{-(\sin n\varepsilon+\varepsilon)\sigma}, \varepsilon \neq 0$ be positive complex function then the derivatives of $\Im(\delta)$ for nth - order will be as following:

1. $SHmath.MAbio\{\delta\ \Im(\delta)\} = -\dfrac{\cos n\varepsilon}{e^{-(\sin n\varepsilon+\varepsilon)\sigma}}\left(\dfrac{SHmath.MAbio(\Im(\delta),\varepsilon)}{\cos n\varepsilon}\right)'$

2. $SHmath.MAbio\{\delta^2\Im(\delta)\} = (-1)^2\dfrac{\cos n\varepsilon}{e^{-(\sin n\varepsilon+\varepsilon)\sigma}}\left(\dfrac{1}{e^{-(\sin n\varepsilon+\varepsilon)\sigma}}\left(\dfrac{SHmath.MAbio(\Im(\delta),\varepsilon)}{\cos n\varepsilon}\right)'\right)'$

3. $SHmath.MAbio\left\{\delta^{n}\Im(\delta)\right\}=\left(-1\right)^{n}$

$$\frac{\cos n\varepsilon}{e^{-(\sin n\varepsilon+\varepsilon)\sigma}}\left(\frac{1}{e^{-(\sin n\varepsilon+\varepsilon)\sigma}}\left(\frac{1}{e^{-(\sin n\varepsilon+\varepsilon)\sigma}}\left(\cdots\left(\frac{1}{e^{-(\sin n\varepsilon+\varepsilon)\sigma}}\left(\frac{SHmath.MAbio\left(\Im(\delta),\varepsilon\right)}{\cos n\varepsilon}\right)'\right)'\right)'\right)'\cdots\right)'$$

Proof:
1.since

$$SHmath.MAbio\left\{\Im(\delta),\varepsilon\right\}=\cos n\varepsilon\int_{0}^{\infty}\underline{\Im}(\delta;\varepsilon)e^{-(\sin n\varepsilon+\varepsilon)\delta}d\,\delta,\cos n\varepsilon\int_{0}^{\infty}\overline{\Im}(\delta;\varepsilon)e^{-(\sin n\varepsilon+\varepsilon)\delta}d\,\delta$$

$$\Rightarrow\frac{SHmath.MAbio\left\{\Im(\delta),\varepsilon\right\}}{\cos n\varepsilon}=\int_{0}^{\infty}\underline{\Im}(\delta;\varepsilon)e^{-(\sin n\varepsilon+\varepsilon)\delta}d\,\delta,\varepsilon\int_{0}^{\infty}\overline{\Im}(\delta;\varepsilon)e^{-(\sin n\varepsilon+\varepsilon)\delta}d\,\delta$$

Derivative above equation with respect ε**, to get:**

$$\left(\frac{SHmath.MAbio\left\{\Im(\delta),\varepsilon\right\}}{\cos n\varepsilon}\right)'=\frac{d}{d\,\varepsilon}\left[\int_{0}^{\infty}\underline{\Im}(\delta;\varepsilon)e^{-(\sin n\varepsilon+\varepsilon)\delta}d\,\delta,\int_{0}^{\infty}\overline{\Im}(\delta;\varepsilon)e^{-(\sin n\varepsilon+\varepsilon)\delta}d\,\delta\right]$$

$$\left(\frac{SHmath.MAbio\left\{\Im(\delta),\varepsilon\right\}}{\cos n\varepsilon}\right)'=-\left((\sin n\varepsilon+\varepsilon)\right)\int_{0}^{\infty}\underline{\Im}(\delta;\varepsilon)e^{-(\sin n\varepsilon+\varepsilon)\delta}d\,\delta$$

$$,-\left((\sin n\varepsilon+\varepsilon)\right)\int_{0}^{\infty}\overline{\Im}(\delta;\varepsilon)e^{-(\sin n\varepsilon+\varepsilon)\delta}d\,\delta$$

From equation (1), to get:

$$\left(\frac{SHmath.MAbio\left\{\Im(\delta),\varepsilon\right\}}{\cos n\varepsilon}\right)'=-\left(\sin n\varepsilon+\varepsilon\right)\frac{SHmath.MAbio\left\{\underline{\Im}(\delta;\varepsilon),\varepsilon\right\}}{\cos n\varepsilon}$$

$$,-\left(\sin n\varepsilon+\varepsilon\right)\frac{SHmath.MAbio\left\{\overline{\Im}(\delta;\varepsilon),\varepsilon\right\}}{\cos n\varepsilon}$$

$$\left(\frac{SHmath.MAbio\left(\Im(\delta),\varepsilon\right)}{\cos n\varepsilon}\right)'=-\left((\sin n\varepsilon+\varepsilon)\right)\frac{SHmath.MAbio\left\{\delta\ \Im(\delta),\varepsilon\right\}}{\cos n\varepsilon}$$

