Remedial Measures to Reduce the Effectiveness of Breast Cancer

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Abstract:

Getting breast cancer is a challenging task that can be dangerous to health if not detected early. There are many tools and technological advances in diagnosing breast cancer. Mammography has become a popular testing method. However, mammography exposes the patient to radiation and causes discomfort to the patient. Thermographic tests do not require mechanical contact and are less expensive than mammography, which allows patients to receive more frequent tests. Advances in artificial intelligence technology have allowed a comprehensive neurological network approach to assist physicians in rapid diagnosis [7, 8]. It compares the effect of combining the medical information collected by each patient with the sample.

Although these efforts in the past were aimed at developing a hot model for breast cancer, the majority were academic exercise by imitation. These modeling efforts combined have the following limitations:

- Lack of clinical data to be measured by model (here, thermography of breast cancer).
- Lack of actual breast shape (i.e., extra geometry), is unique and varies from person to person.
- Lack of true definition of the tumor (i.e., size and (x, y, z) and the inner surface of the breast).
- The use of Pennes' bioheat equation as the dominant, naturally limited and simplified equation.
- Absence of true internal vasculature and blood vessels (i.e., hemodynamic) information in the breast.

Therefore, the aim of the current study was to determine the hot features of breast cancer by creating a computer-assisted hot (or bioheat) model based on actual clinical data.

Full Length Paper:

Breast asymmetry occurs when one breast has a different size, volume, location, or shape in another. Breast asymmetry is very common and affects more than half of all women. There are many reasons why a woman's breasts may change in size or volume, including trauma, puberty, and hormonal changes. Your chest muscles may change as you ovulate, and you may often feel full and tender. It is common for breasts to look bigger because they actually grow in water retention and blood flow. However, during your menstrual cycle, they will return to normal size. Another cause of uneven breasts is a condition called juvenile hypertrophy of the breast. Although rare, this can cause one breast to grow larger than the other. It can be treated surgically, but it can also lead to many psychological problems and insecurity.

During puberty, the left and right breasts usually develop at slightly different speeds. Breasts may appear asymmetrical to full development or they may vary in shape and size throughout a person's life.

Hormonal changes can change one or both breasts at any time in a person's life, for example:

- At certain points of the menstrual cycle
- During or near menstruation
- During pregnancy or lactation
- When using hormonal contraceptives such as birth control pills

Breasts that change size or shape due to hormones often return to normal. Hormonal changes can cause the breasts to become lumpy or lose fat and tissue. However, if these changes do not go away, it is a good idea to consult a doctor who can diagnose potential health problems.

Other conditions that can affect breast size and posture include:

Breast ducts: Also known as breast hypoplasia, tubular breasts develop in one or both breasts during puberty.

Amazia or Amasia: A condition that causes problems with the growth of breast tissue, aurora or nipple.

Polish Syndrome: When the breast muscle does not develop properly, it can affect the breast on one side of the body.

Thermography:

Thermography is a method of studying heat distribution. Thermography can be used in a variety of applications such as firefighting and analyzing heat leaks in a building. In the case of medical imaging, thermography aims to analyze the surface temperature of the body. Thermal imaging is based on the idea of a blackbody, which is an ideal object that absorbs all electromagnetic radiation, that is light, and whose absorption of radiation is related to its emission of radiation. Since human skin has a high emissivity of 0.98 out of 1.0, a relationship between temperature and light emitted by the skin can be determined.

The relationship between emittance, Mλ, and wavelength of light, λ, and temperature of a blackbody, T, is described in Planck's Radiation Law. Emittance, Mλ, is defined as energy radiated per unit volume. Planck's Radiation Law is defined as follows,

$$M_\lambda(T) = \frac{2\pi hc^2}{\lambda^5\left(e^{\frac{hc}{\lambda kT}} - 1\right)} \quad [W\ m^{-2}\mu m^{-1}]$$

where h is Planck's constant, k is Boltzmann's constant, and c is the speed of light [14].

An approximation of Planck's Radiation Law is known as Wein's Displacement Law can be written as From Equation it is very clear that temperature of a blackbody such as skin and emitted wavelength is directly related. Skin temperature of about 33◦C, or 306 K, results in an emitted wavelength of 9.5 µm, which is classified as long-wavelength infrared light. Therefore, infrared cameras are used for thermal imaging of the body, where the above mentioned equations are used to relate the infrared light emitted by the body to temperature. Human bodies are often represented as a blackbody due to a high emissivity of 0.98 [15].

The emissive power, E, of a non-perfect blackbody is represented in Stefan Boltzmann's Law as shown below, where is the emissivity of the object, and σ is Stefan-Boltzmann's constant.

Equation 1.1 can be derived by integrating Planck's Radiation Law over all wavelengths. The emissive power, E, is typically measured in infrared camera sensors.

