Condition-Based Monitoring

Smarter trains. Better future.

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SMARTVISION™ CONDITION-BASED MONITORING PRODUCT FAMILY

DESIGNED TO REVOLUTIONISE TRAIN AND TRACK MAINTENANCE BY LEVERAGING ADVANCED TECHNOLOGIES, THE SMARTVISION™ PRODUCT FAMILY ENABLES THE SEAMLESS TRANSITION TO CONDITION-BASED MAINTENANCE. THIS PROACTIVE APPROACH DETECTS EARLY SIGNS OF DEVELOPING FAULTS IN MECHANICAL DEVICES AND TRACK INFRASTRUCTURE, HELPING TO PREVENT COSTLY AND DANGEROUS FAILURES.

CONTINUOUS MONITORING CAPABILITY

SmartVision™ is EKE-Electronics' condition-based and predictive maintenance platform. The platform enables users to conveniently monitor the health status of their fleet or track infrastructure through our browser-based user interface. Our Monitoring as a Service capability empowers continuous fleet monitoring and extends to the monitoring of track assets as well.

SmartVision™ condition-based monitoring has the power to add value through reduced maintenance costs and/or improved operations. Based on the collected data, SmartVision™ helps operators or maintainers to understand the status of their fleets and infrastructure so that they can make the right decisions regarding operations and maintenance. Developing failures can be identified at an early stage and the maintenance process can be managed based on the condition of the assets.

WHAT DO WE OFFER?

The SmartVision™ product family contains 3 products to automatically monitor the health of trains and track infrastructure 24/7.

01

TRAIN CONDITION MONITORING

Features include:

- Real-time overview of fleet status
- Active and historic events for individual trains
- Status view for individual cars
- Event log and analysis tool
- Event Recorder signal inspection
- Condition trend curves
- Statistical comparisons
- Driver's display

02

TRACK CONDITION MONITORING

Features include:

- Overview of asset health
- Automatic reporting of new asset health changes
- Asset health monitoring
- Trend curves
- Defect diagnosis
- Auto resetting of alerts

03

ADAPTIVE ANOMALY DETECTOR

Features include:

- Low false alert rates
- Optimum detection capability
- No setting or maintaining individual fixed thresholds
- Reliable data for remaining useful life estimates

TRAIN CONDITION MONITORING

TRANSITION FROM FIRE-FIGHTER TO DETECTIVE. COLLECT AND ANALYSE DATA FROM THE EKE-TRAINNET® TRAIN CONTROL AND MANAGEMENT SYSTEM TO UNDERSTAND FLEET STATUS AND MAKE DATA-DRIVEN DECISIONS REGARDING OPERATIONS AND MAINTENANCE BASED ON ACTIONABLE INFORMATION.

WHAT IS TRAIN CONDITION MONITORING?

Train condition monitoring is the process of continuously monitoring various components and systems of a train to assess their health, performance, and potential for failure. The goal is to ensure safe, efficient, and reliable operation by detecting potential issues before they lead to failures or disruptions.

WHY CHOOSE EKE?

SmartVision™ Train Condition Monitoring allows you to quickly and easily extract event and time-series data from the EKE-Trainnet® Train Control and Management System and sensors to monitor the health of the train and its subsystems enabling transition from remote diagnostics to true condition-based monitoring.

01

CONDITION INDICATORS FOR ENHANCED DIAGNOSTICS

Our advanced diagnostics capability harnesses the power of sophisticated algorithms to identify specific data features indicative of potential defects. By employing signal processing techniques, SmartVision™ Train Condition Monitoring analyses data with precision, supported by a robust condition monitoring engine. This combination of technology ensures comprehensive and accurate detection of issues, allowing for timely and effective maintenance decisions.

02

OPEN DATA POLICY

EKE's open data policy is designed to provide seamless access to measured data via the SmartVision™ user interface. This approach allows users to effortlessly view and interact with data, enhancing their ability to make informed decisions. For those who require more detailed analysis, SmartVision™ also offers the option to download raw signal data. This data can be exported and examined using your preferred analytical tools, giving you greater flexibility and control over your data analysis process.