Then, to get:

$$SHmath.MAbio\left\{\delta\ \Im(\delta)\right\}=-\frac{\cos n\varepsilon}{(\sin n\varepsilon+\varepsilon)}\left(\frac{SHmath.MAbio\left(\Im(\delta),\varepsilon\right)}{\cos n\varepsilon}\right)'$$

2. since from the first part, we have :

$$SHmath.MAbio\left\{\delta\,\Im(\delta),\varepsilon\right\} = -\frac{\cos n\varepsilon}{(\sin n\varepsilon+\varepsilon)}\left(\frac{SHmath.MAbio\left(\Im(\delta),\varepsilon\right)}{\cos n\varepsilon}\right)'$$

Taking the derivative for both sides of the above equation:

$$-\frac{\cos n\varepsilon}{(\sin n\varepsilon+\varepsilon)}\int_0^\infty \delta^2\,\underline{\Im}(\delta;\varepsilon)e^{-(\sin n\varepsilon+\varepsilon)\delta}d\,\delta,$$

$$-(\sin n\varepsilon+\varepsilon)\int_0^\infty \delta^2\,\overline{\Im}(\delta;\varepsilon)e^{-((\sin n\varepsilon+\varepsilon))\delta}d\,\delta = \left(-\frac{\cos n\varepsilon}{(\sin n\varepsilon+\varepsilon)}\left(\frac{SHmath.MAbio\left\{\Im(\delta),\varepsilon\right\}}{\cos n\varepsilon}\right)'\right)'$$

Thus :

$$SHmath.MAbio\left\{\delta^2\Im(\delta)\right\} = (-1)^2\frac{\cos n\varepsilon}{(\sin n\varepsilon+\varepsilon)}\left(-\frac{\cos n\varepsilon}{(\sin n\varepsilon+\varepsilon)}\left(\frac{SHmath.MAbio\left(\Im(\delta),\varepsilon\right)}{\cos n\varepsilon}\right)'\right)'$$

3. in similar way, we can prove the third part

$$SHmath.MAbio\left\{\delta^2\Im(\delta)\right\} = (-1)^2\frac{\cos n\varepsilon}{(\sin n\varepsilon+\varepsilon)}\left(-\frac{1}{(\sin n\varepsilon+\varepsilon)}\left(\frac{SHmath.MAbio\left(\Im(\delta),\varepsilon\right)}{\cos n\varepsilon}\right)'\right)'$$

derivative both side of above equation (n-2)-Times, we get:

$$SHmath.MAbio\left\{\delta^n\Im(\delta)\right\} = (-1)^n$$

$$\frac{\cos n\varepsilon}{(\sin n\varepsilon+\varepsilon)}\left(\frac{1}{(\sin n\varepsilon+\varepsilon)}\left(\frac{1}{(\sin n\varepsilon+\varepsilon)}\left(\cdots\left(\frac{1}{(\sin n\varepsilon+\varepsilon)}\left(\frac{SHmath.MAbio\left(\Im(\delta),\varepsilon\right)}{\cos n\varepsilon}\right)'\right)'\right)'\right)'\cdots\right)'$$

Theorem 4:Let $\eta(\varepsilon)=\cos n\varepsilon$ **and** $\beta(\varepsilon)=(\sin n\varepsilon+\varepsilon)$ are differentiable **functions such that** $\Im(\delta)$ be fuzzy function, then:

$$SHmath.MAbio\left\{\delta\Im^{(n)}(\delta)\right\} = -\frac{\cos n\varepsilon}{\sin n\varepsilon+\varepsilon}\frac{d}{d\,\varepsilon}\left(\frac{SHmath.MAbio\left(\Im^{(n)}(\delta)\right)}{\cos n\varepsilon}\right)$$

