



ROHINI COLLEGE OF ENGINEERING AND TECHNOLOGY

AUTONOMOUS INSTITUTION

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DEPARTMENT OF BIOMEDICAL ENGINEERING

VII Semester

OBT357 BIOTECHNOLOGY IN HEALTH CARE

UNIT- 5 BASICS OF IMAGING MODALITIES

5.6 Thermography

Thermography, also known as thermal imaging or infrared thermography, is a non-invasive imaging technique that uses infrared cameras to detect heat emitted by objects, people, or animals. It visualizes temperature variations, creating images (thermograms) where different colors represent different temperatures.

Principle:

Detects infrared radiation (heat) emitted from surfaces, which is invisible to the human eye. Warmer areas emit more radiation, appearing as brighter or warmer colors (e.g., red, yellow) on thermograms, while cooler areas appear darker (e.g., blue, purple).

Components of thermography:

The main components of a thermography system are:

1. Infrared Camera (Thermal Imager)

- Core component that detects infrared radiation emitted by the body.
- Converts invisible infrared energy into a visible thermal image (thermogram).
- High sensitivity is required to detect subtle temperature differences (as small as 0.1°C).

2. Optics / Lenses

- Special infrared-transparent lenses (often made of germanium) focus infrared radiation onto the detector.

- Standard glass cannot be used, as it blocks IR waves.

3. **Infrared Detector / Sensor**

- Converts incoming IR radiation into electrical signals.
- Two main types:
 - **Cooled detectors** (high sensitivity, used in research/clinical settings).
 - **Uncooled detectors** (compact, commonly used in medical and industrial thermography).

4. **Signal Processing Unit**

- Amplifies and processes electrical signals from the detector.
- Converts data into digital form for display and analysis.

5. **Image Display and Recording System**

- Monitor or computer screen to visualize thermograms in real time.
- Software allows adjustment of color palettes, scaling, and temperature mapping.
- Storage for documentation and further analysis.

6. **Calibration System**

- Ensures accuracy of temperature readings.
- Uses reference blackbodies (known temperature emitters) for calibration.

7. **Control and Software Interface**

- Allows user to adjust imaging parameters (focus, contrast, temperature range).
- Provides tools for image enhancement, region-of-interest analysis, and report generation.

8. **Support System**

- Tripod, positioning aids, and environmental controls (to reduce external heat interference).

- Patient preparation area (since skin temperature can be influenced by environment).

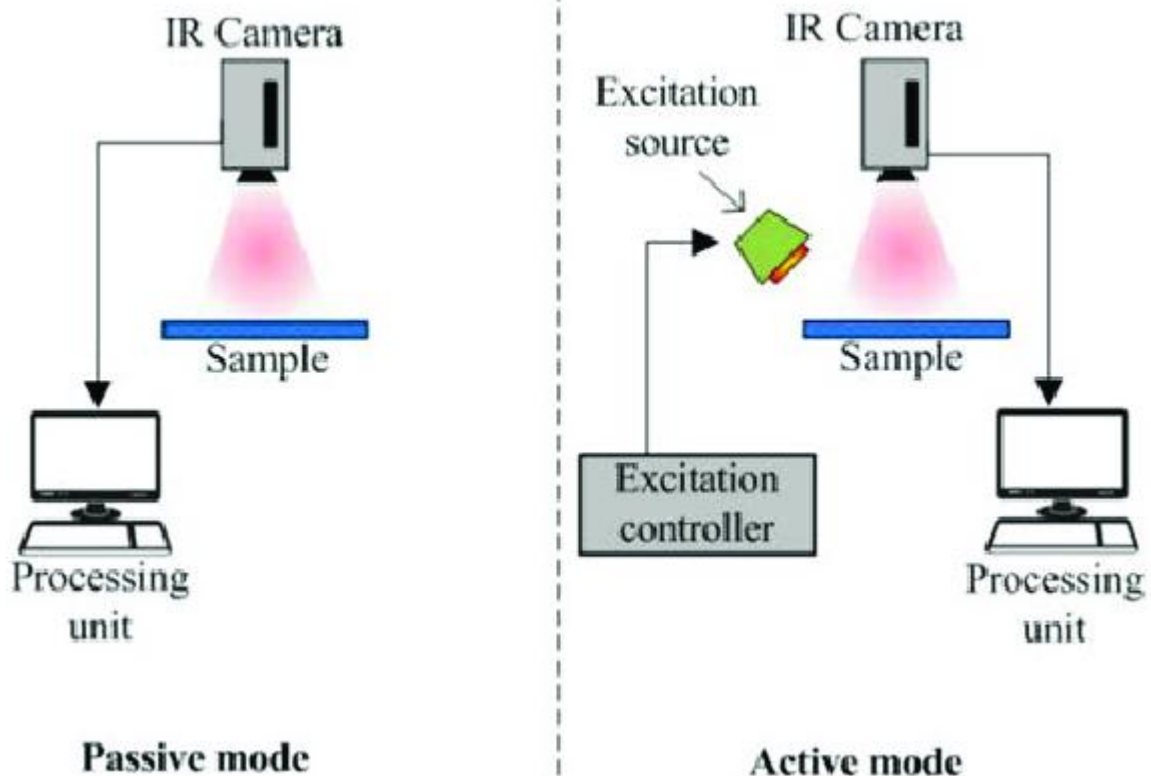
Types of thermography:

Passive Thermography

- Relies on naturally emitted infrared radiation from the body or object.
- No external energy is applied.
- Common in medical diagnostics (e.g., detecting inflammation, vascular issues).

Active Thermography

- External energy is applied (heat, light, ultrasound, electrical current) to stimulate the object/tissue.
- The response (temperature changes) is recorded.
- Used in non-destructive testing (NDT), industrial inspection, and research.



