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Nanorobotics Control Systems Design – A Novel Approach to Breast Cancer Diagnosis and Therapeutics

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Abstract: ***In developed countries, one of the major causes in cancer-related deaths among women are due to Metastatic breast cancer (MBC). Some of the many challenges one faced are diagnostic and therapeutic limitations. The causes of these limitations are due to tumor heterogeneity and also various physiological barriers that make drug delivery to specific metastatic sites difficult. To overcome such challenges, targeted nanoparticles are used. The targeted nanoparticles are exploited for surface fictionalization, and can be directed towards tumor markers and tissue-specific metastases. These targeted nanoparticles techniques may provide an effective tool towards treatment for Metastatic breast cancer (MBC) related patients in case of low-vascularised and small-sized metastases. In this article we considered surface fictionalization nanoparticles as nono machines and presents an approach to control them at the nano-meter or molecular scale (10-9 meter) in the perspective of the theory of cybernetics, the science of control, communication and computation. In this paper, we discuss a specific method of special autonomous nano-robotic systems which can be used for bio-mechanical and bio-medical purposes. We have considered a fuzzy shaped based approach in describing how a single malignant cell can be recognises along with its stage, as a suitable target for medical treatment. After synthesis and imaging of magnetic nanoparticles is complete, functional binding of the magnetic nanoparticles with its medicine takes place which is then directed towards effected regions for targeted drug delivery. Such as in this case cancer treatment which is also presented specially to metastatic breast cancer treatment. The result portrays its massive potential in upcoming transition of the research work into practical clinical practice for an effective diagnosis and treatment of the disease in near future.***

Keywords: ***Breast Cancer, Prognosis, Cybernetics, Fuzzy Logic, Nano-Robot***

I. INTRODUCTION

In developed country, after skin cancer, breast cancer is the most common cancer diagnosed. On carefully analysing the risk model, which is based on average population on each women's breast cancer risk may be higher or lower. The cancer risk depends upon several factors, such as genetics, family history, age of menstruation, and other factors which are not yet identified as shown in Fig. 1(a). Survival rates for breat cancer is also very alarming like five years after diagnosis is 89%, Ten years after diagnosis is 82%, Fifteen years after diagnosis is merely 77% and one consider Race/Ethnicity, survival rates for non-Hispanic White is 88.8%, for Black is 77.5%, for American Indian/Alaska Native is 85.6 %, for Asian is 90.7%, for Pacific Islander is 85.4%, and lastly for Hispanic is 83.8%. This five year survival rate for breat cancer as shown in Fig. 1(a), is based on several factors, i.e., the calculation is based on averages along with Each patient's individual tumor characteristics, genetic background , current state of health, etc. These factors will impact her survival. In addition, an individual immune function, level of stress she is in, willingness to live, and other immeasurable factors plays a significant role in patient's survival as shown in Fig. 1(b). (Data source: American Cancer Society Breast Cancer Facts & Figures, 2011-2012).

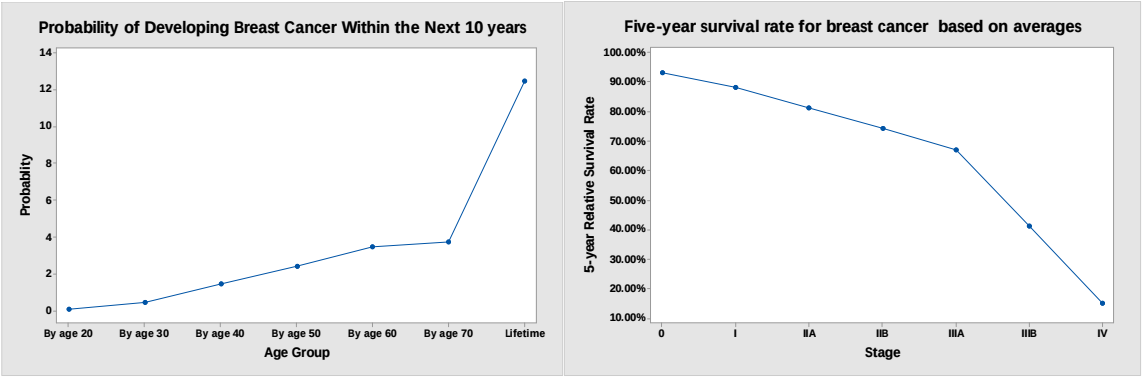

Fig. 1 (a) Probability of developing Breast Cancer within next 10 years among different age group
(b) 5 years survival rate cancer with different stage (based on average)