03

SECURE UPDATE MANAGEMENT

Our Train Software Management System offers a secure way to manage, transfer and activate updates to your the EKE-Trainnet® equipment. The packages are automatically transferred to the entire fleet while the train is at the depot, with users notified when the transfers are complete, allowing them to focus on other tasks. The Train Software Management System provides a high level of granularity both for user and package (version) management.

WHAT DO WE OFFER?

For customers with EKE's Train Control and Management System, we offer three types of train condition monitoring to enable operators and maintainers to implement condition-based maintenance.

REMOTE DIAGNOSTICS BASED ON TCMS DATA

With real-time access to comprehensive performance metrics and system health reports, SmartVision™ Train Condition Monitoring empowers you to proactively identify and address potential issues before they escalate into critical problems. This capability minimises downtime and maximises efficiency, ensuring your fleet run smoothly and reliably.

SmartVision™ Train Condition Monitoring provides in-depth insights into your fleet's operations, enabling more informed and strategic decision-making helping you to optimise resource allocation and improve overall fleet management.

CONDITION MONITORING BASED ON TCMS DATA

SmartVision™ Train Condition Monitoring offers continuous, real-time monitoring of your trains' vital systems, allowing you to detect and diagnose potential issues before they escalate. This proactive approach helps prevent unexpected failures and disruptions, ensuring smooth and reliable operations.

By leveraging detailed performance data and predictive analytics, you can optimise maintenance schedules, enhance safety, and extend the lifespan of your assets. This ensures that your fleet remains in peak condition and operates at its best.

CONDITION MONITORING WITH ADDITIONAL SENSORS

Integrating the EKE-Trainnet® Train Control and Monitoring System (TCMS) data with additional sensors offers an unprecedented level of detail and accuracy in monitoring the health of your trains.

The additional sensors capture critical data points that complement TCMS insights, providing a holistic view of your fleet's condition.

Detect potential issues early with precision and take proactive measures to prevent costly downtime and extend the lifespan of your equipment.

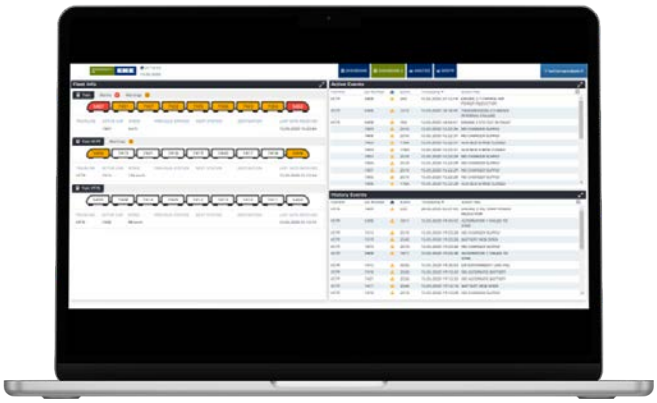
HOW DOES IT WORK?

The SmartVision™ Data Acquisition Gateway collects data from the EKE-Trainnet® Train Control and Management System. Such data typically includes process and message data giving a comprehensive overview of the status of the train.

I/O modules can be added to collect additional information for condition-based monitoring purposes from e.g. HVACs, doors or pneumatic systems with various types of sensors measuring including temperature, pressure or current.

A bogie-mountable sensor gateway can also be utilised for detecting early signs of faults developing in various components of the bogies utilising temperature and high-frequency vibration sensors with sophisticated edge processing functionalities.

1. **Collect data:** Diagnostics data is collected from the EKE-Trainnet® Train Control and Management System.
2. **Transmit data:** The measurement data is then sent to the cloud for processing via cellular/Wi-Fi.
3. **Analyse data:** Advanced diagnostics takes place on the cloud.
4. **Present results:** The user is notified of alerts and warnings via a browser-based interface.



