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D I G E S T

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Monitoring the resilience of railway track infrastructure

A study assessed the use of sensors to monitor railway track infrastructure to determine the performance of different track components during extreme weather events. It concluded that energy efficient transmission mechanisms must be developed to provide reliable and consistent communication to improve track monitoring for condition-based track maintenance.

Railway systems play a key role in modern transport systems by quickly and safely moving cargo and travellers. An increase in the demand to move freight and passengers at a time when the climate is changing means that railway infrastructure needs regular maintenance.

The number and frequency of extreme weather events (e.g. high temperature, icing and storms) are likely to increase in magnitude and frequency. These could result in derailments caused by tracks buckling and other dangerous situations developing (e.g. flooded tracks, landslides and weakened track beds).

While railway inspections are carried out on a regular basis, there can be some delay in detecting and rectifying a fault. Therefore, the railway industry needs to improve the efficiency of track maintenance procedures. Condition monitoring of rail infrastructure is becoming important in determining proper predictive maintenance – before defects occur and failures happen.

The use of automated monitoring can reduce the need for visual track inspection. A number of wired sensor systems exist (e.g. accelerometers, strain gauges, acoustic emission and inclinometers). Wireless sensor systems have been used to provide real-time monitoring and alerts to prevent rail track damage and failure. These can improve track maintenance decisions based on failure prediction rather than on routine operations or after a track failure.

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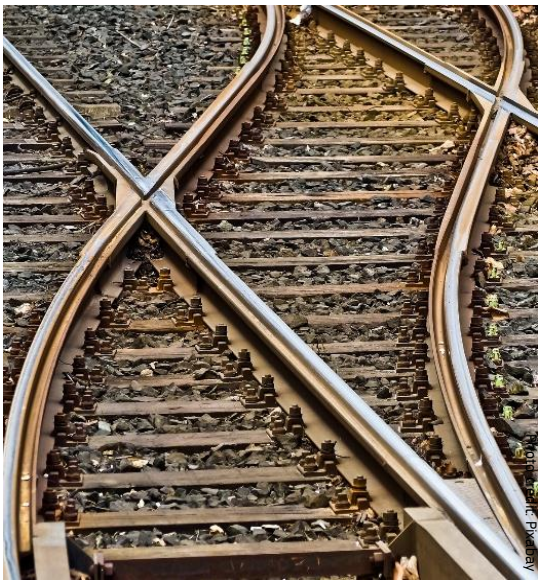
Monitoring the resilience of railway track infrastructure

The aim of railway track monitoring is to identify possible damage, provide real-time conditions, improve safety and reliability, and to shift scheduled and preventive maintenance to future predictive maintenance.

The study reviewed sensors used in rail infrastructure monitoring and found that wireless sensor networks have been used instead of conventional wired systems as they provide benefits with regard to cost and ease of installation.

While wireless sensors perform well in extreme weather events, the transmission process from sensor to base station requires a high amount of energy.



Wired	Wireless
Sensors are physically in contact with the structure, hence the determination of the exact position of damage is expected.	Sensors are not in contact with the structure, thus damage detection is accomplished with less accuracy than for wired systems
Greater number of sensors is needed. The wired system can become significantly complex.	Number of sensors is minimized, and their installation can be easier.
Cables can be damaged easily due to human errors or weather conditions. Hence, long-term maintenance costs can be high.	Initial cost is higher but within a life time analysis it becomes lower and regular monitoring can be achieved.
Inflexible when changes are needed, thus presenting a high time consumption when cables are to be redeployed.	Provide an easier way to physically deploy the equipment requiring shorter periods of time.

Comparison between wired and wireless railway track monitoring systems

Due to the rise in railway traffic and load demands, detecting damage to railway tracks is becoming increasingly important as railway tracks take the strain of train loads and harsh environmental conditions. More data on the state of the railway track needs to be collected. This may involve increasing the number of wireless sensors used in extreme weather over a wide area.

The study concludes by recommending that energy efficient transmissions mechanisms should be developed to provide reliable and consistent communication. The information gained from the use of wireless sensors can improve track monitoring and condition-based track maintenance.