Diagnostic Applications of Thermography

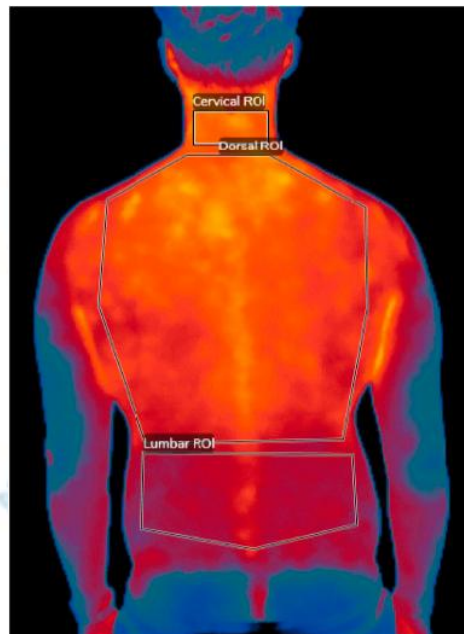
Thermography, or infrared thermal imaging, is used in medical diagnostics as a non-invasive, radiation-free method to detect temperature variations in the body, which can indicate underlying physiological issues. Below is a concise overview of its diagnostic applications, focusing on medical uses:

1. Breast Cancer Screening:

Detects abnormal heat patterns in breast tissue, which may indicate tumors due to increased blood flow or metabolic activity.

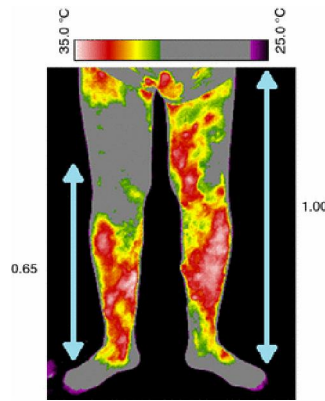
2. Musculoskeletal Disorders:

Identifies inflammation, muscle strains, or joint issues (e.g., arthritis, tendonitis) by detecting localized heat from increased blood flow.

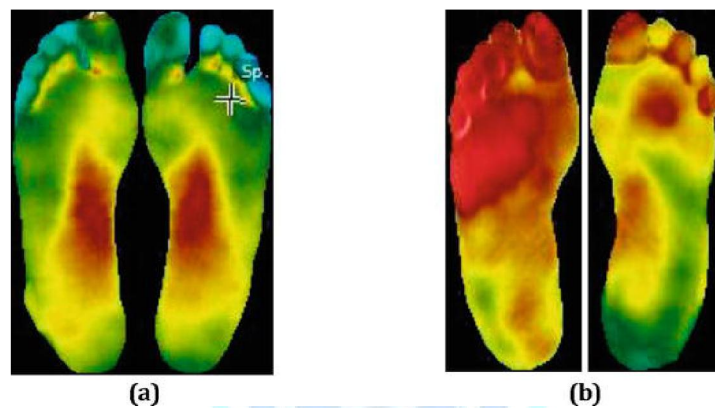


3. Vascular Disorders:

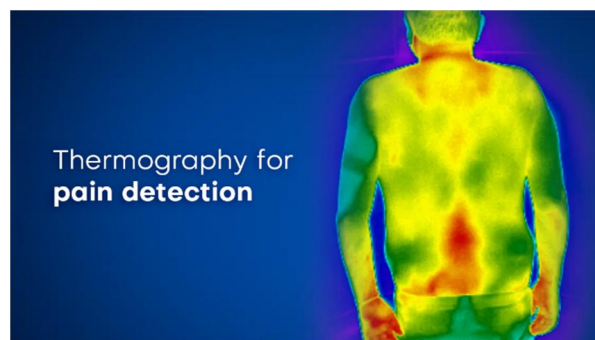
Detects abnormal blood flow, such as in deep vein thrombosis (DVT) or peripheral vascular disease, by identifying temperature asymmetries.



4. **Neurological Conditions:** Identifies nerve dysfunction or damage (e.g., diabetic neuropathy, complex regional pain syndrome) by detecting temperature changes caused by altered nerve function.

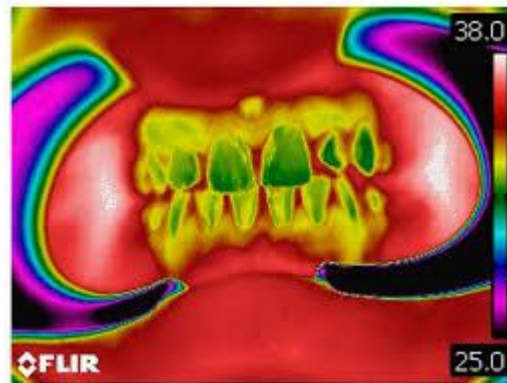


5. **Pain Management:** Maps areas of chronic pain or inflammation, helping identify sources like nerve irritation or soft tissue injury.



6. **Infection and Fever Screening:** Detects localized or systemic temperature elevations due to infections or fever.

7. **Dental and Oral Health:** Detects inflammation or infection in teeth, gums, or jaw (e.g., temporomandibular joint disorders).



Advantages of Thermography

1. Non-invasive & painless
2. Radiation-free (safe for repeated use)
3. Early detection of physiological changes
4. Real-time & dynamic imaging
5. Wide range of medical applications
6. Cost-effective & quick

Disadvantages of Thermography

1. Lower specificity & sensitivity (risk of false positives/negatives)
2. Affected by environmental conditions
3. Operator and interpretation dependent
4. Not a standalone diagnostic tool
5. Limited structural/anatomical information
6. Lack of universal standardization
