Fewer malfunctions and lower costs thanks to smarter maintenance model

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Credit: University of Twente

Researchers at the University of Twente have developed a mathematical model for improving the maintenance schedule for trains, rails, aircraft, self-driving cars, robots and nuclear power plants.

This new model ensures greater reliability and lower costs. Dennis Guck of the UT Department of Formal Methods and Tools recently earned a PhD based on this study.

Maintenance is essential for keeping trains, rails, aircraft, self-driving cars, robots and nuclear power plants in good operating condition and for preventing malfunctions. Researchers at the UT Department of Formal Methods and Tools have developed a new mathematical model for mapping the benefits and costs of maintenance procedures. The model can help organizations to decide which maintenance procedures are essential, and to identify procedures where they can save money and resources. Several organizations have already deployed the model, including ProRail, the Dutch national railway maintenance organization. ProRail's Martijn van Noort had this to say: "We used the UT model to project the maintenance benefits of introducing a new product. It enables us to conduct more reliable cost/benefit analyses, and it's part of the ExploRail programme."

The model

Maintenance is expensive. Organizations such as ProRail, the Directorate-General for Public Works and Water Management and KLM spend millions on maintenance activities annually. For example, ProRail uses special trains for levelling tracks. The tracks are not available while this maintenance is being carried out, which makes the work costly. However, cutting back on maintenance results in a shorter service life for the tracks and more frequent disruptions. Unplanned failures and defects are even more costly than preventive maintenance. Moreover, maintenance is crucial to railway safety. The benefits and costs of maintenance must therefore be carefully weighed.

Operation

Dr Mariëlle Stoelinga, who was Dennis Guck's PhD supervisor, explains how the model works: "Traditional models tend only to look at the cost of maintenance, or at the implications of wear and failure. Our model combines both factors, meaning you can make better decisions. This model combines three ingredients, and it is based on models that describe system component wear and tear: how quickly do system defects occur in the absence of maintenance? And how does maintenance contribute to preventing failures? We developed a probability model to find answers to such questions. Based on this information, we can then predict the impact of component wear on the overall system. Finally, we use advanced probability calculations for the costs and benefits; the University of Twente is the world's premier institution in the field of stochastic model checking. Together, these three factors result in a system that enables maintenance engineers to optimize their activities."

Provided by University of Twente

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