II. BACKGROUND AND PERSPECTIVE

T. Kempowsky-Hamon, et al. presented that the use of Artificial Intelligence likes Fuzzy Logic in personalized medicine [1] that has become a priority in breast cancer patient management. The most pertinent probes were selected and used to define fuzzy molecular grade 1-like (good prognosis) and fuzzy molecular grade 3-like (poor prognosis) profiles and applying the fuzzy logic selection on breast cancer databases and obtained four new gene signatures.

G. H. Miranda and J. C. Felipe in their article shown that Fuzzy logic can help reduce the difficulties faced by computational systems to represent and simulate the reasoning and the style adopted by radiologists in the process of medical image analysis[2]. They provide a new method that applies fuzzy logic concepts to improve the representation of features related to image description in order to make it semantically more consistent, specifically for computer-aided diagnosis tool for automatic categorization of breast lesions.

H. Mahmoodian proposed a fuzzy model[3] to predict the relapse time of breast cancer by using breast cancer dataset (previously published), where microarray analysis and gene expression profile have been widely used in tumor classification, survival analysis and ER statues of breast cancer, with 95 % confidence interval show a reasonable accuracy in prediction.

B. Kovalerchuk, et al., in their paper illustrated that how a fuzzy logic approach[4] can be used to formalize terms in the American College of Radiology (ACR) Breast Imaging Lexicon. In current practice, radiologists make a relatively subjective determination for many terms from the lexicon related to breast cancer diagnosis.

M. M. Mehdy, et al., reported that medical imaging techniques have widely been in use in the diagnosis and detection of breast cancer. The drawback of applying these techniques is the large time consumption in the manual diagnosis of each image pattern by a professional radiologist. Automated classifiers could substantially upgrade the diagnosis process, in terms of both accuracy and time requirement by distinguishing benign and malignant patterns automatically[5].

Z. Mohammadzadeh, et al., reported that Image processing techniques[6] are allowing earlier detection of abnormalities and treatment monitoring, because the time is a very important factor in cancer treatment, especially in cancers such as the lung and breast, imaging techniques are used to accelerate diagnosis more than with other cancers.

To compare observer performance in detecting breast cancer by soft-copy reading of digital mammograms using a routine image-processing parameter[7] versus each of several high-contrast parameters for finding better accuracy was reported by T. Kamitani, et al.. R. Joro, et al. showed that applying image-processing methods[8] optimizing signal-to-noise ratio, morphological image processing and linear image restoration before frequency analysis possess the greatest superiority value, showing the cancer area most clearly also in the match centre of the mammography estimation.

K. M. Lee and W. N. Street reported a unified image analysis approach[9] for automated detection, segmentation, and classification of breast cancer nuclei using a neural network, which learns to cluster shapes and to classify nuclei and also demonstrated the potential effectiveness of such a system on diagnostic tasks that require the classification of individual cells.

T. K. ten Kate, et al. study described an image processing method for the assessment of the mitotic count [10] in Feulgen-stained breast cancer sections. They also reported that although the fully automatic method provided satisfactory results, it is not yet suited for clinical practice. The automated method with an interactive evaluation step gave an accurate reflection of the mitotic count showing an almost perfect correlation with the results of the interactive morphometry (r = 0.998). Therefore this semi-automated method may be useful as pre-screening device. E. J. Kaman, et al. designed the image analysis[11] procedure to give priority to a

low false negative rate, i.e., misclassification of mitoses. The procedure consists of three steps: 1. Segmentation of the image. 2. Reduction of the number of nonmitotic nuclei by using feature values based on the brightness histogram of the objects. 3. Fully automatic classification of the remaining objects using contour features. The objects remaining after the first two steps were visualized in a composite display for interactive evaluation: 10% of the mitotic nuclei were missed, and 85% of the nonmitotic nuclei were eliminated. The result of the fully automatic procedure described in this paper is rather disappointing and gave a loss of 37% of the mitoses while 5% of the nonmitotic nuclei remained. The Image clustering and colour coding is poorly reported and the approach for the same using Fuzzy logic based image clustering will help for proper identification of the regions inside the images and it will create a basis for the next three steps (i) extended verification with blinded comparison studies. (ii) the automatic extraction of the related primitives from the image, and (iii) the detection of lobulated and microlobulated masses based on these primitives.

