

Development of NDE 4.0 Technology for Railway Industry

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With the strategy transition from planning-based maintenance to condition-based maintenance for train crucial parts, higher requirement for NDE techniques on aspect of condition monitoring and fault detection methods are expected. The NDE 4.0 is one digitalization system combined innovation NDT technologies and industry 4.0 technology, such as the Artificial Intelligence & Internet of Things technology (AIoT) based on 5G and AI, machine learning (ML) , which is employed in big data mining and modelling analysis for railway maintenance, plays a vital role in railway safe operation. For the case of the detection and monitoring of running parts of the train, traditional single inspection or monitoring method is hard to offer necessary information for the use of train safety evaluation accurately and efficiently. The manuscript takes the wheelset as an example based on NDE 4.0, describes the study and application of wheelset flaw detection technology system as flowing parts: (1) NDE4.0 technology framework system, explaining the important role and value of digital migration; (2) wheelset flaw mechanical model and digital ultrasonic flaw detection technology. (3) Innovative study on intelligent flaw detection system, such as the use of advanced imaging algorithms to obtain defect morphology, AI-based assisted wheelset flaw evaluation, etc.; (4) Cloud inspection technology based on NDE4.0, including remote control of equipment and cloud diagnosis of data; (5) The Digital twin is studied to achieve the performance trend analysis and life prediction of key train components. Keyword: NDE 4.0, digitalization, intelligence comprehensive inspection system; trend analysis and life prediction