Example of SmartVision™ Train Condition Monitoring user interface showing train status

Example of SmartVision™ Train Condition Monitoring with driver's display

TRACK CONDITION MONITORING

TRANSFORM YOUR TRACK MAINTENANCE WITH SMARTVISION™ TRACK CONDITION MONITORING. THIS ON-BOARD VIBRATION-BASED MONITORING SYSTEM DELIVERS REAL-TIME INSIGHTS INTO TRACK INTEGRITY, ALLOWING FOR EARLY DETECTION OF POTENTIAL ISSUES.

WHAT IS TRACK CONDITION MONITORING?

Track condition monitoring is the continuous assessment and evaluation of the physical condition of railway tracks using advanced technologies. Its primary goal is to ensure safety, reliability, and efficiency by detecting and addressing potential issues early, preventing accidents, reducing maintenance costs, and extending the lifespan of the rail infrastructure.

WHY CHOOSE EKE?

By leveraging vibration monitoring and intelligent algorithms, SmartVision™ empowers users to gain insights into the condition of their tracks and assets, allowing for proactive maintenance planning and defect mitigation.

01

ON-BOARD CONTINUOUS DATA COLLECTION

Our Track Condition Monitoring uses in-service trains to measure track conditions continuously and at a high sampling rate by capturing wheel-induced vibrations. This data-driven approach enables targeted maintenance, optimises resource allocation, and enhances safety. Data is sent to the cloud for analysis and can be reviewed on our user-friendly interface, allowing users to identify and address issues early, preventing major problems.

02

CONDITION INDICATORS FOR ENHANCED DIAGNOSTICS

Condition indicators identify specific defects, enabling targeted repairs and optimised maintenance. This precise defect detection supports data-driven decisions on repairs and resource allocation. The indicators simplify data interpretation, revealing actionable insights and reducing the need for advanced analytics. Our approach uses sophisticated signal processing techniques to analyse high-frequency vibration data, supported by a robust condition monitoring engine.

03

INDIVIDUAL ASSET HEALTH DETECTION

SmartVision™ Track Condition Monitoring assesses fixed assets like insulation joints and switches, generating trend curves to monitor their health. The Rail Asset Database tracks asset types and locations. Users receive critical change notifications via email and the interface. The software's auto-reset feature clears alerts when assets are healthy, reducing manual intervention and allowing users to focus on real alerts.

WHAT DO WE OFFER?

SmartVision™ Track Condition Monitoring is offered as following:

A SIX MONTH PROOF OF VALUE TRIAL

A proof of value trial gives customers the possibility to experience in an authentic live environment how the SmartVision™ Track Condition Monitoring System can monitor the condition of the track from one rolling stock vehicle in operational use.

During the six-month trial, you will experience how our system delivers real-time insights into track conditions, boosting maintenance strategies and operational efficiency. This live environment trial lets you thoroughly assess SmartVision™'s benefits and effectiveness before committing long-term.

MONITORING AS A SERVICE

This includes:

- Continuous monitoring from moving trains.
- The right to use the remote condition monitoring software via a web browser to view the condition of track assets and inspect warnings and alarms automatically generated by the system.
- Daily email reports of new warnings or alerts that occurred in the last 24 hours.
- Software Maintenance Service based on EKE's Service Level Agreement.
- Regular service review meetings.

OPEN DATA POLICY

Our open data policy ensures transparency and flexibility by granting users access to all measured data via the SmartVision™ user interface.

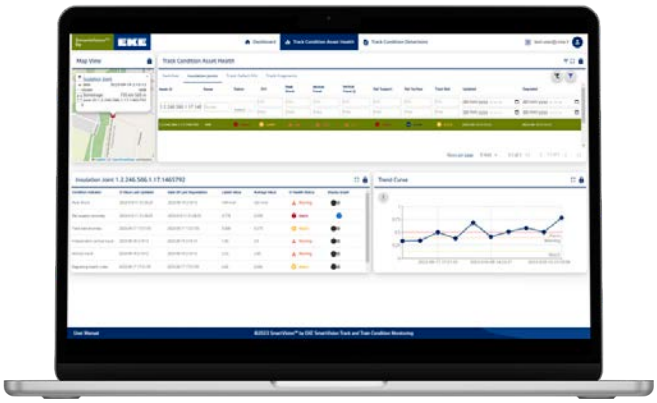
Users can download raw signal data for in-depth analysis with their preferred tools, empowering them to conduct custom investigations and derive tailored insights.

