**Rayleigh wave based characterization of Rolling Contact Fatigue micro-cracks array using Machine Learning**

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Abstract:

Rolling Contact Fatigue (RCF) cracks occur due to cyclic loading of the material, which causes flaws like cracks on surface of railroads, gears, and other components involving rolling or sliding contact. These cracks typically occur in an array and over time cause pitting and spalling of material. Using FEA model of such common array of cracks surface acoustic waves simulation was conducted to characterize RCF fatigue damage. The scatter field of Rayleigh waves shows harmonic behavior of transmission coefficient (Tc) as a function of receiver distance from array cracks, making it challenging for identifying the depth and number of cracks in the array. A multi-output decision tree regressor was trained on the extracted features to predict the depth of cracks and number of cracks in an array. The input for the regression model was a loss of correlation (Locor) feature matrix. The features in the matrix are the function of receiver position from the cracks cluster. It has been shown that the model predicts depth <500µm and 3 to 7 cracks in a cluster with accuracy > 90%. The effect of signal-to-noise ratio (SNR) on the data has also shown the robustness of the model. MSE and R2 have been reported for depth and cracks number from the validation set.