# Overview

A first prototype for the validation of the technology has been constructed with the required integration and communication between the involved components and software tools. The adjustment of the hardware, software and electrical parameters was performed in order to maximize the detection of the cracks. Obtained results from the demonstrator gave very good results and thus a successful validation of the technology.
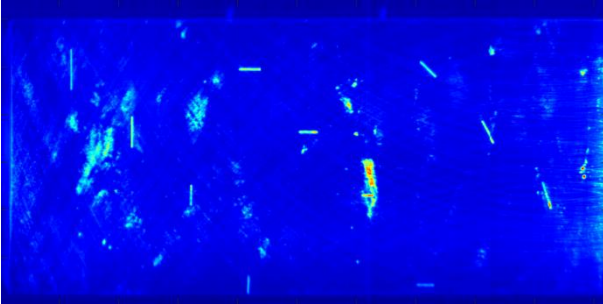
A demonstration event was carried out in Asturias, Spain (at the end user facilities, TAM), to show the suitability of the system to detect surface defects through an automated and faster solution. The goal was also to show the potentiality of the system to the train maintenance companies and related train transportation sector companies. They could evidence the usefulness of the technology as a surface crack detection system, that may replace the current visual inspection and other surface inspection technologies, reducing inspection times and thus increasing productivity.
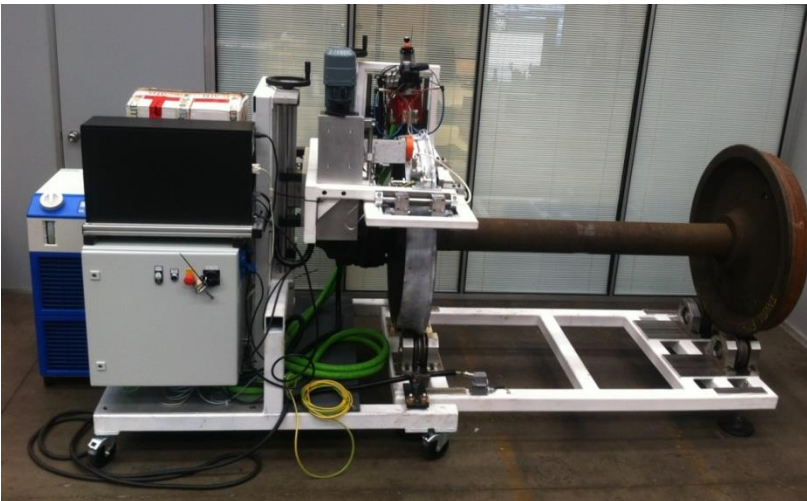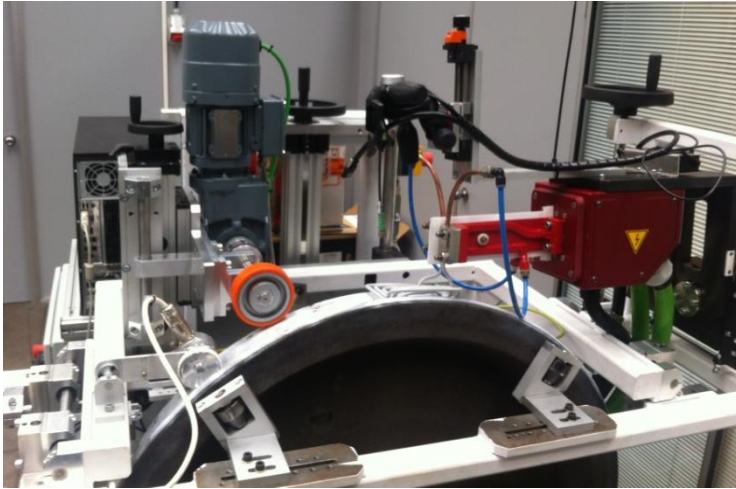
The trainwheels solution as a system for the early prediction of cracks of wheel manufacturers will make possible to repair them or improve altogether the new ones, with expected savings of up to 25%. The controlled heating and feedback by the infrared camera and the coupled software, makes the system to run under efficient parameters and operating costs. Sales forecasts for the period 2017-2021 have been estimated in terms of units and in terms of revenue for the three types of target customers.

