# SKIN CANCER DETECTION USING THZ WAVES

Early and precise detection of tumor cells is critical for improving cancer treatment outcomes and patient survival rates. This study explores the development of a next-generation optical biosensor integrating terahertz (THz) wave technology with artificial intelligence (AI)-driven analytics and Internet of Things (IoT)-enabled connectivity. The microstructure fiber (MSF)-based biosensor leverages the unique electromagnetic properties of THz waves to enhance tumor diagnostics by detecting distinctive absorption and refractive index variations associated with malignant cells.

The proposed biosensor capitalizes on optical advancements, utilizing microstructure fiber to enhance light-matter interactions, facilitating superior signal transmission and ultra-sensitive tumor detection. Graphene-based coatings and plasmonic metamaterials further amplify THz signal interactions, significantly improving detection accuracy.

The integration of AI-powered machine learning algorithms enhances the biosensor's capability to classify cancerous cells with high precision. the system can efficiently process vast amounts of THz spectral data, distinguishing between healthy and malignant tissues while minimizing false positives and negatives. AI-driven signal analytics further refine the diagnostic accuracy, making the system more reliable compared to conventional optical detection methods.

Additionally, microfluidic-assisted sample handling ensures the rapid isolation and monitoring of circulating tumor cells (CTCs), allowing for early cancer detection. The IoT framework enhances remote diagnostics by enabling seamless data transmission to cloud-based platforms, fostering predictive healthcare capabilities and accessibility in clinical settings.

Compared to conventional optical cancer sensors, THz-based optical biosensors offer multiple advantages. Unlike fluorescence or Raman-based techniques, which require external markers or contrast agents, THz spectroscopy provides a label-free, non-invasive diagnostic approach with enhanced sensitivity to biochemical and structural changes at the cellular level. Furthermore, traditional optical biosensors suffer from limited penetration depth and interference from biological media, whereas THz waves effectively interact with biomolecular signatures while minimizing scattering effects. The AI-enhanced data analytics further improves diagnostic accuracy by reducing false positives and negatives, surpassing conventional pattern recognition techniques.

The anticipated outcomes of this research include improved diagnostic accuracy, real-time tumor monitoring, early intervention capabilities, and reduced dependence on invasive biopsy procedures. By merging THz spectroscopy, optical microstructure fiber technology, AI-driven analytics, and IoT connectivity, this interdisciplinary approach paves the way for a transformative shift in cancer diagnostics, enhancing global healthcare accessibility and significantly reducing cancer mortality rates.

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