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Survival Analysis of Tumor using 7 Tesla MRI

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ABSTRACT

Magnetic resonance imaging (MRI7) is a very powerful imaging technique for the assessment of stroke aetiology (Condition) and brain imaging. Another class of MRI is ultrahigh frequency based MRI using 7 Tesla is now developed by seamen's for better imaging in humans. This study examines these MRI. This article highlights an alternative approach, denoted "interval monitoring," whose aims is related with more timely detection of tumor cancer changes. The conceptual background and the computational realization of the proposed method are outlined, and its application is illustrated by an empirical example from the image-based photo science, cancer registry of America. Monitoring of cancer patient survival is the first step of its cure so across the globe practice routinely employed by many cancer registries, which is an essential component for its cure. However, changes in prognosis over time are disclosed with considerable delay, with traditional methods of monitoring cumulative survival. Our study took sequence of MRI images, GMPLS function locate the cancer after filtering and skeletonization. This study saves time and difference for calculation of cancer equation. This study uses statistical technique to get the desired matrix, further its inverse provides us real time mathematical equation which is unique for each patient. Further survivor analysis is employed to achieve the break or death of subject. The Aim of this research is to provide unique mathematical model of a cancer patient, provides real time graph about cancer health and survivor function depicts the death of subject respectively.

1. INTRODUCTION

Stochastic possesses have shown that they are very useful in applied probability, statistics, reliability, operation research, economics, and other related fields and medical science sciences, especially reliability analysis[1]. Various types of stochastic orders and associated properties have been developed rapidly over the years [2]. Medical imaging provides meaningful information about the patient health. Magnetic resonance imaging (MRI) is one of the eminent technology across the globe,3 Tesla (T) is one of the best examples and proved it has powerful imaging and diagnosis technology. MRI is also helping us to highlight infarct morphology and stroke etiology .Siemens Corporation provides a new technology called, ultrahigh-field (UHF) MRI at 7 T has been available for cancer imaging further it shows relevant diagnostic benefits brain, breast cancer, tumors, cerebral abnormalities, Parkinson's disease and sclerosis[3][4]. However, this technology is not yet available for routine practicing, research is undergoing that's why it's not public. In this study we will explore the mathematical algorithm and related results.

a) Mathematical Model:

Here we will use difference of quotient method and compare the tumors results in terms of time. This estimation can be done using two columns $e_0^{(n)}$ and $q_1^{(n)}$. The relationship between these columns is as follows.

$e_k^{(n)} - e_{k-1}^{(n+1)} = q_k^{(n+1)} - q_k^{(n)}$,

$q_{k+1}^{(n)} - e_k^{(n)} = e_k^{(n+1)} - q_k^{(n+1)}$,

Spatial transformations: Forward mapping in tumors [4][5]

(x,y) = T{(u,v)}, that maps points from one space (input space) to another (output space). The most obvious procedure is called forward mapping. It works as follows: Consider each input image pixel in turn. For each input image pixel:

- Determine its location in an image, (uk,vk).
- Map that location with recent image (xk,yk) = T{(uk,vk)}.
- Figure out recent image pixel info with previous image (xk,yk).
- Copy the input pixel value to that recent image pixel.[6][7]

Figure 1, given below illustrates the procedure:

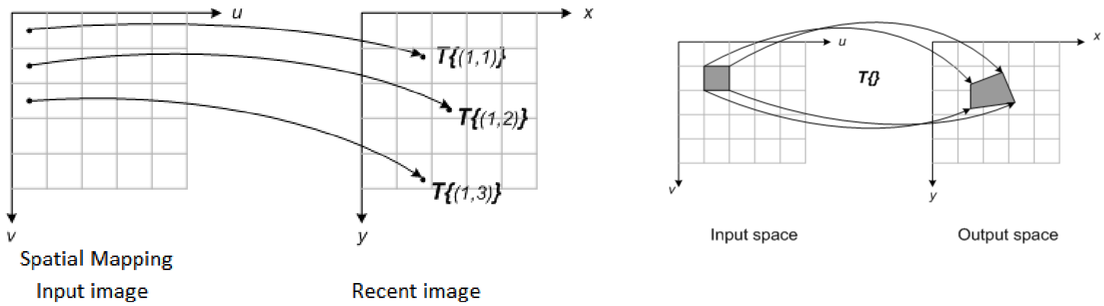

Figure 1.Spatial mapping of tumors.