Thermography, also known as thermal imaging, is a non-invasive imaging technique that captures images of infrared radiation emitted by objects. It works by detecting the thermal energy (heat) that is emitted by the objects and converting it into an image that can be analyzed to reveal information about the object's temperature distribution.

Thermography has a wide range of applications, including medical imaging, industrial inspection, building energy audits, and environmental monitoring, among others. In medical imaging, it is commonly used for the diagnosis of various conditions, such as breast cancer, musculoskeletal disorders, and cardiovascular diseases, among others.

The main advantage of thermography is that it is completely safe and non-invasive. Unlike other imaging techniques, such as X-rays and mammography, it does not use ionizing radiation and does not expose the patient to any harmful effects. Additionally, thermography can detect temperature changes and blood flow, making it an excellent tool for detecting early stage tumors and other conditions.

Thermography is performed using a thermal imaging camera, which captures infrared radiation emitted by the objects and converts it into a thermal image. The image is then analyzed to identify any temperature anomalies or patterns that may be indicative of a condition.

Preparing the Space Where You Will Use the Thermal Imaging System

- Room temperature should be 68–76 °F (20–24 °C) and humidity 10–50 percent.
- Try to control other substances that may affect the temperature reading:
- Avoid reflective backgrounds (e.g., glass, mirrors, metal surfaces) to reduce reflected infrared radiation.
- Use in a draft-free (air circulation) room away from direct sunlight and intense heat (e.g., portable heaters, electrical sources).
- Avoid bright light (e.g. incandescent, halogen and quartz tungsten halogen light bulbs).

5.1. History of Thermal Detectors

Heat exchangers are designed to receive radiation from certain wavelength bands. In this way, they aim to work with high penetration and minimal loss in the selected length.

In 1969, Richard D. Hudson identified areas for thermal imaging, medical, scientific, military, and industrial applications. Hot photography programs for these four areas have different needs and designs. Today, this technology is widely used in the military.

Heat conductors were first built in the 1940s with 1 - 2.5 µm wavelength sensitive lead sulfur (PbS). In addition, when a lead sulfide cooling system is used, the radiation sensitivity is reflected in the band range of 2 - 4 µm. This means that with this band list you can capture near-infrared radiation. With the discovery of indium antimonite (InSb) in 1952, Heinrich Walker paved the way for thermal imaging systems that could operate across the central red band.

Following this discovery, Lawson acquired a mercury cadmium tellurium (HgTeCd) in 1959 and a remote infrared band (8-14 μm) was introduced. Heat systems began to be used in battlefields.

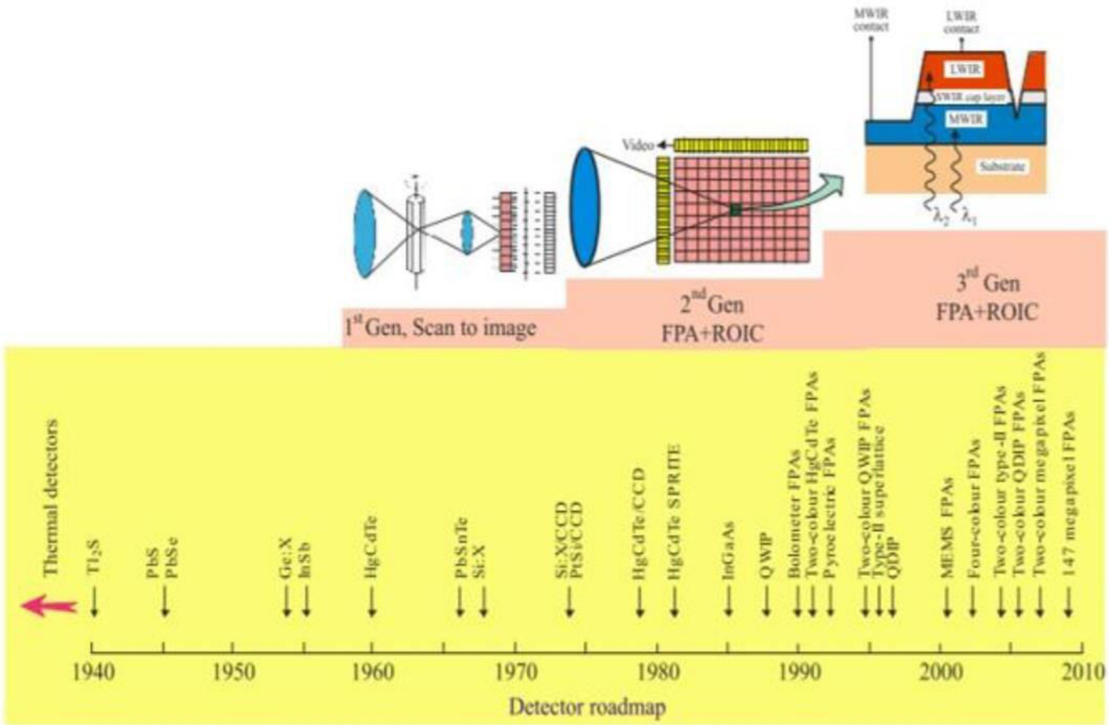

Figure 5.1: History of the development of thermal detectors [12]

The use of drugs in the field began in the 1970s. The technology of thermal imaging systems is basically divided into two parts: liquid crystal contact thermography and a non-abrasive black body. Initially, the performance of the camera was not at the desired level due to the newly developed technology. The crystal thermography of liquid used in the medical field in the 1970s was insufficient for temperature adjustment (± 0.5 ° C), reaction time (> 60 sec) and local adjustment.

