

## ABSTRACT

This research explores the application of Multiple Input Multiple Output (MIMO) technology in Future Railway Mobile Communication Systems (FRMCS). MIMO technology is known to increase capacity and spectrum efficiency, enabling high-speed data transmission and reliable communication in congested environments such as railways. The objective of this research is to evaluate the optimization of MIMO antennas at 1900 MHz frequency and meet specific communication needs in railway operations, focusing on improving user experience and system efficiency.

Furthermore, this research uses Simulink as software to generate and process the initial signal. This process involves basic signal generation and modulation using the Quadrature Phase Shift Keying (QPSK) block diagram as per the required specifications. The modulated signal is then processed through the High Power Amplifier (HPA) block to ensure adequate transmission power before being sent via the USB interface to the Software Defined Radio (SDR). This allows the SDR to transmit Radio Frequency (RF) signals configured via Simulink.

In this research, the MIMO antenna is arranged using a microstrip antenna with FR-4 substrate material, which has 4 elements consisting of a 2-patch array arrangement. This antenna can meet the working frequency parameters for 1900 MHz-1920 MHz, with sufficient bandwidth. Based on testing, the antenna has a unidirectional radiation pattern with elliptical polarization and has a gain of 5.256 dBi. This research is expected to make an important contribution to the development of FRMCS communication systems as a more efficient and reliable future solution for safety, as well as the overall operational efficiency of trains.

**Keywords:** Future Railway Mobile Communication System (FRMCS), microstrip antenna, Simulink, Software Defined Radio (SDR)