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Review of Imaging Techniques for Analysis in Medical and Industrial Field

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Abstract- This is a review paper which shows a descriptive comparison of the technologies available for imaging and its various applications in industrial and medical fields. Since tomography is highly used for imaging and fault finding it has been given greater interest by researchers in these fields. For medical applications some in cases it is highly crucial about adapting a specific technique for diagnosis and cure of certain faults in human body. There are different technologies available for imaging and fault finding variably used in either or both industrial and medical fields such as, Computed Tomography, Microwave Tomography, Electromagnetic Induction Tomography, Radiography, Electrical Capacitance Tomography, Electrical Resistance Tomography and Ultra Sound Tomography. All these may not be applicable for one type of fault finding simultaneously but are applicable for at least one or two types of faults in either of the fields. After reading this paper one may get a clear picture of opting and enhancing over a specific type of imaging techniques according to their requirement.

Keywords: Analysis, Fault Finding, Imaging, Industrial, Medical, Tomography

1.0 Introduction

Imaging techniques emerged in early decades of 1900's in medical fields and later were adopted effectively almost in every medical institution for diagnosis of different problems in human body or for study of human body. Radiology began as a medical sub-specialty after the discovery of x-rays by Professor Roentgen. The development of radiology grew at a good pace until World War II. Extensive use of x-ray imaging during the second world war, and the advent of the digital computer and new imaging modalities like ultrasound and magnetic resonance imaging have combined to create an explosion of diagnostic imaging techniques in the past 25 years. Electrocardiograph (ECG), Fiber endoscopy, Ultrasound imaging, X-ray mammography, Computed Tomography (CT) scanning, Magnetic Resonance Imaging (MRI) are few successful techniques used worldwide. Microwave tomography is budding into medical applications and also in industrial applications. [3]

2.0 Literature Review

The development of imaging techniques involved the use fluorescent screens and special glasses so the doctor could see x-ray images in real time. This caused the doctor to stare directly into the x-ray beam, creating unwanted exposure to radiation. In 1946, George Schoenander developed the film cassette changer which allowed a series of cassettes to be exposed at a movie frame rate of 1.5 cassettes per second. By 1953, this technique had been improved to allow frame rates up to 6 frames per second by using a special "cut film changer." [3]. Later for detecting the baby and its heart beat in the mother's womb was a topic of curiosity for the researchers in this field hence ultra sound technology was developed in 1960. It facilitated the doctors to look at the abdomen and kidneys, fetal baby, carotid blood vessels and heart [3].

Most of the literature is focused on the medical applications of imaging in fault finding techniques. There are applications of Microwave tomography in ground penetrating radars, in [4], it is explained that Ground penetrating radar (GPR) is a geophysical tool currently adopted by police forces to locate buried objects and missing human bodies. However, a systematic assessment of its achievable imaging capabilities is still an open issue. In addition, sometimes, conventional data processing tools do not provide accurate and reliable information, thus leading to a misinterpretation of the location and geometry estimation of the target. In this framework, this paper deals with a case study referred to a tropical environment, and investigates the imaging capabilities offered by a linear microwave tomography approach. The results of three experiments, referred to the same organic target and carried out at different times by means of 270 MHz and 900-MHz antennas, are presented. The comparison between the Microwave Tomographic approach and the widely used Kirchhoff migration suggests that the former procedure allows improved performances in locating both the target and the grave [4]. Compared to the Tomographic imaging techniques mentioned previously, microwave tomography is based on the measurements of the scattered electromagnetic fields produced by an object, and it generates images of dielectric properties. The development of microwave tomography systems can be dated back to the late 1970s and early 1980s, since then; there have been a significant number of papers published in the literature on the subject. The achievements, difficulties, and challenges in the development of microwave Tomographic imaging techniques, algorithms, and systems from 1980 to 2010 have been reviewed in [1].

3.0 IMAGING IN FOR FAULT FINDING IN VARIOUS FIELDS

The advent of computer aided technologies image processing techniques has become increasingly important in a wide variety of medical applications. Intervention between the protection of useful diagnostic information and noise suppression must be treasured in medical images. Image denoising is an applicable issue found in diverse image processing and computer vision problems. There are various existing methods to denoise images. The important property of a good image denoising model is that it should completely remove noise as far as possible as well as preserve edges. The objective in all discipline is to extract information about the scene being imaged. The rapid progress in computerized medical image reconstruction and the associated developments in analysis methods and computer-aided diagnosis has boosted medical imaging into one of the most important sub-fields in scientific imaging Ultrasound, MRI, CT-Scan, PET Scan are the medical techniques mainly used by the radiologist for visualization of internal structure of the human body without any surgery. These provide ample information about the human soft tissue, which helps in the diagnosis of human diseases [5]. As far as instrumentation for microwave imaging is concerned, it should be mentioned that illuminating/receiving systems are essentially based on two approaches. The first one concerns the use of one or more probes (linear or circular arrays) operating in a real or synthetic mode. The prototype of tomography previously mentioned belongs to this category. Usually, probes are constituted by dipoles or small horns. The second approach involves the use of passive probes that are sequentially modulated. Let us consider for example a short dipole loaded with a nonlinear element (e.g., a PIN dipole). If a signal with square waveform is used to polarize the load element, depending on the status of the polarization, the antenna scatter or not the incoming field. In this way, it is possible to use an array of passive dipoles with loads sequentially polarized and to measure (with a proper aperture antenna) a field which is proportional to the incoming field exactly in the space point where the selected dipole is located. This technique is known as the Modulated Scattering Technique (MST) and has been satisfactory applied for imaging applications. In particular, an efficient microwave camera has been developed in, whereas an improved Apparatus, based on slot antennas, has been recently designed and constructed [2].

4.0 CONCLUSION

Various techniques are emerging in recent research with the use of microwaves for imaging; also the previous techniques have increased a greater hold over the specifications of application such that one can categorize the technique to be used for respective applications. Above all the discussion it can be concluded that microwave tomography has a wide application in industrial as well as medical fields and they are not as hazardous as radiography to human body, hence in near future some of the places the microwave tomography can take over the existing technology in imaging and fault finding.

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