How Thermography Detect breast issue

The thermography machine uses an infrared camera to detect temperature differences inside your breast tissue. During a thermogram test, the machine never touches your body.

In the thermogram, the "hot spots" appear red compared to the surrounding tissues which appear yellow, green or blue. Anything that causes an inflammatory reaction in the body will appear on the thermogram as it heats up.

Instead of using x-rays to detect abnormalities in the mammary gland, thermography makes such a diagnosis based on temperature differences of breast tissue. This is possible with digital infrared thermal imaging (DITI). Doctors detect abnormalities in the breast tissue by examining temperature differences. They see a problem that needs further investigation when the tissue appears red, which means there is more heat. Excess heat occurs in adverse reactions due to an increase in nitrous oxide in the tissues.

One of the main reasons why patients prefer thermographs compared to mammograms is because the procedure is not invasive. A mammogram requires breast compression that can sometimes be painful in patients. Even with a hot chest test, the machine does not touch you at all. Another advantage of having thermograms is that they are not exposed to radiation because digital infrared thermal imaging is used. Patients may also find that they do not need to adjust their thermogram during their menstrual cycle because their cycle and hormonal changes do not affect the results, unlike mammograms.

5.3. Benefits of Thermography

Here are some benefits of using thermography for breast abnormality detection:

1) Non-invasive: Unlike mammography or biopsy, thermography does not involve any radiation exposure or tissue sampling, making it a non-invasive option for breast evaluation.

2) Early detection: Thermography can detect changes in breast temperature that may indicate the presence of breast cancer or other abnormalities, which can be an early sign of disease.

3) Safe for women with implants: Thermography is safe for women with breast implants, as it does not involve radiation or physical compression.

4) Cost-effective: Thermography is typically less expensive than other imaging tests like MRI or mammography.

5) No discomfort: Thermography is a painless and non-invasive test that can be performed quickly and easily, without the discomfort associated with other imaging tests.

So, we use thermogram technique to predict the breast abnormality, because it’s easy to collect the data without any harm to patients.

Thermography in Medical Diagnosis

- Measure a person's surface skin temperature at once.
- Position the person a certain distance from the thermal imaging system directly in front of the camera (follow the manufacturer's instructions for use).
- If using an image, the image area should include the person's full face and calibrated blackness.

- If a temperature rise is detected using thermal imaging, another method should be used to confirm fever. Public health officials can help you determine if a fever is a sign of infection.

CONCLUSION

With the aim of creating a segmentation algorithm and a method for analyzing a new database of images of patients in the prone position, the proposed method was successful. The algorithm found an ROI that included the breast and excluded most of the chest wall. Compared to other segmentation methods that often-included larger portions of the chest wall either below or above the breast, this method was more accurate. This method also made it possible to segment breasts of different shapes without excluding any region of the breast.

However, compared to automatic methods, the segmentation algorithm developed here is more tedious and prone to human errors. The analysis method of studying thermal profiles and corresponding gradients was a unique method that was successful in identifying peaks in the profiles that indicated important features such as tumors or veins. This method makes it possible to complete studies on the thermal diffusion of the tumor, since the physical information on the size of the breast is known. The hotspot detection algorithm was able to locate abnormal regions, or hotspots. The method was less successful because it depended on the number of pixels covered by the tumor and was skewed by the warmer chest wall. Overall, the algorithm is a good groundwork for further improvement in segmentation and tumor thermal diffusion studies.

Given the preliminary, exploratory nature of this dissertation work, the results are also informative regarding possible directions for future work that may yield important results. For example, since MATLAB does not allow us to use a large number of features in ANNs, the first step in the future is to evaluate the method more thoroughly using other programming. Tests focus only on the accuracy of tumor detection. However, further analysis on other validated reference data sets may reveal the accuracy of the method in detecting each tissue type. In turn, it is useful for clinicians to know that both types of (dense) breast tissue can very easily hide signs of cancer and are often missed. Scanned and can't watch afterwards. Therefore, reliable information on the distribution of such tissues and even a method for more thorough examination of such tissues may provide more useful diagnostic aid. Another direction for future work is to focus on cancer or normal image analysis, which can classify samples as malignant and benign and use the method to differentiate cancer types.

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