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PantoSystem helps Siemens getting ready for the implementation of eHighway on German Motorways

The customer

The German government has introduced several initiatives to promote overhead contact lines for trucks, also known as eHighway. This solution makes road freight transport more energy efficient and environmentally friendly[1]. The latter point is especially important and urgent, as the German government´s climate protection plan calls for reductions in CO_2 emissions by 40% from the transport sector by 2030[2]. Since 2018 the Ministry of Environment in Germany is funding field trials of the eHighway system on real highway[3]. The challenge is to ensure that operations of this solution can be scaled up, which the users will be much more numerous as well as diverse. To prepare for this, the experience and solutions from PantoInspect were called upon.

Germany's transport ministry has announced the scaling up phase of eHighway in Germany. Analysis from among other Germany's National Platform for New Mobility (NPM) show that electrifying 4.000 km of motorways by 2030 is a cost-effective way to reach the climate targets. Analysis also shows the potential benefits of expanding the concept to neighboring countries such as Denmark and Sweden[4]. Ultimately, as contact line technology is in global use and climate change is a global problem, the objective is to spread the eHighway concept to the rest of the world.

Since the eHighway project has come very far in the technical development stage, the team is now part of Siemens Rail Infrastructure, the division responsible for electrification of rail, and now also road. The eHighway project started in 2010 with the aim of developing two main components, namely the catenary system for use on motorways and pantographs for electrified trucks. In 2017, Siemens Mobility was commissioned up to €15 million ($16 million) by the German state of Hesse to build a 10 km overhead contact line for electrified road freight transport on a motorway. The eHighway project, which was part of one of the first three test tracks on a German motorway, running between the interchange Mörfelden (close to the Frankfurt airport) and the interchange Weiterstadt (close to Darmstadt).

The challenges/problems

An important task to the eHighway team was to find a pantograph monitoring solution which was suitable for electrified trucks that could be connected to the overhead contact line. It was important for the team to have a system that could inspect the pantograph of the trucks to ensure the availability of the catenary system on the highway. Therefore, the eHighway team was looking for an inspection system that could help them detect defect pantographs to prevent potential damage

[1] https://www.bmvi.de/SharedDocs/EN/Dossier/Electric-Mobility-Sector/electric-mobility-sector.html
[2] https://www.oeko.de/fileadmin/oekodoc/Climate-friendly-road-freight-transport.pdf
[3] https://ec.europa.eu/jrc/sites/jrcsh/files/20201028_eu-hgv-workshop_sue_public.pdf
[4] https://www.linkedin.com/posts/steen-n%C3%B8rby-nielsen-5736886_tysklands-transportministers-klimaplan-for-activity-6732401194108620800-6Ybn

of the catenary system. They also needed an inspection system that could help them detect if the pantograph is in an operating state and check that wear on the carbon strips was within acceptable range. In additional, making sure that the pantograph had no other mechanical deformations that could potentially damage the catenary system. One of the main challenges was to find a pantograph monitoring system for electrified trucks, which could be installed above an overhead line in the highway environment. Electrified trucks do not have metal wheels, and therefore two pantographs are needed to establish two electric poles which they can draw the power from. For this reason, pantographs on electrified trucks normally have four carbon strips and two overhead contact lines, unlike a train pantograph, which usually has two carbon strips and a single overhead contact line. Since the pantographs on the trucks contain more parts, the monitoring system required more sensors and technology than the usual system used for railways to ensure that the truck can leave the electrified lane and connect to it again.

Figure 1: PantoSystem installed on first eHighway test track in Germany

The solution

To ensure a high availability of an eHighway, it is important that no defective or worn-out pantographs will contact the overhead contact line. Since the operator of an eHighway System has no direct influence on the technical condition of the participating vehicles, it is very important to monitor the technical conditions of the connected vehicles. Siemens Mobility evaluated the Pantoinspect sensor system at the eHighway test facility in Groß-Dölln because the combination of camera and laser scanner provides the necessary basic requirements, for checking eHighway pantographs. With the results of the laser scanner, the geometric dimensions of the pantograph can be verified and compared with the limit values stored in the Backend Monitoring System. Critical wear and tear as well as geometrical deviations can be detected and transmitted to the

operation and control center. If necessary, an operator can use the high-resolution camera images to verify a detected deviation and inform the user that his pantograph is damaged, and the use of the overhead line is no longer permitted. The evaluation showed, that for a later series production some potential for optimization will be necessary, however the main task can be fulfilled with the PantoInspect portfolio.

Werner Pfliegl, Product Management of Siemens Mobility GmbH, Germany said: "PantoInspect was chosen by the eHighway team because the company has the advanced technical expertise and many years of proven track record in supplying some of the major infrastructure owners and rail operators in the global railway industry. The PantoSystem was very beneficial for the eHighway project since the team considered it as an all-in-one system that combines both a camera system and a laser system".

Figure 2: eHighway trucks with new pantograph design on German highway roads

The eHighway team also believed that the software was very good at providing statistical data to give the operator a detailed overview of the condition of the pantograph. PantoInspect carried out a lot of research and development to build up a model which was able to recognize every part of the pantograph on electrified truck correctly. The triggering system was also challenging in the beginning since the data on the speed of the vehicle needed to be found through the laser scanner itself to trigger the camera system correctly. However, PantoInspect managed to make extensive modification on both the hardware and software to meet the requirements of the eHighway project. The laser scanning device of the PantoSystem helped the team to build 3D models of the pantographs, which detected the working condition of the pantograph. The camera system was also used as a back-up system to help the operator verify potential pantograph defects. They also believe that the system can help the owners of electrified trucks to get data on worn out pantographs and ensure less maintenance of the catenary system as well as reduce the risk of damaged overhead contact lines. Siemens Mobility sees many advantages in using the PantoSystem for future applications in both electrified trucks and railways to help prevent an

installed technical base from any type of damage. The team also see many future potentials in using the PantoSystem on 1000s of km of electrified tracks on motorways to evaluate the condition of the catenary system and for maintenance purpose. The system could potentially also help the BAG (Bundesamt für Güterverkehr) to identify electrified truck with defect pantographs, during their regular inspections, and thereby maximize safety on the highways. The PantoSystem can help Siemens offer a complete solution which includes both the identification of trucks as well as detection of defect pantographs, and thereby add great value to the company. This fits very well with PantoInspect´s vision of creating environmentally friendly solutions for both electrified railways and trucks.

About PantoInspect

PantoInspect was the first company world-wide to develop an automated pantograph inspection system, in partnership with Banedanmark, the Danish railway infrastructure manager, around 2008. Today, PantoInspect is one of the world's most recognized and respected brands, and a market-leading manufacturer and supplier of automated and real-time Wayside Pantograph Monitoring systems to the global Railway industry. We have supplied several pantograph monitoring systems to some of the world's leading infrastructure managers and rolling stock operators such as Deutsche Bahn, RATP, Infrabel, Sydney Trains, Network Rail and TRA.

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