# PERFORMANCE ANALYSIS OF MASSIVE MIMO ON TERAHERTZ COMMUNICATION


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## Approval for Examination

Scholar's Name: **Abdinasir Hirsi Abdi** Registration No. **60479 (02-244191-015)** programme of Study: **MS(EE),** Thesis Title: **Performance Analysis of Massive MIMO ON Terahertz Communication**. It is to certify that the above scholar's thesis has been completed to my satisfaction and, to my belief, its standard is appropriate for submission for examination. I have also conducted plagiarism test of this thesis using HEC prescribed software and found similarity index **15 %** that is within the permissible limitset by the HEC for the PhD degree thesis. I have also found the thesis in a format recognized by the BU for the PhD thesis.

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**Date: 02-April- 2021**
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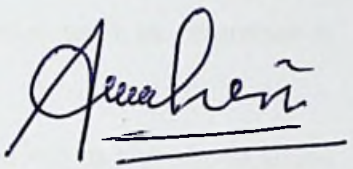
## Author's Declaration

I, **Abdinasir Hirsi Abdi** hereby state that my MS thesis titled **"Performance Analysis of Massive MIMO ON Terahertz Communication"** is my own work and has not been submitted previously by me for taking any degree from this university. **Bahria University** or anywhere else in the country/world. At any time if my statement is found to be incorrect even after my graduation, the University has the right to withdraw/cancel my MS degree.



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# ABSTRACT

Growing mobile traffic demand, wireless technologies must expend mobile wireless capacities. 6G is designed to provide a high standard infrastructure enabling a variety of technologies including fully Artificial Intelligence (AI), Augmented Reality (XR), the Internet of Things (IoT), e-health, smart vehicles and mobile broadband communication. The terahertz band (0.1-10 THZ) communications are expected to be essential to assist in making 6G wireless technology vision conceivable of the next decade. Although THz supporting a high data rate but there are many practical challenges that needs to be addressed. This thesis focuses performance analysis of massive Multiple Input Multiple Output (MIMO) antennas on terahertz bands for 6G wireless technology. We analyze the outdoor performance of massive MIMO systems for two ultra-high frequencies (73 GHz and 100 GHz). The simulation was performed with the Matlab based NYUSIM statistical simulator which gave us an accurate analysis and measurements at millimeter and terahertz wave bands with the carrier frequency range from 500 MHz to 100 GHz.

For designing our model, we considered a physical model because of cost, suitable for simulation and low computational complexity. We specially selected Geometry Based Stochastic Model (GBSM) because of accuracy. Modeling of massive MIMO channels used GBSM model also called Statistical Special Channel Model (SSCM) and the simulation was realistic scenarios. This thesis investigates different transmitters and receivers, LOS and NLOS propagation environment with lower and upper bound T-R separation distance at 50 m to 500 m by using two Ultra high frequencies (73 GHz and 100 GHz) in Urban Micro (UMi) cellular scenario.

The result parameters including omnidirectional and directional Path Loss (PL), omnidirectional Power Delay Profile (PDP), Directional PDP with strongest power, Angle of Arrival (AoA) power spectrum and Angle of Departure (AoD) power spectrum for both LOS and NLOS environment in UMi scenario were compared. The results shows that line of sight environments provides better received power due to power is concentrated in one direction rather than distributing the same power in different directions and PL are too high in NLOS environments. The AoA and AoD we found different lobes of signal power spectrum which help wireless designers to get an information of antenna arrays and beam steering algorithms to select maximum strength of the signal. The investigation frequencies (73 GHz and 100 GHz) are a key component for technologies on 6G wireless communication.

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