III.MOST COMMON TYPES OF BREAST CANCER

There are a great number of different types of breast cancer, and quite frequently one encounters a combination of different types of breast cancer within the same patient. A listing of the most common types of breast cancer would probably include papillary breast carcinoma, and apocrine breast carcinoma. The most common sign of breast cancer is a painless, hard lump with irregular edges.

A. Papillary Breast Carcinoma

Papillary carcinoma is a very uncommon from of infiltrating ductal breast cancer. Papillary literally means ‘nipple-like‘, and this cancer is characterized by a well-defined margin and many small projections, which look like little fingers or nipples, or like the bumpy surface of taste-buds on the tongue. Papillary breast cancer is commonly discovered as a palpable lesion or a nodule on mammogram, or as a complex cyst with solid elements, of about 2-3 cm in diameter, containing a brownish mixture of neoplastic tissue and blood clot. About 1/2 of all cases occur beneath the nipple, resulting in a bloody nipple discharge. Sometimes it is called ‘intracystic‘ papillary carcinoma, which simply means the tumor is found ‘inside‘ a cyst, or a dilated duct segment, and is therefore somewhat more fluid and ‘cyst-like‘ than a solid mass. Papillary breast cancer is diagnosed in 1% to 2% of all patients. Occasionally the disease is found in men as well. Papillary carcinoma most frequently occurs in older, post-menopausal women, and commonly presents as a moderate or ‘grade 2‘ tumor in terms of perceived aggressiveness. Solid papillary carcinomas are tumors morphologically characterized by round, well-defined nodules composed of low-grade ductal cells separated by fibrovascular cores. These tumors are rare and affect predominantly older women. Although they are considered in situ carcinomas, debate and uncertainty still exist regarding their true nature, because immunohistochemistry for myoepithelial cells has shown absence of myoepithelial cell layer along the epithelial-stromal interface of the tumor in many cases. Clinically, these tumors present as a palpable, centrally located mass or as bloody nipple discharge. Pathologically, solid papillary carcinomas exhibit low-grade features, and often the tumors display neuroendocrine and mucinous differentiation. In the majority of cases an associated invasive carcinoma is present, with colloid and neuroendocrine carcinomas being the most common. The pathologic differential diagnosis is broad and ranges from benign to malignant lesions. The treatment for solid papillary carcinomas is surgical excision. When invasive carcinoma is not present, the prognosis is excellent. Histology image of papillary breast carcinoma and region marking with image clustering are shown in Fig. 2.

