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Cargo Wagon Structural Health Estimation Using Computer Vision

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Concept

Fig 1. Camera bridge with passing cargo wagon.

To guarantee the safety of their operations, European railway companies need to maintain their assets regularly.

The proposed system aims to automatically deliver useful and timely insights on wagon health during normal operations. With this, the maintenance needs can be diagnosed without interrupting the normal process.

The proposed overall system consists of four stages. First, a camera bridge for the acquisition of cargo wagon images. Second, object/ROI identification stage. Third, A wagon health estimation stage. Lastly, a decision support system.

The results of this paper cover the first two stages of the concept.

Camera bridge (Image acquisition)

The camera bridge was installed near a hump yard in order to scan the wagons passing by at lower speeds before being resorted (See Fig 1).

The scan acquires one image of the top of the wagon and two of each side. The lateral images consist of one upper image (See Fig 2.) focusing on the payload and one lower image focusing on the wheels, brakes, frame and other structural components. A lateral stretching is caused by the acceleration of the wagons going downhill.

ROI identification

Twelve different objects were selected and labelled for wagon identification or for further diagnostics. Later on, Multiple object detection models were trained taking into account the stretching on the acquired pictures as well as the environmental photometric distortions.

Results

The trained algorithms can detect the labelled objects even with the mentioned challenges. Results of the models mAP_{50} are presented in Table 1. All objects except of the maintenance plate have detections performance higher than 90%. The plates location, size and lack of features pose problems for the current models.

Model	Objects	mAP_{50}
Cascade RCNN-Resnet-101	All	0.652
Cascade RCNN-Resnet-101	Bumper	0.956
Cascade RCNN-Resnet-101	UIC ID	0.936
Cascade RCNN-Resnet-101	Plate	0.366

Table 1. Results for Cascade RCNN Detectors.

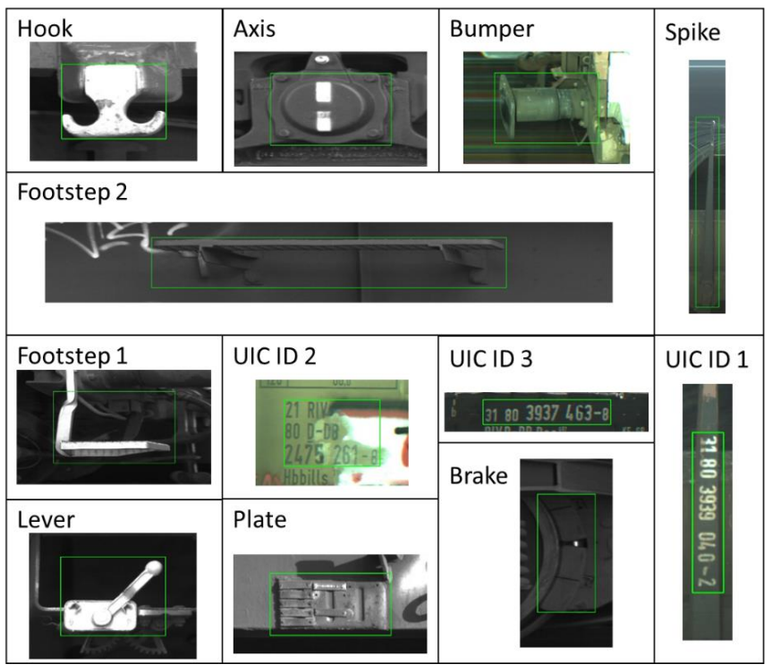

Fig 3. Detected objects/ROIs.

Outlook

The obtained results prove the viability of camera bridge acquisition techniques as well as the use of computer vision techniques to extract objects of interest to improve the maintenance process.

Next steps will focus on detecting anomalies and defects on the recognized objects, as well as their evolution over time. The interfaces of the decision support system will also be tackled.

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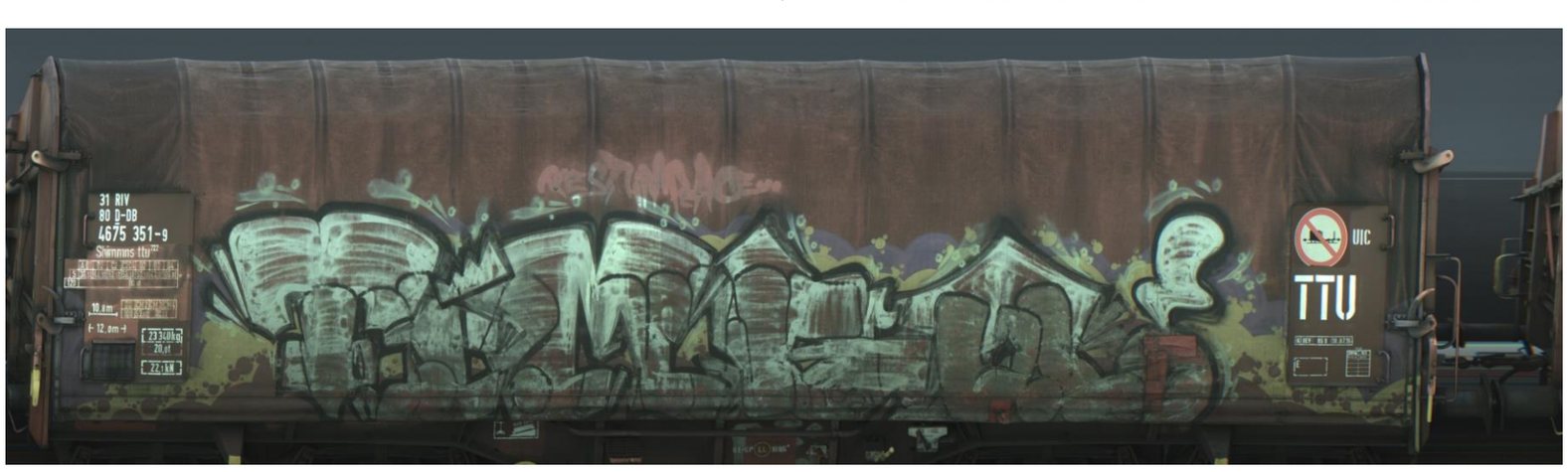

Fig 2. Image acquired by camera bridge.

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