Proof:
Since

$$SHmath.MAbio\left\{\Im^{(n)}(\delta),\varepsilon\right\} = \cos n\varepsilon\int_0^\infty \underline{\Im}^{(n)}(\delta;\vartheta)e^{-\left(\sin n\varepsilon+\varepsilon\right)\delta}d\,\delta, \cos n\varepsilon\int_0^\infty \overline{\Im}^{(n)}(\delta;\vartheta)e^{-\left(\sin n\varepsilon+\varepsilon\right)\delta}d\,\delta$$

$$\frac{SHmath.MAbio\left\{\Im^{(n)}(\delta),\varepsilon\right\}}{\cos n\varepsilon}=\int_0^\infty \underline{\Im}^{(n)}(\delta;\vartheta)e^{-(\sin n\varepsilon+\varepsilon)\delta}d\,\delta,\int_0^\infty \overline{\Im}^{(n)}(\delta;\vartheta)e^{-(\sin n\varepsilon+\varepsilon)\delta}d\,\delta \qquad (2)$$

By derivative above equation respect to ε , then :

$$\frac{d}{d\,\varepsilon}\left[\frac{SHmath.MAbio\left\{\Im^{(n)}(\delta),\varepsilon\right\}}{\cos n\varepsilon}\right]=\left[\int_0^\infty \underline{\Im}^{(n)}(\delta;\vartheta)e^{-(\sin n\varepsilon+\varepsilon)\delta}d\,\delta,\int_0^\infty \overline{\Im}^{(n)}(\delta;\vartheta)e^{-(\sin n\varepsilon+\varepsilon)\delta}d\,\delta\right]$$

From equation 2:

$$\frac{d}{d\,\varepsilon}\left[\frac{SHmath.MAbio\left\{\Im^{(n)}(\delta),\varepsilon\right\}}{\cos n\varepsilon}\right]=-(\sin n\varepsilon+\varepsilon)\frac{SHmath.MAbio\left\{\delta\underline{\Im}^{(n)}(\delta;\vartheta),\varepsilon\right\}}{\varepsilon}$$

$$,-(\sin n\varepsilon+\varepsilon)\frac{SHmath.MAbio\left\{\delta\overline{\Im}^{(n)}(\delta;\vartheta),\varepsilon\right\}}{\varepsilon}$$

Then: $SHmath.MAbio\left\{\delta\Im^{(n)}(\delta)\right\}=-\frac{\cos n\varepsilon}{\sin n\varepsilon+\varepsilon}\frac{d}{d\,\varepsilon}\left(\frac{SHmath.MAbio\left(\Im^{(n)}(\delta)\right)}{\cos n\varepsilon}\right)$

Theorem 5: Assume that $\varphi^{\backslash}(\sigma)$ be continuous fuzzy-valued function and $\varphi(\sigma)$ the primitive of $\varphi^{\backslash}(\sigma)$ on $[0,\infty)$, we have:

1. $S\overline{H}math.MAbio\left[\varphi^{\backslash}(\sigma)\right]=(\sin n\varepsilon+\varepsilon)S\overline{H}math.MAbio\left[\varphi(\sigma)\right]\ominus\cos n\varepsilon\varphi(0)$,where φ is the first form differentiable
2. $S\overline{H}math.MAbio\left[\varphi^{\backslash\backslash}(\sigma)\right]=-\cos n\varepsilon\varphi(0)\ominus(-(\sin n\varepsilon+\varepsilon))S\overline{H}math.MAbio\left[\varphi(\sigma)\right]$, where φ is the second form differentiable

4. Fuzzy $SHmath.MAbio$ -Transform for Fuzzy nth- Order Derivative

Theorem11: Assume that $\Im(\delta),\Im^{\backslash}(\delta),...,\Im^{n-1}(\delta),\Im^{(n)}(\delta)$ are continuous fuzzy-valued functions on $[0,\infty)$ and of exponential order and that $\Im^{(n)}(\delta)$ be pricewise continuous fuzzy-valued on $[0,\infty)$. Let $\Im^{(i_1)}(\delta),\Im^{(i_2)}(\delta),...,\Im^{(i_\varphi)}(\delta)$ are the second form differentiable functions for $0\le i_1\le i_2...\le i_\varphi\le n-1$ and $\Im^{(p)}$ be first form differentiable function for $p\ne i_j$, $j=1,2,...,\varphi$, then:

