Dipl.-Ing. Christoph TUSCHL
Mining University of Leoben
Chair for Automation
Peter-Tunner-Straße 25
A-8700 Leoben
Austria
e-mail: christoph.tuschl@stud.unileoben.ac.at

Christoph Tuschl is a PhD student at the Chair of Automation of the Mining University of Leoben in Leoben, Austria.

QIRT-2024-061
ABSTRACT
PRESENTATION
PAPER

Priv.-Doz. Dr. Beate OSWALD-TRANTA
Mining University of Leoben, Chair for Automation, Leoben, Austria
Dr. Sven ECK
Materials Center Leoben Forschung GmbH, Leoben, Austria
David KÜNSTNER
Voestalpine Rail Technology GmbH, Leoben, Austria
Peter DORNIG
ÖBB-Infrastruktur AG, Graz, Austria

A NOVEL APPROACH TO CREATE A RAIL SPECIMEN WITH SURFACE CRACKS FOR THE CALIBRATION OF AN INDUCTIVE THERMOGRAPHY INSPECTION SETUP

Predictive maintenance is a key factor in the railway industry to ensure traffic safety as well as sustain traffic schedules. If defects on a railway component are found in their early stages, proper maintenance work can be planned, and this is often the deciding factor between repairing or replacing this component. Thus, methods for non-destructive testing (NDT), which can detect surface and/or subsurface anomalies in materials of railway components, are widely used in the railway industry. However, the emergence of new materials challenges the established NDT-methods, so that improvements or new methods are needed.

Induction thermography is a method for the detection of surface defects in steel components. In previous work it was shown that this method is applicable for manganese steel, which is used for premium grade turnout frogs in the Austrian railway system. This material has preferable mechanical properties, however ultrasonic and eddy-current testing, two commonly used NDT-methods in this industry, are not applicable. During an induction thermography measurement, the specimen is heated ($\Delta T < 10$ K) with a short inductive pulse ($t \leq 1$ s) and the surface temperature is recorded with an infrared camera. The resulting image sequence is evaluated via pixelwise Fourier transform to create a phase image. In this image the phase values surrounding the detected crack correlate to its penetration depth and angle. Hence, static inductive measurements can be used to estimate the depths and penetration angles of surface cracks, a major advantage of this method. However, to estimate these parameters with sufficient certainty, a specimen with defined surface cracks is needed to calibrate the method for a specific steel grade and setup.

At the chair of Automation and Measurement wire eroding is one commonly used method to introduce defined cuts into a specimen and thus creating a calibration body for inductive thermography. Since the method cuts the material with a wire, the resulting cuts have an opening with at least the diameter of that wire. With increasing spatial resolution of infrared cameras this becomes an issue, as the infrared camera also records the temperature differences at the bottom of the cut, which would not be the case with real cracks. Methods for creating defined and crack-like defects are available, but in most cases, they are very expensive or not applicable for railway components.

This work presents a novel approach to create defined cracks in such a calibration body for characterising surface cracks in manganese railway rails and turnouts. Wire eroding was used to introduce 80 defined cuts with specified depths and inclination angles at both gauge corners of a one-meter-long manganese rail piece. The cuts resemble defects which commonly occur in railway components due to rolling contact fatigue (RCF). The used wire had a thickness of 0,3 mm. To create a sample with defects that better resemble the real RCF defects in track, a method has been developed to close the surface cracks. The rail with the EDM cuts was rolled over in a 1:1 wheel-rail test rig at voestalpine Rail Technology GmbH. The cuts on one gauge corner of the rail were rolled over with defined loads, whereas the cuts on the other side of the rail remained unchanged. The 1:1 wheel/rail test rig is usually used to simulate specific RCF damage patterns from the track in the laboratory. Parameters such as rolling speed, vertical and horizontal loads and slip are set by the operator.