Size of cancer can be estimation by using the following relationship V=$\left(\frac{4}{3}.\frac{22}{7}.\left(\frac{D^3}{8}\right)\right)$, further the relationship will be used to get the actual number of cancer cells, so the relationship is as follows $\frac{V_f}{V_i}=\left[\frac{0.917}{0.917}.\frac{D_F^3}{D_i^3}\right]$ or$\frac{V_f}{V_i}=\left[\frac{D_F^3}{D_i^3}.\frac{1}{10E^{-6}}.\frac{1}{m}\right]$[7] .This relationship depicts total actual no of tumour cells, as we know that 1 gram of tumour is equal to 10^9cells. The following Table.1 shows the interval, time and physician prescription. Survival analysis involves the modelling of time verses event data; in this context, death or failure is considered an "event" in the survival analysis. Traditionally only a single event occurs for each subject, after which the subject is dead or break.

The object of primary interest is the survival function, conventionally denoted S, which is defined as S(t)=Pr(T>t); t is some unit time and T is random variable denoting the time of death whereas Pr stands for probability, if S(0)=1 or less than 1 than there is a possibility of immediate death or model failure.[7][8]

The mean residual life function (mrlf) of a subject is defined as the expected remaining lifetime of the subject given that the subject has survived up to a given time[9].There are two types of analysis in this regards one is medical or biological science and other one is engineering. In medical research it is known as survival analysis which begins with start of treatment to the occurrence of a particular condition or of death in contrary in engineering it is concerned with reliability and the analysis of failure times that is how long a component can be used until it fails[9][10][11]. In this research the survivor function is explained by the following data. Age as covariate function (5,1,49) the first variable is 5 which is observation up to five months, 1 means subject died so sensor c=1 , 49 is the age at the time of enrolment , in the triplet two the data will be (6,0,35) means subject is still alive. Now this study can take sensor data as β or conditional probability and the relationship is as follows f(t, β,x) = $Lim_{\Delta t\to 0}$ {F(t+Δt, β,x)-F (t, β,x)/ Δt}[12][13][14][15]. For example the death time is 5 months, the number of risk is n_2=4 and the number of death (d)=1, so the estimated conditional probability is

$\widehat{S(4)}$ =(4-1)/4=0.75

Further $\widehat{S(5)}$ =1.0*(4/5)*(3/4)=0.6 also

$\widehat{S(6)}$ =1.0*(4/5)*(3/4)*(2/3)=0.6

$\widehat{S(22)}$ =1.0*(4/5)*(3/4)*(2/3)…….=0.0

The survivor function shows no subject will survive after 22 months[16][17][18][19][20]

Table 1

S.No	Time(t) Hrs	1 Day 24 Hrs	1Week 168Hrs	42 Days 1008Hrs	70 Days 1680	Treatment Method
1	9899	9739	7891	5637	4469	X1
2	21397	19739	17894	15603	12401	X2

Sno	Time		$\Delta f(x)$	$\Delta^2 f(x)$	$\Delta^3 f(x)$	$\Delta^4 f(x)$	$\Delta^5 f(x)$
1	00PM		9899				
				-160			
2	24		9739		- 1688		
				-1848		1282	
3	168		7891		-406		210
				-2254		1492	
4	1008		5637		1086		
				-1168			
5	1680		4469				

Sno	Time		$\Delta f(x)$	$\Delta^2 f(x)$	$\Delta^3 f(x)$	$\Delta^4 f(x)$	$\Delta^5 f(x)$
1	00PM		2137				
				17602			
2	24		19739		- 19447		
				-1845		19001	
3	168		17894		-446		- 19466
				-2291		-465	
4	1008		15603		-911		
				-3202			
5	1680		12401				

