

Chapter 14

Fuzzy Logic for Breast Cancer Diagnosis Using Medical Thermogram Images

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ABSTRACT

In this chapter, how medical thermography can be utilized as early detection technique for breast cancer with fuzzy logic is explained. Breast cancer is the leading cause of death among women. This fact justifies researches to reach early diagnosis, improving patients' life expectancies. Moreover, there are other pathologies, such as cysts and benign neoplasms, that deserve investigation. In the last ten years, the infrared thermography has shown to be a promising technique to early diagnosis of breast pathologies. Works on this subject presented results that justify the thermography as a complementary exam to detect breast diseases. Various algorithms that can be utilized for Breast Cancer diagnosis utilizing medical thermography are listed and also the advantages of medical thermography over other imaging modalities is given.

INTRODUCTION

Breast cancer can be defined as a cancerous growth that inhabits the tissues in the breast where they produce milk for infant nutrition. In this type of cancer, the cells in the breast region grow abnormally and in an uncontrolled way. Breast Cancer has become one of the most horrifying experiences in today's women's health. The incidence of breast cancer in India is on the rise and is rapidly becoming the number one cancer in females. India accounts for nearly six percent of deaths due to breast cancer in the world. One out of every 22 women in India is diagnosed with breast cancer (Pragati, 2012).

Early breast cancer detection, is one of the most important areas that researchers are working on, and it can increase the rate of diagnosis, cure and survival of the affected women. Considering the high cost of treatment as well as the high prevalence of the disease among women, early diagnosis will be the most significant step in reducing the health and social complications of this disease. Mammography

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is recognized as the standard method of diagnosing breast cancer. Infrared Thermography based cancer diagnosis is able to detect cancer in its early stage of development and progression, thus longer survival is possible (William, 2003) Thermal (Or infrared) radiation emission from human body will be higher around the regions where an anomaly such as tumor is present inside the body due to:

1. Higher metabolic activity of cancerous cells compared to normal cells.
2. **Angiogenesis:** A cancer tumor starving for nutrients produces a chemical that promotes the development of blood vessels that supply the tumor and also causes normal blood vessels to dilate to provide more blood in tumor growth. (Debi et al., 2012).

There are many different methods to detect breast cancer, with different advantages and disadvantages (Pragati et al., 2012), (William, 2003). Some of these methods are mentioned as follows:

1. **Breast Examination by a Physician:** In this exam, physicians inspect the breasts followed by a physical examination of the patient in different body positions. Physicians look for asymmetry, masses, lesions, skin changes and dimpling in the breasts. The physician will try to measure the size of the mass by his/her fingers.
2. **Mammography:** If the patient is older than 40 years, usually the physician will ask for mammography. In mammography, the patient is exposed to X-ray and the breast is compressed using two parallel plates. Parallel plate compression evens out the thickness of breast tissue to increase image quality by reducing the thickness of tissue penetrated by X-ray. Some women find this method annoying while some women find it painful. The mammography must be checked and interpreted by a radiologist. Also, because of some technical problems, the mammography must be repeated, that means more radiation exposure for the patients.
3. **Ultrasound:** Since mammography evaluation is difficult and often incomplete due to dense breast parenchyma in women under 35 years of age, ultrasound or sonography may be used to rule out breast cancer in this age group. This method uses high frequency sound waves to create images of the internal structures of the human body. Ultrasound imaging can help to determine if an abnormality is solid or fluid-filled or both cystic and solid. One of the major limitations is that some breast cancers may not be visible on Ultrasound; moreover it requires a highly experienced and skilled operator for interpretation of Ultrasound Images.
4. **Thermography:** Is a noninvasive imaging method that is used as a diagnostic tool. The main idea of this method is based on infrared radiation of bodies with temperatures higher than absolute zero. Thus, production of a patient's thermogram will show the temperature distribution in the patient's body. Due to the higher metabolic activity and angiogenesis surrounding the cancerous tissue, the cancerous parts have a higher temperature in comparison to normal tissue. Therefore, the cancerous tissue is highlighted and easily differentiated from normal tissue in a thermogram. Thermograms can give highly dynamic information about tumors. In this method in addition to normal tumors, very small tumors are also easily and very quickly detected (Ng, 2011) . Tumors can be seen as a high temperature spot in thermographic imaging. In mammography it is little different. If the tumor is smaller than a certain size, x-ray will pass through the tumor unaffected and it won't be observed in the mammography. This qualifies infrared imaging as an effective diagnostic tool for early detection of breast cancer. A general advancement to modern thermographic techniques is

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