This approach supports greater data accessibility, fosters independent analysis, and enhances overall decision-making capabilities.

HOW DOES IT WORK?

SmartVision™ Track Condition Monitoring measures the smoothness of ride experienced by a normal in-service train passing in full load and with full speed over the track. These frequent measurements complement less frequently produced track geometry measurements from measurement trains. Sudden and quickly developing problems, such as broken rails or damage caused by wheel slip are detected. Early detection can result in more cost-effective repair whilst reducing the risk of secondary damage.

1. **Collect data:** Vibration data is collected as the train travels on the rails.
2. **Transmit data:** The measurement data is then sent to the cloud for processing via cellular/Wi-Fi
3. **Analyse data:** Advanced diagnostics takes place on the cloud.
4. **Present results:** Information about traffic impacting failures is sent via the daily email report and the user interface.



Example of SmartVision™ Track Condition Monitoring user interface showing asset health for predictive maintenance

Example of SmartVision™ Track Condition Monitoring user interface showing detections for reactive maintenance

ADAPTIVE ANOMALY DETECTOR

humaware
Powering Predict & Prevent
an EKE company

EARLY DETECTION OF ANOMALIES SUCH AS EVENTS, DISCONTINUITIES AND TRENDS IN THE DATA, IS ESSENTIAL FOR IMPLEMENTING PREDICTIVE MAINTENANCE. THE ADAPTIVE ANOMALY DETECTOR IS PROVIDED BY HUMAWARE, UK, AN EKE COMPANY.

WHAT IS AN ADAPTIVE ANOMALY DETECTOR?

An adaptive anomaly detector is a type of system or algorithm that is capable of identifying abnormal or unusual patterns in data and adapting its detection methods over time. Unlike traditional anomaly detection methods that rely on fixed thresholds or rules, adaptive anomaly detectors can dynamically adjust their parameters based on changes in the data distribution or the underlying environment.

WHY CHOOSE EKE?

Humaware's Adaptive Anomaly Detector provides users with trusted actionable information to optimise maintenance schedules and increase asset availability. It has the ability to detect minor, gradual, and sudden changes in your condition monitoring data.

01

ADAPTIVE DETECTION TECHNOLOGY

The Adaptive Anomaly Detector, originally developed for helicopter gearboxes, uses condition indicators for precise defect identification. Its adaptive threshold technology and automatic trend detection provide sensitive alerts with minimal false positives. Offered by EKE's UK-based subsidiary, Humaware, AAD ensures accurate trend analysis and reliable automatic alerts.

02

APPLICATION INDEPENDENT AND INDUSTRY AGNOSTIC

Overcoming industry limitations, the Adaptive Anomaly Detector offers application independence and industry neutrality. It performs exceptionally across varied environments, ensuring precise anomaly detection. Its advanced algorithm identifies abrupt, subtle, and gradual data changes, adapting to complex data patterns and distributions.

03

INDIVIDUALISED COMPONENT ANALYSIS

By using a granular approach, the Adaptive Anomaly Detector recognises that healthy components have distinct behaviours while deteriorating ones share similarities. It adjusts thresholds based on meticulous analysis, ensuring precise fault identification. Discarding fixed thresholds, Adaptive Anomaly Detector dynamically adapts to normal behaviours, enhancing fault detection and prognostic capabilities with exceptional efficiency and precision.

WHAT DO WE OFFER?

EKE, in partnership with Humaware, offers the following:

TRIAL ENVIRONMENT

Experience firsthand the power of the Adaptive Anomaly Detector with a limited Proof of Value trial. Import data from your own condition indicators to further enhance your understanding and control over system performance.

