

Title: Performance improvement of THz MIMO antenna with graphene and prediction bandwidth through machine learning analysis for 6G application

Author: Md Ashraful Haque, Redwan A. Ananta, Jamal Hossain Nirob, Md. Sharif Ahammed, Narinderjit Singh Sawaran Singh, Liton Chandra Paul, Abeer D. Algarni, Mohammed ElAffendi, Abdelhamied A Ateya

Abstract: This article provides the findings of a study that integrated simulation, an RLC equivalent circuit, and machine learning (ML) techniques to improve wireless indoor communications clusters with future 6 G applications. The antenna being presented is constructed on a polyimide substrate. It exhibits an isolation of 27 dB and has a bandwidth of 4.331 THz, ranging from 0.631 THz to 4.962 THz. Along with its small size (95.52×227.24) μm^2 , it boasts an impressive maximum gain of 13.3 dB and an efficiency rating of 95 %. The ECC value drops below 0.0002 when the DG goes over 9.99. An advanced design system (ADS) creates a model like the proposed MIMO antenna to compare the return loss caused by CST (Computer Simulation Technology). Subsequently, following extensive data sampling with CST MWS (Microwave Studio) simulation, we employed supervised regression ML techniques. Gaussian process regression demonstrates exceptional accuracy, reaching almost 99 %, as evidenced by the high R-square and var scores. Additionally, it achieves the lowest error, less than one, while predicting bandwidth. The proposed antenna demonstrates strong potential as a formidable contender for 6 G THz band applications, as evidenced by the outcomes of the CST simulations and the prognostications derived from the machine learning techniques.

Keywords: THz, MIMO, 6G, Machine learning, RLC

DOI: <https://doi.org/10.1016/j.rineng.2024.103216>

<https://www.sciencedirect.com/science/article/pii/S2590123024014713>