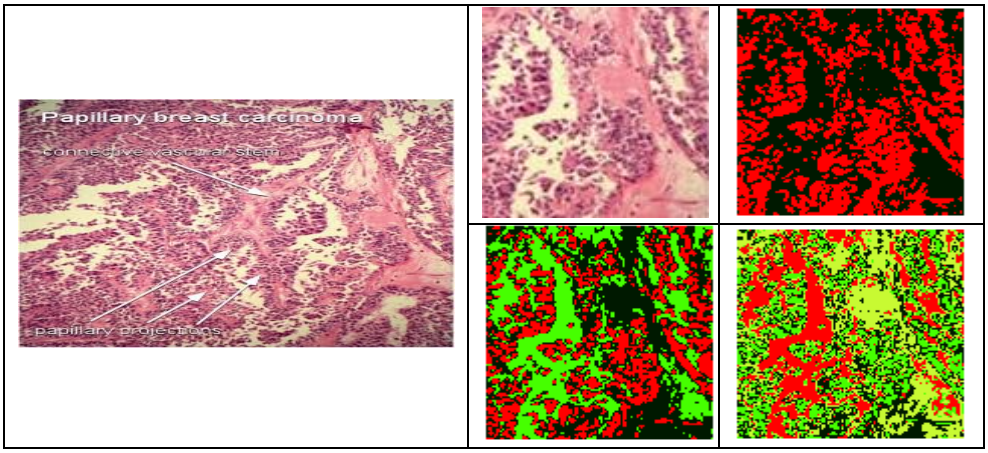

Fig. 2 Papillary breast carcinoma and region marking with image clustering

B. Apocrine Carcinoma of the Breast

Breast carcinoma with abundant eosinophilic cytoplasm, large round nuclei and sharp cell borders. Clinically significant criteria have not generally been agreed upon but most describe some degree of abundant eosinophilic cytoplasm, sharp cell borders, round nuclei and prominent nucleoli, some simply refer to GCDFP15 positive carcinomas as apocrine. At least 75% of microscopic fields must demonstrate the following features: Large cells with abundant eosinophilic cytoplasm, usually granular; Nucleus to cytoplasm ratio of 1:2 or more; Nuclei round, large and vesicular; May be pleomorphic; sharply defined cell borders; Minor (non-mandatory) criteria; Prominent nucleoli in >50% of fields; Apical cytoplasmic snouts into lumenal spaces. Histology image of Apocrine Carcinoma and region marking with image clustering are shown in Fig. 3.

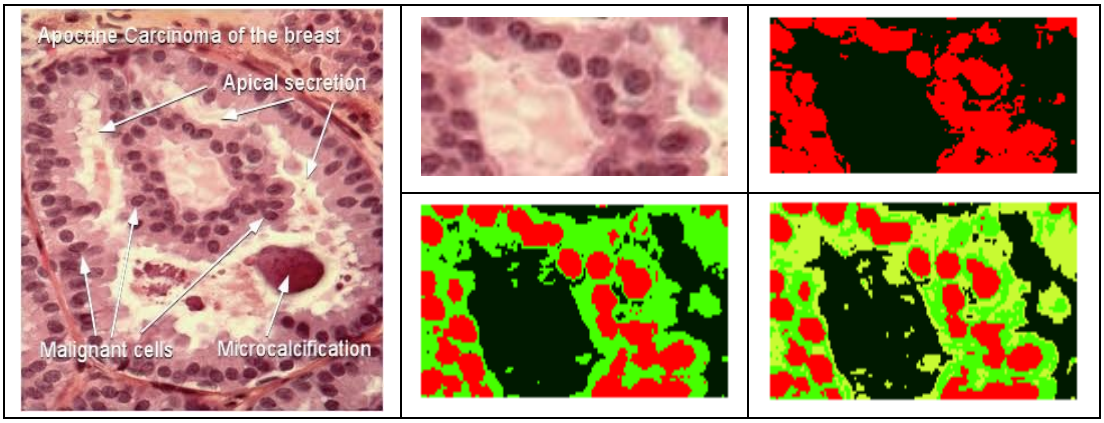

Fig. 3 Apocrine Carcinoma of the breast and region marking with image clustering

IV. CONCLUSIONS

All over the world, one of the leading causes of death among can be consider as breast cancer. Currently, many practitioners gave their similar view in cancer treatment that the treatment itself should not be based only on prognostic factors and chemotherapy, but also on induvial's quality of life both during and after treatment. These individual's tolerability, compliance and quality of life will become the most important factor in future cancer therapy. in our opinion, by using nano-technological therapeutic agents during cancer treatment will represent a great potential and hope for successful cancer therapy in near future. As an application, here we discussed how a nano-robot agent can able to diagnose and kill the specific cancer cell [12-14] by controlled drug transfer to particular site. The result, we have obtained from our research work are validated with the clinical findings and only with some minor enhancement in some fields, the final result will give satisfactory output. Future work including a statistical way of operational research in evaluating a large scale performance, simulations of new environments and nano-robot designs. We strongly believe that these operational nano-machines can only progress by merging of new technologies. Bottlenecks and open research questions in Nanorobotics are to construct dynamic models at nano-scale, for verification, the right tools or methods to check accuracy and correctness of the modelling and control using cybernetics and general systems theory.