Here you may see the medicine X_2 cure rate is significantly higher than the previous one X1

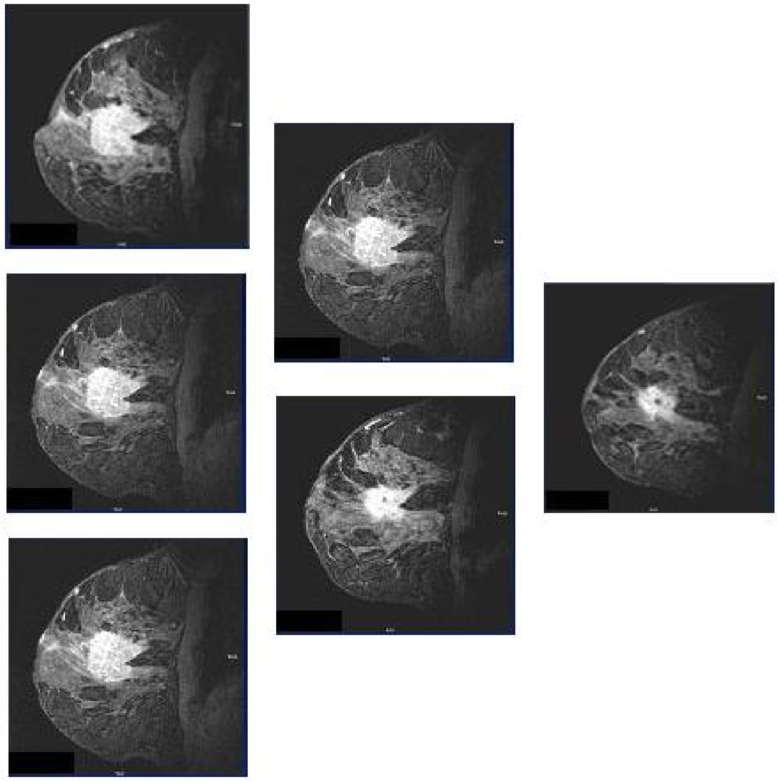

Figure 2 Tumor cells estimations.

2. ALGORITHM

7 Tesla provides high quality medical images for cancer estimation rate. Algorithm of this system is given below:

Step1.Load Dicom Images I_1 (MRI).

Step2. Get Image (MxN).

Step3.Load Dicom Images I_2 (MRI).

Step4. Get Image (MxN).

Step5. Select ROI of I_1& I_2.

Step6. Save MI_1: = I_1 and MI_2 : = I_2

Step7. Applying FILTERS

7.1 Gaussian Filter to un sharp

$$h_g(n_1, n_2) = e^{-(n_1^2 + n_2^2)/(2\sigma^2)}$$

$$h(n_1, n_2) = \frac{h_g(n_1, n_2)}{\sum_{n_1}\sum_{n_2} h_g}$$

7.2 Applying Multidimensional Image Filtering

$$\frac{1}{(\alpha+1)}\begin{bmatrix} -\alpha & \alpha-1 & -\alpha \\ \alpha-1 & \alpha+5 & \alpha-1 \\ -\alpha & \alpha-1 & -\alpha \end{bmatrix}$$

7.3 Save $MI_{1Filtered}$: = MI_1 and $MI_{2Filtered}$: = MI_2

Step8.Compare Filtered Images with Original Images

Img1 =img subtract.($MI_{1Filtered}$, I_1)

J1 = Inverse.(Img1);

SHOW Image.(J1)

SHOW Image.(I_1)

And

Img2 =image subtract.($MI_{2Filtered}$, I_2)

J2 = Inverse.(Img2);

SHOW Image.(J2)

SHOW Image.(I_2)

Step9.LOOP

SAVE $MI_{1Filtered}$& $MI_{2Filtered}$

ImageDiff =image subtract.($MI_{2Filtered}$, $MI_{1Filtered}$)

