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WEAR MONITORING IN THE WHEEL-RAIL INTERFACE: A REAL-TIME APPROACH

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Summary: Wheel-rail wear is an important maintenance factor regarding rail transport systems. It takes a particularly onerous form in tram operations due to the intensive nature of the operation (frequent acceleration and braking, small radius curves, small wheel diameter, poorer track maintenance etc.). The methods currently used to measure wheel and rail wear in actual use consist of measuring the effects aggregated over a certain period of time or a certain mileage (i.e. Archard method, wheel profile measurements). However, using those methodologies we are not able to point out its causes and relate them to specific vehicle operating conditions. One of the numerous numerical models can be used for this purpose, but the inherent simplifying assumptions, big computational effort or complex validation process make them limited in this application. This work presents a new method for real-time wear measurement on a rail vehicle using thermal imaging and deep neural networks. The idea is to combine the temperature distribution at the wheel-rail interface with an index of instantaneous wear intensity, and subsequently comparing this value to specific driving conditions and location on the track network. It is worth noting that this measurement method is completely non-invasive, as it only requires the installation of a thermal imaging camera and its additional accessories. The developed measurement system also allows automatic identification of the type of wheel-rail contact to one of the predefined classes. The system is based on algorithms using deep neural networks trained on a dedicated roller rig replicating actual driving conditions and measurement results from field experiments. The results of the wear intensity measurements and identification of the type of contact are subsequently plotted on track network maps, providing easy-to-read support tool to the staff of rail system operators in making decisions about operating conditions and planning maintenance processes.The first tests of the system in real-life operation, demonstrated the validity of the adopted methodology for the estimation of real-time wear intensity of tram wheels. The highest estimation accuracy was noted for the extreme wear regimes (mild and catastrophic).