

A MIMO-OFDM Channel Sounder for High-Speed Railroad Applications

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The communications requirements of railroads have increased dramatically in recent years in order to meet ever more demanding goals for safety and efficiency in the face of increasing congestion and higher speeds. In the near future, schemes such as GSM-R will give way to more sophisticated schemes based upon MIMO-OFDM technology that will provide higher throughputs and capacities than existing systems and provide the means to offer more capable and sophisticated services.

Specification of a MIMO-OFDM technology that will meet the requirements of high-speed rail applications will require models that capture our knowledge and understanding of the propagation impairments that degrade the performance of MIMO-OFDM systems in representative environments. Although various groups have developed numerous such models, none of these models address the unique morphology of the railway environments. Four particular cases of interest include level grade, bridges and trestles, cuts and tunnels.

Measuring the characteristics of wireless channels in railroad environments is complicated by restrictions on the size and nature of the equipment that can be carried aboard operational trains. In response, we are developing a MIMO-OFDM channel sounder that is based on Ettus Research's USRP (Universal Software Radio Peripheral). Here, we present the specifications for our channel sounder, details of its implementation, results of tests that we have conducted to verify its performance both in the lab and in the field and plans to use the instrument to characterize the wireless propagation environment at selected locations along the Zhengzhou–Xi'an High Speed Railway, also known as the Zhengxi Passenger Line, a high-speed railway line connecting the cities of Zhengzhou and Xi'an, in the People's Republic of China that went into operation on February 6, 2010.