ExactDiff =MAP.(ImgDiff , $MI_{2Filtered}$)

REM: %How much change at bit level

CALCULATE

Result=Number of Non Zero.(ExtDiff)

CALCULATE PERCENTAGE

[M,N]= Size of Img.(Result)

Percent= (Result/(M*N))*100

ELSE

SAVE I_1 and I_2

ImageDiff =image subtract.(I_2 , MI_1)

ExactDiff =MAP.(ImgDiff , I_2)

REM: %How much change at bit level

CALCULATE

Result=Number of Non-Zero.(ExtDiff)

CALCULATE PERCENTAGE

[M,N]= Size of Img.(Result)

Percent%= (Result/(M*N))*100

Step10.

SHOW IMAGES

CALCULATE the difference.

The proposed work depicts the impact of medicine on tumor cell ,7 Tesla MRI shows the exact size of tumor cell and tells the physician either is increasing or decreasing. Seven Tesla imaging improves the medical imaging in following ways:

(1) Full body high resolution high spectroscopy is possible from head to feat.

(2) Bright MRI images or smart images can be taken.

(3) Seven Tesla imaging is ultra-fast either its MRI or angiography

(4) This application is best for neurosciences imaging as well.

(5) Resonance can be changed to get the desired results.

(6) Medical science is currently practicing 4Tesla for high and accurate results 7Tesla is used for animal spectroscopy scientist used 9.4 Tesla [21][22][23][24]

b) Calculating Cancer equation

Sno	A	B	C	D	E	F	G
	Y	X	X2	X3	X4	XY	X2Y
	Cancer	Days					
1	627	0.02083	0.000434	9.04E-06	1.8826E-07	13.0604	1.8826E-07
2	600	1	1	1	1	600	1
3	937	15	225	3375	50625	14055	50625
4	743	30	900	27000	810000	22290	810000
	sum Y	∑ Ξ	∑X2	∑X3	∑X4	∑XY	∑X2Y
	46.0208	46.02083	1126	30376	860626	36958.1	860626

The Matrix of tumor is as follows

648576.25 a+1104.5 b+ 4 c = 2934

419917824a+648576.25b+1104.5c=887641.5

2.85535E+11 a+419917824b+648576.25c=2.85535E+11

Now the equation of cancer is as follows

$0.0002X^2-0.1726X+7.7385=0$

The aforementioned equation is the equation of cancer of a patient, by using time interval user can see the cure rate the following graph shows the cancer condition graphically. The following graphs depicts the patient tumor condition which is steadily increasing .It's also a forecast for physician to change the treatment method[16][17][18][25].

1	0.001713
2	0.002279
3	0.003245
4	0.00461
5	0.006376
6	0.008541
7	0.011107
8	0.014073
9	0.017438
10	0.021204
11	0.025369
12	0.029935
13	0.034901
14	0.040266
15	0.046032
16	0.052197
17	0.058763
18	0.065729
19	0.073094
20	0.08086

