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Analytical Optimization of X-ray Mammography for Increased Benefits and Safety; using: Data-Analytics, Electronics Engineering and Artificial Intelligence

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Abstract

To analyse, understand and investigate common X-ray Mammography techniques, terminologies and properties; and how the X-ray Mammography systems can be optimized for a safer, more effective, more efficient, more energy efficient procedure for breast cancer diagnosis; using Deep Learning (DL)/Artificial Intelligence (AI) , Analytical, Electronic Engineering, tools and Methodologies.

Using data and breast cancer image datasets from validated open source data stores; investigative and comparative analyses were carried out on common X-ray Mammography techniques in relation to breast cancer diagnosis and treatments for Women; as well as optimization analyses using Electronic engineering principles and Artificial Intelligence principles on the quality, intensity, radiation photon energy, HVL(Half Value Layer), Tube current-time product, Metal filters properties (e.g. K-edge energy cut off), and classification validation accuracy of the X-ray Mammography properties, procedure, processes and systems. The methodical and data-driven analyses were carried out using the following Data, Artificial Intelligence (AI) and Electronic Engineering, methodologies and algorithms: Data Analytics, Convolutional Neural Networks (CNN) in Machine Learning (ML) Engineering, and X-ray-Impedance Circuit Composite System Analysis.

The modern CESM (Contrast-Enhanced Spectral Mammography) technique, confirms to be the most efficient especially for a dense breast, but other techniques (including CESM) can also

improve in efficiency when set up with the appropriate metal filter combination(s). Furthermore, the electronic impedance circuit shows good promise in the intelligent reduction of X-ray radiation intensity and further variations in energy; which is needed for a safer and quality X-ray Mammography procedure. Additionally, an interesting estimation of the number of pooling layers needed to achieve a quality metric for breast cancer image classification was investigated and proposed.

Data, AI and Technological processes, techniques and systems are shown to be a promising contributor to medical science; and will no doubt create huge collaborative and multidisciplinary solutions needed for more efficient, effective and safer diagnoses and treatments of breast cancer for Women and also potentially other forms of cancer.

Keywords: X-ray Mammography, Breast Cancer, Women, Data, Analytics, Convolutional Neural Networks (CNN), Artificial Intelligence, Electronic Impedance Circuit, Electronic Engineering.