Rolling Contact Fatigue Crack Depth Characterization in Rails Using Electromagnetic Field Imaging Technology

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Effective rail maintenance strategies are vital for controlling and managing rolling contact fatigue/damage (RCF/RCD) and reducing wear of rails especially for the railroads who are operating under heavy axle load (HAL) conditions. RCF in rail is primarily a result of the interaction of railway wheels with the railhead. It poses a significant burden on track maintenance and also causes issues during the regular ultrasonic testing of rails. Nondestructive evaluation (NDE) technologies that can perform an accurate and efficient assessment of rail surface cracking while remaining insensitive to flaking and spalling are sought. The ideal NDE technology would be non-contact, real-time, and in-motion capable. This paper discusses the evaluation of an electromagnetic field imaging (EMFI) NDE technology for RCF crack depth characterization. Several in-motion tests were designed in MxV Rail's railway track to evaluate the repeatability, RCF crack detection and depth accuracy, and speed capabilities of the EMFI technology. The test results obtained demonstrated EMFI technology in-motion capability to measure RCF crack and pit depth and a good correlation to the defect depth measurements as verified by destructive testing. Defect depth measurements correlated well at speeds from 8 kph to 24 kph. Additionally, methods of compensating for the effects of changes in rail head profile and rail metallurgy were also demonstrated.