Validation results

The first results showed a promising detection potentiality. There the differences between a clean wheel (brushed wheel from FhG) and a very used wheel with natural cracks are observed (Figure 1).
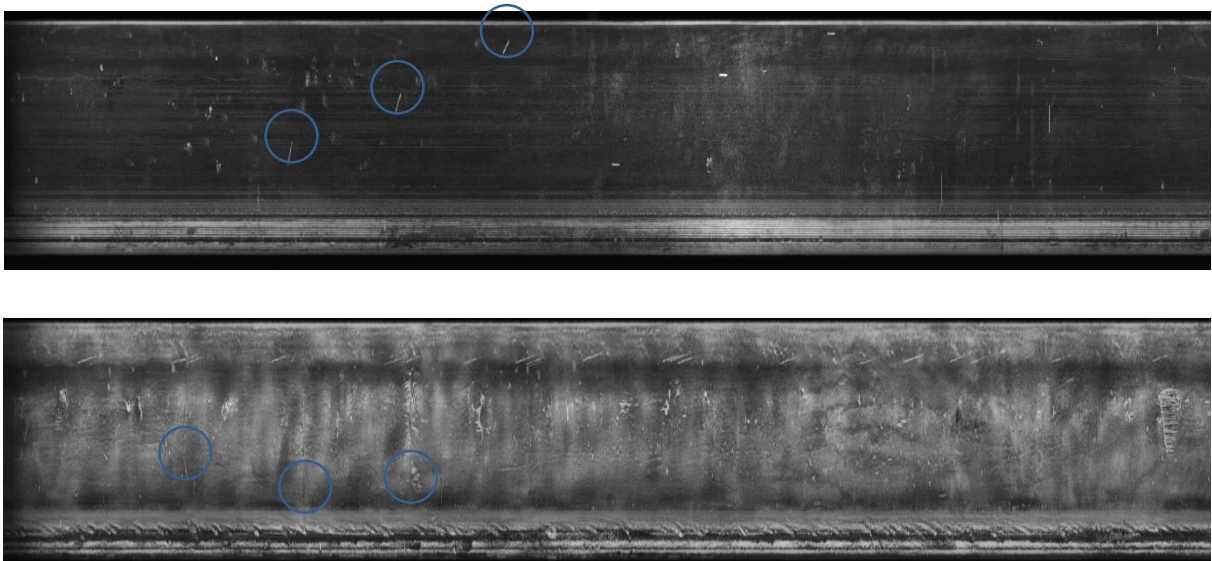

Figure 1: Acquisition images FhG wheel set (top), TAM wheel set (bottom), defects blue.

The smaller and sharp-edged defects of the creprofiled wheel set generate a much better thermal indication than the defects of dirty wheel set. The reason therefore is that the sharp-edged defects are leading to a higher eddy-current density and thus to more heat generation at the defect. Nevertheless, the Trainwheels thermography system is able to detect the cracks on both wheel sets. Figure 2 shows a comparison of the result images of the two wheel sets, evaluated with identical evaluation parameters. The red markers are indications classified as a crack, the yellow markers are indications which were detected by the software but not classified as crack. The reference cracks are marked blue. In Figure 2 can be also seen, that the pitting around the surface of dirty's wheel set produces a lot of false indications, because the edges of the small pitting craters act like a crack. The false alarms in the flange area of the reprofiled wheel set are caused by 0.5 mm to 1 mm deep rills from the lathe form feed.
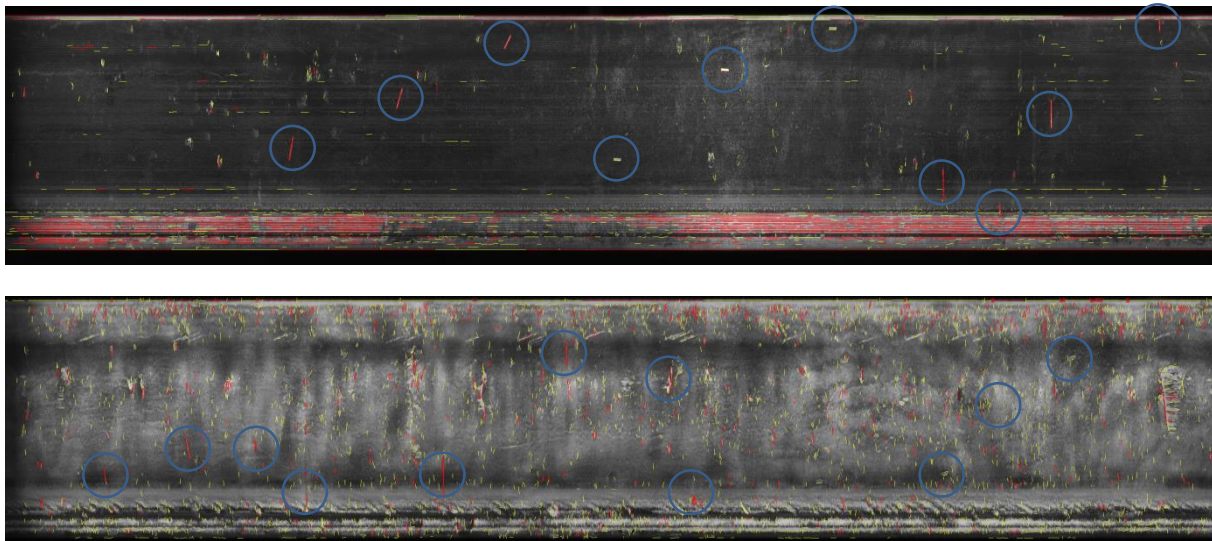

Figure 2: Result images profield wheel set (top), and dirty wheel set (bottom)[1].

The evaluation software allows decreasing the rate of the false alarms by setting up these parameters more coarse. As demonstrated in the figure it is possible to eliminate most of the false alarms in the flange but to keep the defects. In the context of the detection possibilities on the dirty wheel set should be mentioned that railroad experts told, a wheel set like the one that was used for the tests at TAM's facilities shows the worst case and in common a wheel set like this would never be inspected without t re-profiling before.

About the reproducibility of the Trainwheels thermography system can be stated that the reproducibility of the crack detection is given. In about 30 tests during the testing period the all cracks were detected when the system was set up correct and the cracks were representative for natural cracks. There is only a slight unsteadiness in detecting radial cracks on the tread when the cracks are 100 % parallel to the side faces over their complete length.

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[1] Due to the fact that the cracks are very small in relation to the wheel dimensions and that in this report all thermal images are scaled down it might happen that some features markers or indications are lost because of the printing resolution.