

## ABSTRACT

*In the modern era of mobility, advancements in telecommunications technology in the railway sector present a challenge that demands innovative solutions. As railway technology evolves towards high-speed trains, there is a critical need for enhanced telecommunications technology. The transition from Global System for Mobile Communication for Railway (GSM-R) to Future Railway Mobile Communication System (FRMCS) offers increased capacity, performance, and communication flexibility to meet growing connectivity demands. This transition is crucial given the frequent complaints from high-speed train users about unstable telecommunications networks while in motion.*

*Multiple Input Multiple Output (MIMO) technology emerges as a promising solution to enhance wireless network performance in the high-speed railway sector. MIMO systems involve multiple antenna elements serving as transmitter (Tx) and receiver (Rx) antennas. MIMO antennas are effective in facilitating the transition of telecommunications technology from GSM-R to FRMCS, primarily due to their superior network capacity.*

*In our final project, the design of MIMO antennas employs a 1x4 Array technique with 4 ports to achieve robust network capacity. The antenna dimensions are tailored to fit the poles along the high-speed railway tracks. Additionally, an inset feed method is applied to maximize the specified performance parameters of the designed antennas.*

*Designing a 4-element MIMO antenna using a 1x4 array technique resulted in an antenna that operates at a frequency of 1900 MHz for cellular communication. Measurement results of the designed antenna show a gain of 4.2-5.33 dBi, elliptical polarization, unidirectional radiation pattern, and bandwidth of 200-310 MHz. The designed antenna meets the specified requirements according to existing regulations.*

*Keyword: Future Railway Mobile Communication System (FRMCS), MIMO, antenna microstrip, Simulink.*