Discover how the Adaptive Anomaly Detector's advanced algorithms identify changes in your data earlier than traditional fixed threshold methods, significantly reducing false alerts.

INTEGRATED AS PART OF SMARTVISION™

The Adaptive Anomaly Detector can be integrated into SmartVision™'s Condition Monitoring solution, enhancing its continuous monitoring capabilities with anomaly detection technology.

This integration would enable SmartVision™ to leverage advanced algorithms that identify deviations from normal patterns earlier and more accurately than traditional methods, thereby enhancing its predictive maintenance.

ANALYTICS SUPPORT

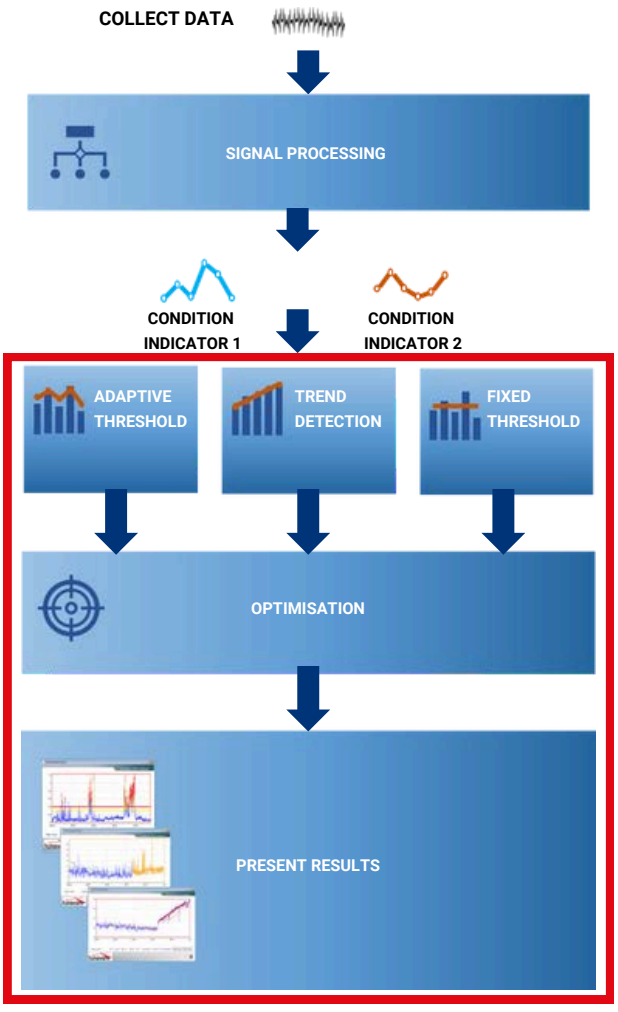
We can provide comprehensive analytics support to ensure you get the most out of the Adaptive Anomaly Detector. We provide training that will teach you how to effectively use the system and interpret its results, empowering you to make data-driven decisions with confidence.

Additionally, we offer assistance in developing condition indicators tailored to your specific needs, enhancing the detector's ability to monitor and analyse your unique operational environment. This ensures that you can fully leverage the capabilities of the Adaptive Anomaly Detector for maximum effectiveness.

HOW DOES IT WORK?

The processing behind the Adaptive Anomaly Detector automatically sets and maintains a unique threshold for each component or asset being monitored and adapts to the "normal" behaviour of the component/asset. This means that no threshold management is required.

1. **Collect data:** Raw data is collected.
2. **Signal processing:** Features are identified that relate to defects to produce condition indicators. The resulting condition indicators are uploaded to the Adaptive Anomaly Detector.
3. **Analyse data:** The adaptive threshold technique is applied to the data to check for changes while trend detection identifies key turning points in the data. Fixed thresholds can be used to enforce safety standards or OEM limits.
4. **Optimisation:** Automatic error checking is performed to maintain the false alert rate at the level it is required.
5. **Present results:** Information about anomalies and trends detected is presented to the user.



The red box indicates the Adaptive Anomaly Detector processing

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