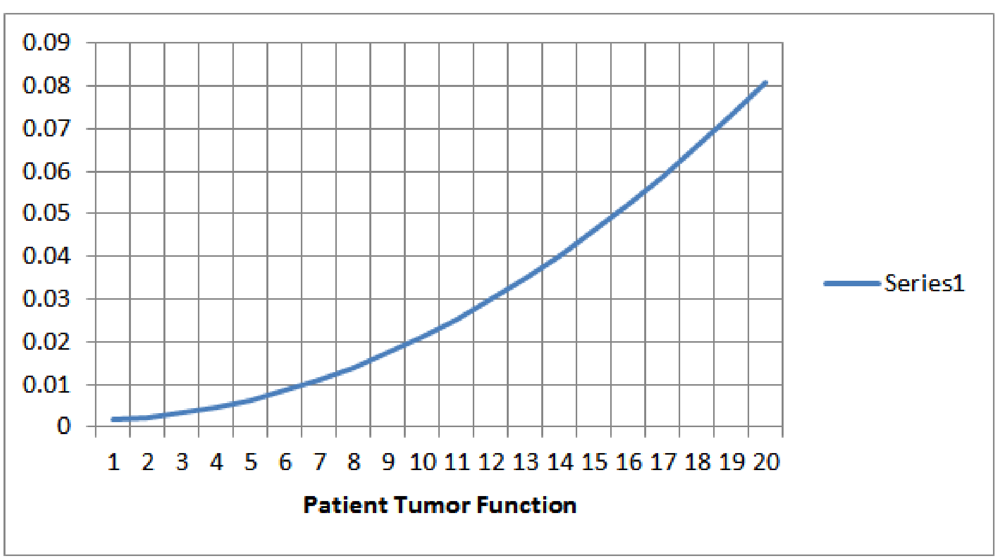

Figure 3 Growth of Tumor cells using proposed cancer function.

3. CONCLUSIONS

The principle of period monitoring is shown to be analogous to the well-established use of period life tables in the field of cancer treatment. Computational realization of period monitoring can be achieved with simple modifications of standard survival analysis techniques, 7Tesla MRI provides clear and bright images for cancer interval monitoring. Compared with traditional methods of monitoring survival, period monitoring can advance detection of changes in cumulative survival considerably [26][27]. Despite some limitations with respect to the ease of data interpretation, period monitoring offers a useful supplement to existing methods of monitoring patient survival. This study depicts spatial forward mapping (GMPLS) among 7 Tesla MRI images and shows the results by our newly proposed algorithm which is based Newton difference of quotient, filters, edge detection using Prewitt, canny, related comparison [28]. Research saves data w-r-t time and proposes a mathematical model for each cancer. We have tested twenty five plus samples, brain tumors and breast cancers are the main area of our research. This research tells the physician whether his treatment is going in the right direction or not. Accuracy is the main tool of success that's why this study proposes 7 Tesla MRI to get the best images for the best results.

References

1. Sheldon M.Ross(2000) Introduction to Probability Models 9th Edition. Elsevier, India.

2. C.C Compton et al,(eds.), AJCC Cancer staging Atlas:A Companion to the seventh Editions of the AJCC cancer Staging Manual and Handbook, DOI 10.1007/978-1-4614-2080-4_2,©2012 American joint committee on Cancer.

3. Swaminathan R and Bernner H, “Statistical Method for cancer survival analysis”. chapter 2,2011.

4. Adnan Alam Khan ,“Monte Carlo Simulation of Environmental and Business Data with Matlab and R”, Applied Information Technology , ISOSS 2014 : 12th International Conference on Statistical Sciences,24-26March,2014.

5. A.A.Khan ,"Multispectral Statistical Irises Matching for large Database" ,Life Science Journal-Acta Zhengzhou University Overseas Edition" its ISSN is 1097-8135

6. Adnan Alam Khan ,"High efficiency multi-crystalline Inorganic Solar cell using Er+3 based Plano Convex lens" Life Science Journal-Acta Zhengzhou University Overseas Edition" its ISSN is 1097-8135

7. Adnan Alam Khan , “Fast Subsequent Color Iris Matching in large Database” International Journal of Computer Science Issues (IJCSI),(ISSN:1694-0814,IJCSI

8. Adnan Alam Khan , “Flickers forecasting in CRT using Stochastic Analysis” in Sind University Research Journal (SURJ),(ISSN:1813-1743),2012.

9. Adnan Alam Khan , “WiMax at Ultra High Bandwidth with Spectrum 60 GHz: An Operational Approach” in Sind University Research Journal (SURJ),(ISSN:1813-1743),2012.

10. Adnan Alam Khan ,ELSEVIER "Performance Evaluation of WiMAX Higher Frequency band using its Physical layer “Journal, Procedia Engineering, (ISSN: 1877-7058, ELSEVIER), 2011.

