Terahertz Tomography

What is Terahertz Tomography?

Found in 1997, Terahertz tomography is a class of tomography where **sectional imaging is done by terahertz radiation.**

What is it used for?

Terahertz imaging can provide an endogenous contrast between normal & cancerous tissue. It can be used in many medical imaging applications including **skin, oral, breast, gastric & colorectal cancers.**

Why Terahertz radiation?

Terahertz radiation is **non-ionizing** unlike X-rays & UV light. Hence it's safe for human tissue. In addition, it is heavily absorbed by moisture which is appreciated in the medical imaging field.

What are its advantages?

Terahertz imaging provides a **higher contrast image** for the diseased tissue versus the healthy tissue, the former having a higher content in water. This can provide a way to more accurately **define the exact margin of early-stage tumors.**

Terahertz radiation

Terahertz Radiation is a part of the broad electromagnetic spectrum that spans the region between far IR and millimeter wavelengths. Referred to as the terahertz gap, it is formally defined as the spectrum from 30 μm (10 THz) to 3000 μm (0.1 THz).

THz tomography in medicine allows conducting analysis of the upper layers of a human body — skin, vessels, joints and muscles. There are known successful applications of THz tomography for detecting skin and breast cancers at early stages.

Unique features

The major advantage of terahertz waves is that many materials which block visible and IR spectra, appear to be transparent in the terahertz region. It's non-invasive & label-free identification of living cells. It can also image skin through wound dressings.

Applications

Terahertz imaging system is developed based on pulses of Terahertz (THz) radiation generated & detected using all- optical effects accessed by irradiating semiconductors with ultrafast pulses of visible laser light. It's commonly referred to as T-Ray Imaging or THz Pulse Imaging (TPI).

TPI images show good contrast between different animal tissue types. Moreover, the diagnostic power of TPI has been elucidated by the spectra available at each pixel in the image, which are markedly different for the different tissue types. This suggests that the spectral information inherent in TPI might be used to identify the type of soft and hard tissue at each pixel in an image and provide other diagnostic information not afforded by conventional imaging techniques.

Experimental study

The first THz image of human tissue was an extracted tooth. The time of flight of THz pulses through the tooth allows the thickness of the enamel to be determined, & is used to create an image showing the enamel & dentine regions. Absorption of THz pulses in the tooth allows the pulp cavity region to be identified.

Initial evidence strongly suggests that TPI may be used to provide valuable diagnostic information pertaining to the enamel, dentine, & the pump cavity.