Title: Design of an Octagon-Shaped THz Photonic Crystal Fiber Biosensor for Coordinated Diabetes Detection Using Dilated Causal Convolution with Botox Multi-Head Self-Attention Network

Abstract: Diabetes is a global health concern requiring early and accurate diagnosis to prevent complications. Existing diagnostic techniques often lack the sensitivity and specificity needed for reliable detection of biomarkers at low concentrations. This study presents an octagon-shaped terahertz (THz) photonic crystal fiber (PCF) biosensor designed for coordinated diabetes detection. The biosensor features an optimized octagonal core with a central air hole and silica background, which enhances light confinement and improves the effective refractive index. Its unique structural configuration ensures higher light-matter interaction, leading to increased sensitivity while minimizing signal loss.

The working principle involves guiding THz waves through the fiber, where biomarker-induced changes in the refractive index are detected and analyzed. The Dilated Causal Convolution with Botox Multi-Head Self-Attention Network (Dil-2CBM-SAN) is integrated to efficiently extract features and classify biomarkers with high precision. Additionally, the Botox Optimization Algorithm (BOA) enhances computational efficiency by tuning network parameters.

Experimental validation demonstrated the biosensor's ability to detect biomarkers at low concentrations with 99.9% accuracy. Comparative analysis with conventional methods showed significant improvements in sensitivity, specificity, and response time. The proposed AI-driven framework offers a real-time, reliable solution for early diabetes detection, contributing to better patient outcomes.

This research introduces a robust biosensor architecture with promising applications in healthcare diagnostics. Future work will explore its adaptability for detecting other diseases and its integration into portable diagnostic devices.

Keywords: Terahertz, Refractive Index, Dilated Causal Convolution, Multi-Head Self-Attention, Botox Optimization Algorithm, Photonic Crystal Fiber, Biosensor, Diabetes Detection.