11. Adnan Alam Khan , “Colour Iris Recognition in Controlled Conditions” published in IET National Conference on Signal and Image Processing Applications organized by College of Engineering Pune INDIA in IET (UK) Journal.

12. Adnan Alam Khan , “Knowledge Transformation and Economic Development: The Role of Digital Technology- An Analysis”. University Library of Munich, Germany in its series MPRA Paper with number 5575.

13. Adnan Alam Khan , “HD Tele-Medical Image Compression for On-line decision” in Institute of Business Management (IBA) 4th International Conference on Information and Communication Technologies(ICICT 2011) 23-24 July 2011, Karachi, Pakistan.

14. Adnan Alam Khan , “Statistical Techniques in Multidimensional Error Forecasting” in Fifth Mathematics colloquium, Pakistan Journal of Engineering Technological Science (PJETS) in Institute of Business Management.
15. Adnan Alam Khan , “Performance Evaluation of WiMAX Higher Frequency Band Using Its Physical Layer” International Conference on Intelligence and Information Technology (ICIIT 2010).

16. Adnan Alam Khan , “Differential Image Encoding for Telemedicine: A Novel Approach” Pakistan Journal of Engineering, Technology & Sciences (PJETS), Journal of Institute of Business Management.

17. Burney, et. Al,TempR-PDM: Conceptual Temporal Reational Model for Managing ,Patient Data ,Proceedings Int. WSEAS 2010 ,Conference on Recent Advances in Artificial Intelligence, Knowledge Engineering and Data Bases, University of Cambridge, UK, pages 237-243.

18. Burney, Aqil S.M. et.al: Information and Communication Technology in Healthcare Management System: Prospect for Developing Countries. IJCA,ISSN(0975-887,Vol.4 No.2 ,pp 31-44

19. M. Kayid,S. Izadkhah,and H. Alhalees, "Reliability Analysis of the Proportional Mean Residual Life Order"Hindawi Publishing Corporation Mathematical Problems in Engineering Volume 2014, Article ID 142169, 8 pages http://dx.doi.org/10.1155/2014/142169

20. Madai VI, von Samson-Himmelstjerna FC, Bauer M, Stengl KL, Mutke MA, et al. (2012) Ultrahigh-Field MRI in Human Ischemic Stroke – a 7 Tesla Study. PLoS ONE 7(5): e37631. doi:10.1371/journal.pone.0037631

21. B.S CHOWDHRY, FAISAL A, (2003) "Telemedicine Modernization and expansion of health care systems", ISBN 969-8680-00-4, published by Mehran Info Tech Consultants, pp. 105-124.

22. KP Lam3, “Towards a Practical Differential Image Processing Approach of Change Detection”, in the proceeding of Innovative Algorithms and Techniques in Automation, Industrial Electronics and Telecommunications School of Computing and Mathematics, University of Keele, STAFFS ST5 5BG, U.K , 2007.pp 229-234.

23. Bradley S.Tice, “Aspects of Kolmogorov Complexity:The Physics of Information”, River Publisher Series in Information Science and Technology,para1 page 63 2010.

24. Divya Mohandass and J. Janet, “An improved three pattern Huffman compression algorithm for medical images in telemedicine’s”, in the proceeding of Information Processing and Management, Springer Berlin Heidelberg, 2010.263-268.

25. Adnan Alam Khan, Sahir,Asim Iftikhar "HD Tele-Medical Image Compression for On-line decision " Institute of Business Administration IBA,(2011)

26. S. E. Abu-Youssef,"Testing Decreasing (Increasing) Variance Residual Class of Life Distributions Using Kernel Method",Applied Mathematical Sciences, Vol. 1, 2007, no. 39, 1915 – 1926

27. Hermann Brenner, M.D., M.P.H’ ,Olaf Gefeller, Ph.D "An Alternative Approach to Monitoring Cancer Patient Survival", American Cancer Society,1996.

28. Sujit K. Ghosh,Shufang Liu," Regression Analysis of Mean Residual Life Function", Institute of Statistical Mimeo Series # 2613,2008.