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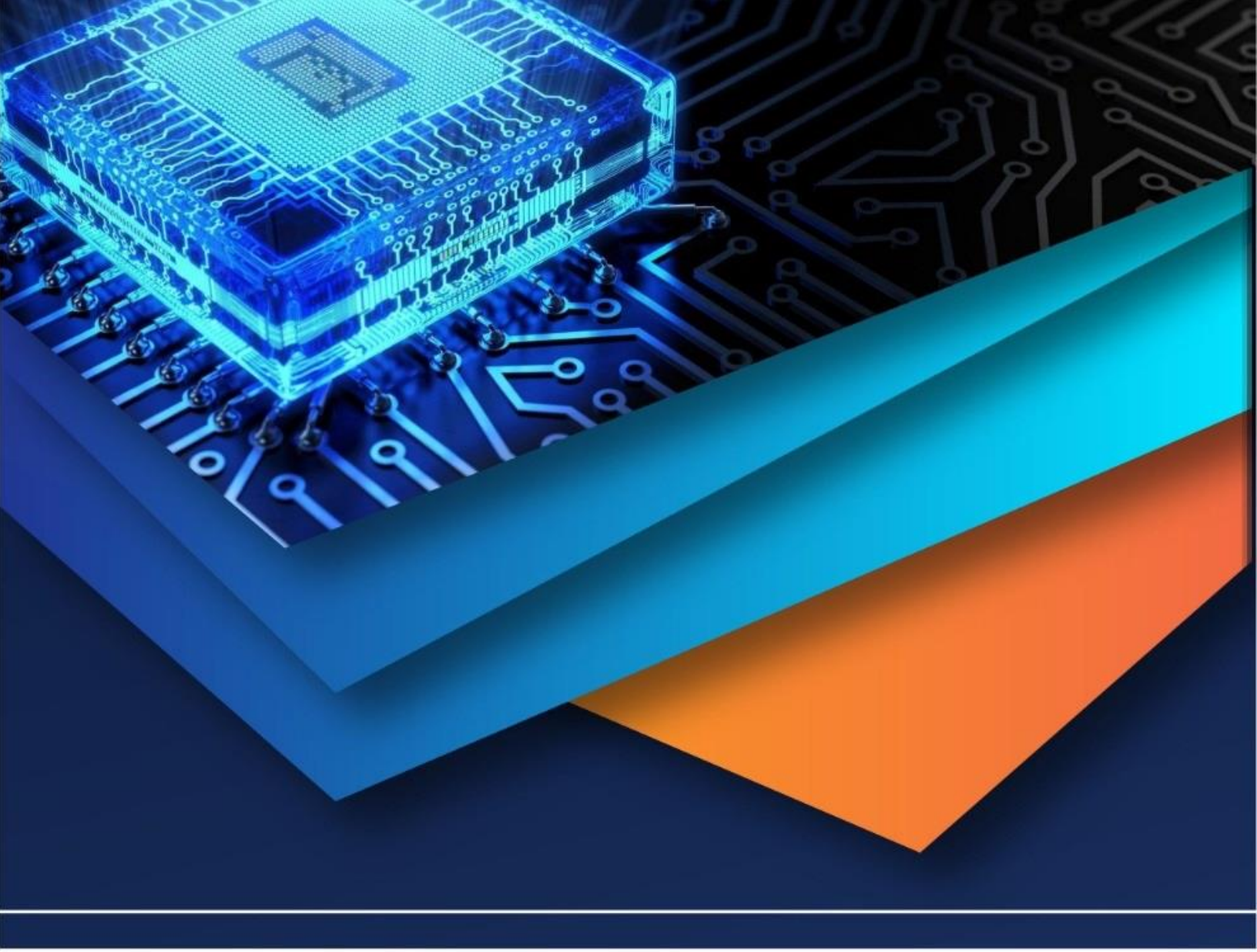
REFERENCES

[1] T. Kempowsky-Hamon, et al., "Fuzzy logic selection as a new reliable tool to identify molecular grade signatures in breast cancer--the INNODIAG study," BMC Med Genomics, vol. 8, p. 3, Feb 07 2015.
[2] G. H. Miranda and J. C. Felipe, "Computer-aided diagnosis system based on fuzzy logic for breast cancer categorization," Comput Biol Med, vol. 64, pp. 334-46, Sep 2015.
[3] H. Mahmoodian, "Predicting the continuous values of breast cancer relapse time by type-2 fuzzy logic system," Australas Phys Eng Sci Med, vol. 35, pp. 193-204, Jun 2012.
[4] B. Kovalerchuk, et al., "Fuzzy logic in computer-aided breast cancer diagnosis: analysis of lobulation," Artif Intell Med, vol. 11, pp. 75-85, Sep 1997.
[5] M. M. Mehdy, et al., "Artificial Neural Networks in Image Processing for Early Detection of Breast Cancer," Comput Math Methods Med, vol. 2017, p. 2610628, 2017.

