A Signal Framework for Reliable Terahertz Biomedical Imaging

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Abstract

Terahertz (THz) imaging is emerging as a promising modality for non-invasive biomedical applications due to its ability to capture molecular information and fine tissue structures. However, the adoption of THz imaging in medical diagnostics remains limited by strong signal attenuation in biological media, noise sensitivity, and phase distortion. To address these challenges, this work aims to present a signal processing framework tailored for THz biomedical imaging. The framework integrates adaptive noise reduction with compressed sensing-based reconstruction to enhance image clarity under low signal-to-noise ratio (SNR) conditions. In addition, a phase correction strategy is introduced to mitigate wavefront distortion caused by tissue heterogeneity. The proposed approach is expected to improve the reliability and diagnostic value of THz imaging, enabling applications such as early-stage cancer detection, tissue characterization, and intraoperative surgical guidance. This study aims to highlight how advanced signal processing techniques may help overcome fundamental limitations in practical THz medical imaging.

Key words

Terahertz imaging, biomedical signal processing, compressed sensing, noise reduction, tissue characterization

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