

Defect recognition method for Magnetic leakage detection in oil And gas steel pipes based on Improved neural networks

ABSTRACT

The aging infrastructure of petroleum and natural gas pipelines poses a threat to national economies, necessitating precise defect detection for safety and efficiency. To enhance the accuracy of predicting pipeline defect sizes, this study introduces a magnetic leakage detection system, employing Backpropagation (BP) neural networks optimized with genetic algorithms. Traditional BP networks face challenges, including parameter determination and slow convergence, addressed through genetic algorithms' global search capabilities. Simulated data are generated using ANSYS software by using models of semi-circular defects in steel pipes, producing magnetic leakage signals of varying intensities. MATLAB was used to construct both standard BP and genetically optimized BP neural networks. Results show that the latter significantly reduces computational errors, demonstrating improved accuracy in defect dimension prediction. The approach contributes to overcoming nonuniqueness in the recognition process and the complex nonlinear relationship between magnetic signals and defect size parameters. The study offers a guided approach for selecting BP neural network parameters, enhancing practicality. Simulations validate the method's effectiveness, indicating low workload and high reliability. This research provides a meaningful advancement in the detection of defects in long-distance pipelines, impacting the safety and efficiency of petroleum and natural gas transportation.