[6] Z. Mohammadzadeh, et al., "Advances in Optimal Detection of Cancer by Image Processing; Experience with Lung and Breast Cancers," Asian Pac J Cancer Prev, vol. 16, pp. 5613-8, 2015.
[7] T. Kamitani, et al., "Detection of breast cancer by soft-copy reading of digital mammograms: comparison between a routine image-processing parameter and high-contrast parameters," Acta Radiol, vol. 51, pp. 15-20, Feb 2010.
[8] R. Joro, et al., "Dynamic infrared imaging in identification of breast cancer tissue with combined image processing and frequency analysis," J Med Eng Technol, vol. 32, pp. 325-35, Jul-Aug 2008.
[9] K. M. Lee and W. N. Street, "An adaptive resource-allocating network for automated detection, segmentation, and classification of breast cancer nuclei topic area: image processing and recognition," IEEE Trans Neural Netw, vol. 14, pp. 680-7, 2003.
[10] T. K. ten Kate, et al., "Method for counting mitoses by image processing in Feulgen stained breast cancer sections," Cytometry, vol. 14, pp. 241-50, 1993.
[11] E. J. Kaman, et al., "Image processing for mitoses in sections of breast cancer: a feasibility study," Cytometry, vol. 5, pp. 244-9, May 1984.
[12] S. Karan, D. Dutta Majumder and A. Goswami, "A mathematical formalism of self-assembly for design and fabrication of nanostructured materials: a new paradigm for nanotechnology," Indian Journal of Physics, vol. 86(8), pp. 667-676, 2012. http://link.springer.com/article/10.1007%2Fs12648-012-0125-z
[13] D. Dutta Majumder, S. Karan and A. Goswami, "Synthesis and Characterization of Gold Nanoparticles – A Fuzzy Mathematical Approach", Pattern Recognition and Machine Intelligence, Lecture Notes in Computer Science, Springer Berlin / Heidelberg, Vol. 6744, 2011, pp 324-332 , http://link.springer.com/chapter/10.1007%2F978-3-642-21786-9_53
[14] S. Karan, D. D. Majumder and S. Chaudhuri, "Biological Response Modifier-a nanorobotics control system design for immunotherapy in cancer treatment", International Conference on Recent Advances in Information Technology (RAIT), IEEE Press, 2012, pp. 645-650. http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=6194605
[15] D. D. Majumder, S. Karan, A. Goswami, "Characterization of gold and silver nanoparticles using it's color image segmentation and feature extraction using fuzzy C-means clustering and generalized shape theory", International Conference on Communications and Signal Processing (ICCSP), IEEE Press 2011, pp. 70-74. http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=5739402
[16] S. Karan and D. D. Majumder, "Molecular machinery-a nanorobotics control system design for cancer drug delivery", International Conference on Recent Trends in Information Systems (ReTIS), IEEE Press, 2011, pp. 197-202 http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=6146867
[17] S. Karan, D. DuttaMajumder and A. Goswami, "Nanoscale Color Image Segmentation ans feature Extration using Fuzzy C-Means Clustering and Generalised Shape Theory for Characterization of Nanoparticles," International Congress on Productivity, Quality, Reliability, Optimization and Modeling, ed. Indian Statistical Institute, Allied Publishers, Delhi, 2011, ISBN:978-81-8424-708-4, pp. 294-306
[18] D. D. Majumder and S. Karan, "Infinitesimal Machinery - A Nanorobotics System for Cancer Treatment", Third National Conference on Computer Vision, Pattern Recognition, Image Processing and Graphics (NCVPRIPG), IEEE Press, 2011, pp. 142-145. http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=6133021



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