(1) If φ is an even number, we have

$$M\left(\Im^{(n)}(\delta)\right)=(\sin n\varepsilon+\varepsilon)^n M\left(\Im(\delta)\right)\ominus\cos n\varepsilon(\sin n\varepsilon+\varepsilon)\Im(0)®\sum_{\kappa=1}^{n-1}\varepsilon^{n-\kappa+1}\Im^{(\kappa)}(0)$$

such that

$$® = \begin{cases} \ominus, & \text{The second form allows for distinct differentiation based on the frequency of repetitions} i_1,...,i_\kappa \\ & \text{if and only if it an even number} \\ -, & \text{Can the second type be distinguished from the first by the total number of occurrences } i_1,...,i_\kappa \\ & \text{seems to be an odd number} \end{cases}$$

2. If φ is an odd number, we have

$$M\left(\Im^{(n)}(\delta)\right) = -\cos n\varepsilon^{n+1}\Im(0)\ominus\left(-\cos n\varepsilon^{n}\right)M\,(\Im(\delta))®\sum_{\kappa=1}^{n-1}\cos n\varepsilon^{n-\kappa+1}\Im^{(\kappa)}(0),$$

such that

$$® = \begin{cases} \ominus, & \text{if there are a sufficient number of second-form differences } i_1,...,i_\kappa \\ & \text{is an odd number} \\ -, & \text{if the difference between the second form } i_1,...,i_\kappa \\ & \text{is an even number} \end{cases}$$

proof: the proof depends on the duality between fuzzy Laplace – **Fuzzy** *SHmath.MAbio* -Transforms from as follows

$$SHmath.MAbio(\varepsilon) = SHmath.MAbio\left[\Im(\varepsilon)\right]\; F(p) = L\left[\Im(\aleph)\right]$$

$$SHmath.MAbio_n(\varepsilon) = SHmath.MAbio\left[\Im^{(n)}(\delta)\right] \text{and}\, F_n(p) = L\left[\Im^{(n)}(\aleph)\right]$$

From duality relation (1), we have

$$SHmath.MAbio_n(\delta) = SHmath.MAbio\left[\Im^{(n)}(\delta)\right] = \cos n\varepsilon F_n(\sin n\varepsilon + \varepsilon)$$

Let φ is an even number. Then from theorem 4 when φ is an even number, equation 2becomes

$$SHmath.MAbio_n(\delta) = \cos n\varepsilon$$

$$\left[(\sin n\varepsilon+\varepsilon)^n F(\sin n\varepsilon+\varepsilon)\ominus(\sin n\varepsilon+\varepsilon)^{(n-1)}\Im(0)®\sum_{\kappa=1}^{n-1}(\sin n\varepsilon+\varepsilon)^{n-(\kappa+1)}\Im^{(\kappa)}(0)\right]$$

$$= (\sin\varepsilon+\varepsilon)^n\, SHmath.MAbio\left[\Im(\delta)\right]\ominus\varepsilon(\sin\varepsilon+\varepsilon)^{(n-1)}\,\Im(0)®\varepsilon\sum_{\kappa=1}^{n-1}(\sin\varepsilon+\varepsilon)^{n-(\kappa+1)}\,\Im^{(\kappa)}(0)$$

Let φ is an odd number. Then from theorem 4, equation (3) becomes:

$$SHmath.MAbio_n(\varepsilon) =$$

$$\left[-(\sin n\varepsilon+\varepsilon)^{(n-1)}\Im(0)\ominus\left(-(\sin n\varepsilon+\varepsilon)^n\right)F(\sin n\varepsilon+\varepsilon)®\sum_{\kappa=1}^{n-1}(\sin n\varepsilon+\varepsilon)^{n-(\kappa+1)}\Im^{(\kappa)}(0)\right]$$

$$=-\cos n\varepsilon(\sin n\varepsilon+\varepsilon)^{(n-1)}\Im(0)\ominus\left(-(\sin n\varepsilon+\varepsilon)^n\right)$$

$$\left[\cos n\varepsilon F(\sin n\varepsilon+\varepsilon)\right]®\cos n\varepsilon\sum_{\kappa=1}^{n-1}(\sin n\varepsilon+\varepsilon)^{n-(\kappa+1)}\Im^{(\kappa)}(0)$$

$$=-\cos n\varepsilon(\sin n\varepsilon+\varepsilon)^{(n-1)}\Im(0)\ominus\left(-(\sin n\varepsilon+\varepsilon)^n\right)$$

$$SHmath.MAbio\left[\Im(\delta)\right]®\cos n\varepsilon\sum_{\kappa=1}^{n-1}(\sin n\varepsilon+\varepsilon)^{n-(\kappa+1)}\Im^{(\kappa)}(0)$$

Application: The following Classification skin cancer(distributed diseases) the usage of *SHmath.MAbio* -transform.

