Title: High-Performance Multiband THz MIMO Antenna for Future 6G Wireless Communications with Machine Learning Validation

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Abstract: This study presents a comprehensive industrial and innovation design along with an in-depth analysis of a THz Multiple Input Multiple Output (MIMO) antenna intended for future 6G communication systems. The antenna utilizes polyimide as the substrate and graphene as the patch material, with copper serving as the ground plane. This design enables the antenna to operate across six distinct frequency bands, making it a multiband antenna. The resonance frequencies of the antenna are 3.512 THz, 4.4448 THz, 6.704 THz, 7.672 THz, 8.664 THz, and 9.672 THz, with corresponding gains of 11.72 dB, 12.59 dB, 13.077 dB, 13.945 dB, 14.77 dB, and 16.028 dB, respectively. To further understand the electrical behavior of the antenna, an RLC equivalent circuit was developed using Advanced Design System (ADS) software. Subsequently, we employed supervised regression Machine Learning techniques following extensive data sampling using CST MWS (Microwave Studio) simulations. The results, highlighted by robust R-squared and variance scores, demonstrate that Extra Trees Regression delivers exceptional accuracy, approaching 98%. Additionally, it achieves the lowest error in predicting resonance frequency.

Key words: Industrial and innovation, THz antenna, Multiple-Input Multiple-Output (MIMO), Graphene, Sixth-Generation (6G), Envelop Correlation Coefficient (ECC), Radio Link Control (RLC)

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