Online-Monitoring of Hollow Axles Using Ultrasound

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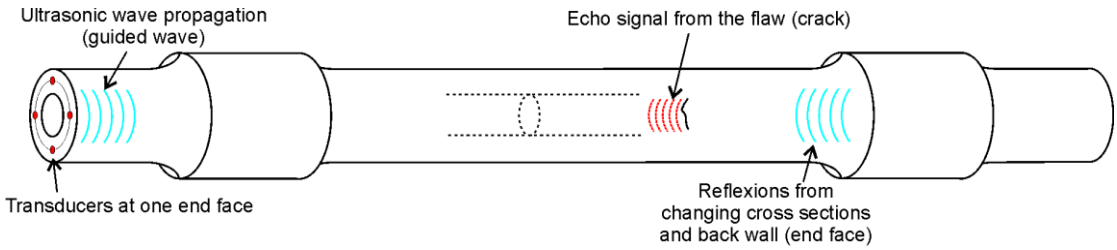
Abstract

The structural integrity of wheelset axles of high-speed trains as well as freight wagons is of major importance for the safety of rail transport. Up to now the inspection of wheelset axles is part of a periodic maintenance which is expensive due to long inspection times and highly influenced by the human factor, especially if those inspections are carried out during night time. Permanently installed Structural Health Monitoring (SHM) systems at each axle would be able to monitor the structural integrity and could reduce the maintenance effort. However, due to mechanical constraints, requirements, and regulations, the mounting options of such SHM-systems are limited. Approaches with ultrasonic transducers mounted at one end face of the axle can excite guided waves and could be able to monitor the entire component from only one sensor position.



The geometry of the axle with many cross-sectional variations results in reflections and changing dispersion relations along the wave propagation direction and lead to complex wave propagation problems hiding flaw echoes. Thus, echo signals are difficult to interpret and correlations between echo signals and flaws are hard to reveal.
In the contribution, we present a signal processing approach to extract information on the structural integrity from ultrasonic guided wave echo data. On a mock-up, we could show that the suggested method is able to detect a crack growth reliably. Based on the knowledge of wave propagation and on results from numerical simulations, classification algorithms are developed and applied to additionally enhance the prediction accuracy of crack size and position.

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