System Analysis and Design: In this part, various image processing approaches were used to achieve Automatic Border (Types of Diseases) Identification, and then it will be classified with the of fuzzy *SHmath.MAbio* - transform. The developed system works on RGB color images with size 128 x 128 pixel. The system is built with four primary processes these are explained in figure (1-1).

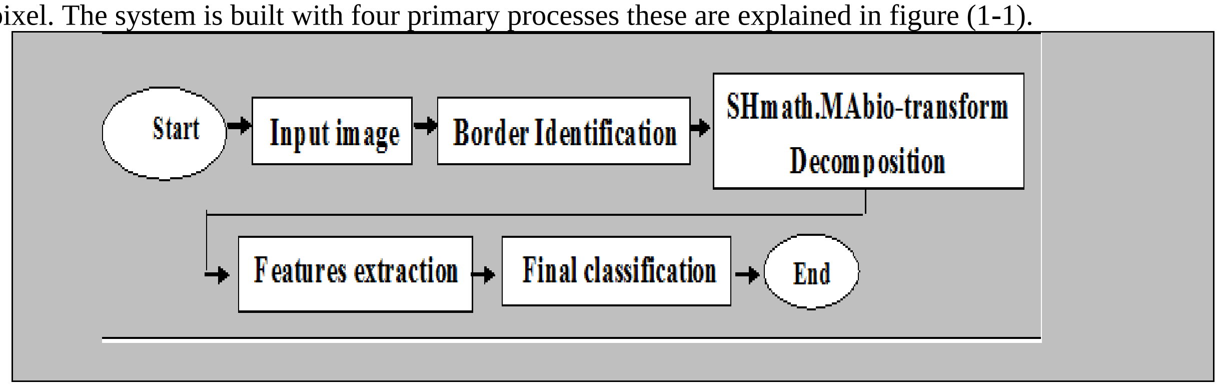


Figure (1-1)Main stages for the Automatic Border (skin cancer(distributed diseases)) Identification

The system database:

Each stage of the Mycosis Fungoides disease is represented by one of the database's 40 photos.. An image of your skin Ten pictures for each phase Mycosis Fungoides Skin imaging databases of two categories were used in this study:

1. Database developed in our conditions, photos taken from Al-Sder Hospital.2.The Skin Database [4] and some other photos retrieved from: A coetaneous T-cell lymphoma, Mycosis Fungoides is a rare condition. T-lymphocyte proliferation, also known as helper T cell proliferation, is the underlying cause of the disease, which is why the disease is in its early stages:.

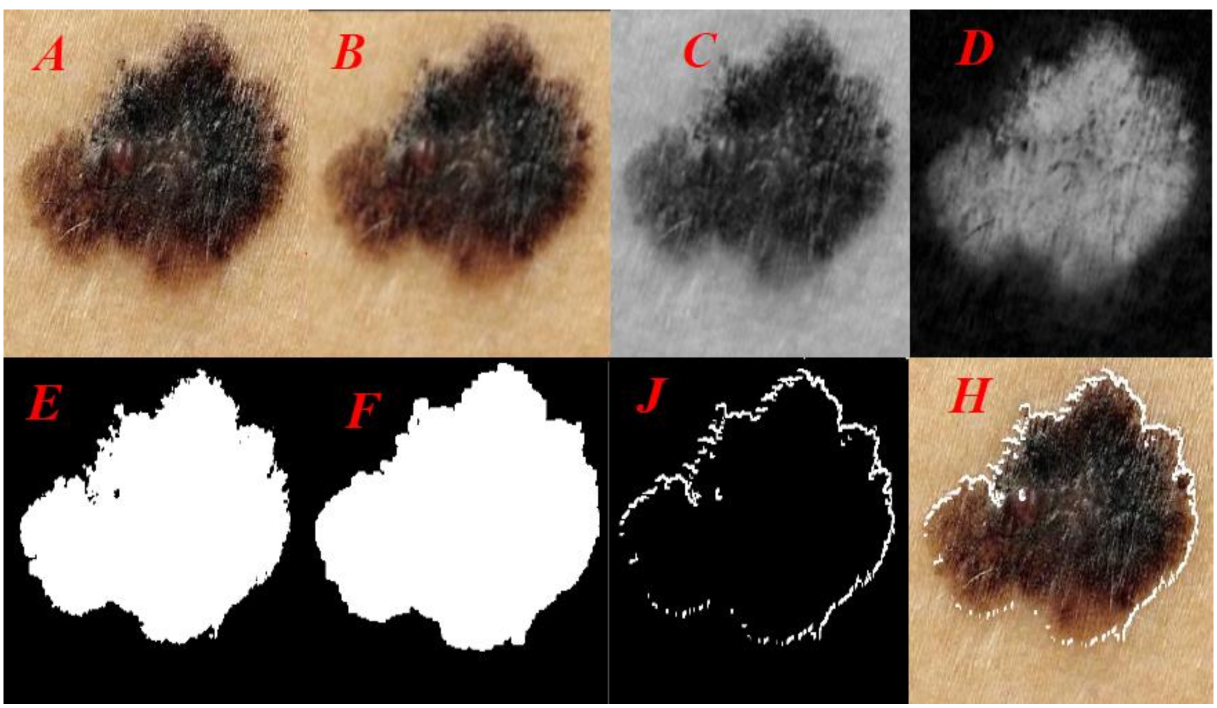
Stage 1: The cancer only affects a small portion of the skin, resulting in red, dry, and scaly patches, but no tumors have yet formed. The lymph nodes do not appear to be any larger than usual.

