

# **Design of Matrix phased array ultrasonic transducer for the Construction of 3D images at rail defects**

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The railway is the main means of transportation for passengers and freight. The train derailment can occur due to rail failures and defects. It is very important to inspect rail defects to prevent the train derailment. The orientation of defects at rails is classified into longitudinal and transverse direction. Among different nondestructive testing methods, the ultrasonic testing method is widely used to inspect internal defects of rail. In the ultrasonic testing methods, There are multi channel ultrasonic testing using single piezoelectric element and phased array ultrasonic testing using linear array elements. It is difficult to inspect longitudinal and transverse defects of rail by using linear phased array ultrasonic testing. Therefore, it is need to application of matrix phased array ultrasonic transducers for inspection of both directional defects. In this study, appropriate design parameters were selected by taking into account geometry of rail and analyzing beam directivity of phased array ultrasound in longitudinal and transverse directions, respectively. Simulation of phased array ultrasonic beam field with the designed parameters were conducted by using CIVA software. The results of beam field simulations were analyzed and compared with matrix phased array ultrasonic transducers with different design parameters. Simulations of the detection of longitudinal and transverse defects in the rail were performed.