Stage 2:The skin is red, dry, and scaly in areas, but there are no tumors. The lymph nodes themselves are larger. normal, but free of any cancerous cells Tumors can be seen on the skin. Normal or larger than normal lymph nodes do not contain cancerous cells.

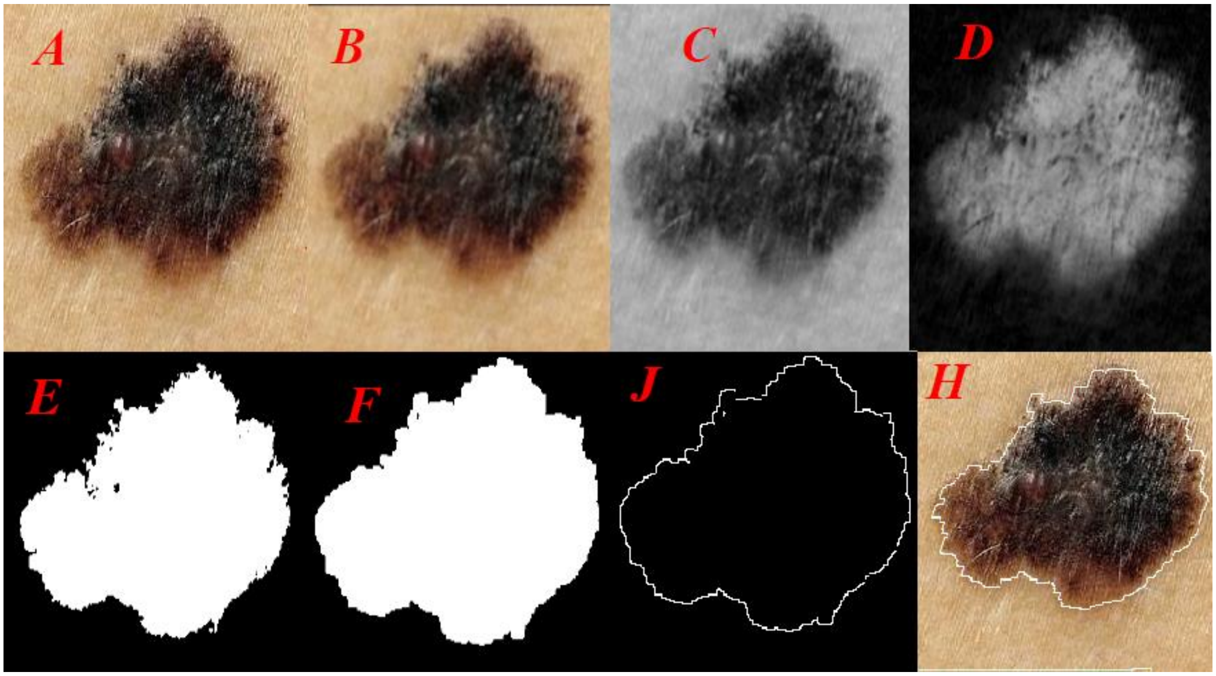
Stage 3: The skin has turned red, dry, and scaly across much of its surface. The lymph nodes are either normal or larger than normal, but they do not contain cancerous cells.

Stage 4: Involvement of the skin as well as any of the following. A cancerous tumor's lymph nodes The cancer has progressed to other organs including the liver or lungs

Figure (2-2): Database Consists of 36 Images

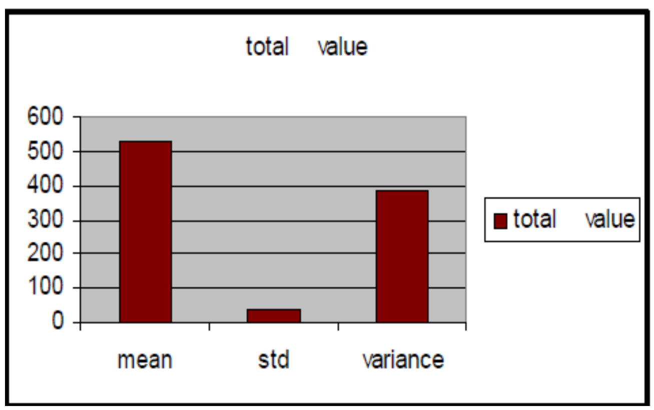


Figure(3-3)**:** (**A**) Color original image of skin cancer (**B**)noise removing (**C**) image obtain after mapping colors into intensity (**D**)difference between each pixel in image and the mean of background (**E**) threshold of difference image (**F**)filling operator to threshold image (**J**) Laplace edge detection (**H**)OR operator between (**A**)and (**J**)

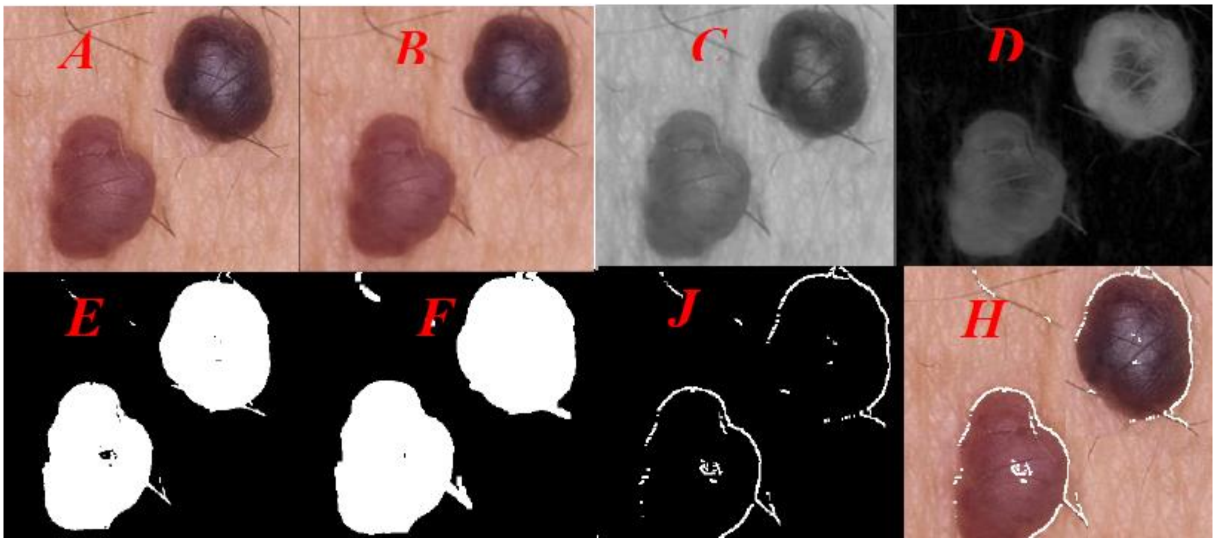


Figure(4-4)**:** (**A**) Color original image of skin cancer (**B**)noise removing (**C**) image obtain after mapping colors into intensity (**D**)difference between each pixel in image and the mean of background (**E**) threshold of difference image (**F**)filling operator to threshold image (**J**) Fuzzy *SHmath.MAbio*-transform edge detection (**H**)OR operator between (**A**)and (**J**)

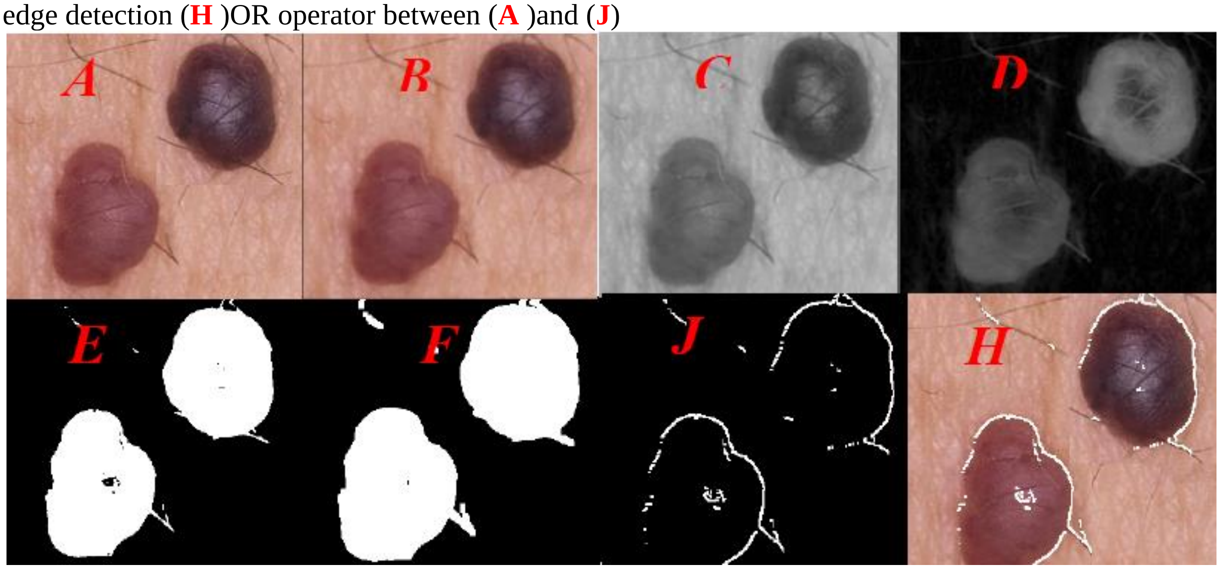
Person one			
Texture 1 of Dermatitis	mean	std	variance
total value	527	36	385



table(1-1) Statistics case one

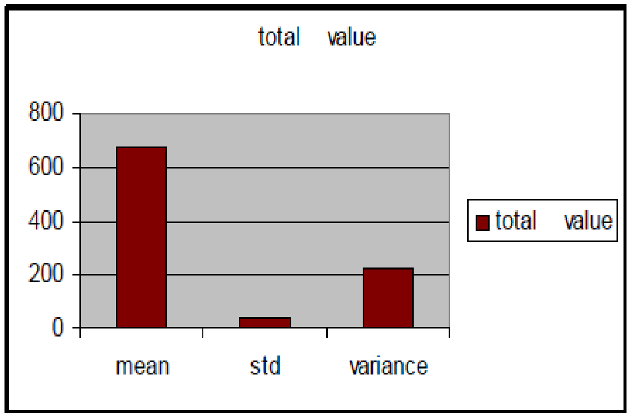


Figure(5-5)**:** (**A**) Color original image of skin cancer (**B**)noise removing (**C**) image obtain after mapping colors into intensity (**D**)difference between each pixel in image and the mean of background (**E**) threshold of difference image (**F**)filling operator to threshold image (**J**) Laplace edge detection (**H**)OR operator between (**A**)and (**J**)



Figure(6-6)**:** (**A**) Color original image of skin cancer (**B**)noise removing (**C**) image obtain after mapping colors into intensity (**D**)difference between each pixel in image and the mean of background (**E**) threshold of difference image (**F**)filling operator to threshold image (**J**) Fuzzy *SHmath.MAbio*-transform edge detection (**H**)OR operator between (**A**)and (**J**)

Person two			
texture 2 of Dermatitis	mean	std	variance
total value	676	37	222



table(2-2) Statistics case two

5- Conclusion:

In this paper we introduce a comparison between the proposed method and fuzzy Laplace transform to indicate that the results obtained in the proposed method have surpassed the other methods because of its transform used to adapt to the image content of medical and this adaptation result of edge (national, and horizontal and vertical as illustrated in the following:

1- In terms of the shapes:
We find that the shapes (4-4) and (6-6) edges detection using the transfer more than the clarity and the accuracy of shapes (3-3) and (5-5)edges detection using fuzzy Laplace transform.
2- The Proposed models are much better in terms of identifying the edges and the cause of the fact that the method in time domain compared with fuzzy laplces transform as identifying the edges be in the frequency domain, according to scientific studies have preferably edges detection in the time domain as it deals with the real values of the image of reverse frequency domain, where it deals with the values of transition.for this reasonthe resolution would not be clear in case of fuzzy laplaces transform.

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