

09.2016 | EN

Ultimate Rail

MAGAZINE FOR RAILWAY TRACKING

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Frauscher Tracking Solutions provide new possibilities for railway applications

20 FAdC

Preventive maintenance and quick configuration: new tools for the FAdC

THE NEW
GENERATION
OF LIVE TRACKING

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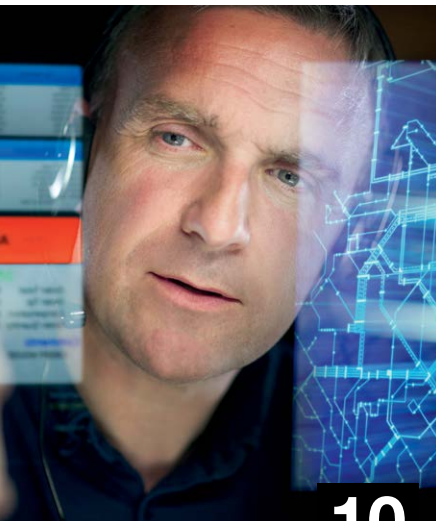
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We are where our customers are: represented by subsidiaries around the globe and on-site at all important railway exhibitions.

Dear readers

"Track more with less": Generate more information with less effort; this thought is of an increasing importance for modern railway signalling systems. True to this philosophy we also want to make it simple for system integrators and operators to get all relevant information they need to operate and monitor their networks and to protect their infrastructure.

Therefore, we are focusing on improving the performance and reliability of existing products, such as wheel detection systems and axle counters. In parallel we are aiming at most simple integration, diagnostics and handling. We are optimising systems, reducing the number of components and making additional information available.

For this purpose we are going to invest even more in research and development in the future. We are also looking for partnerships within new technological areas, such as Distributed Acoustic Sensing (DAS). Over recent years we have tested appropriate technologies that were available on the market. Encouraging outcomes and an increasing interest from several customers have convinced us to develop a new business area based on DAS: Frauscher Tracking Solutions FTS fits perfectly with our existing portfolio. Furthermore, they can be combined with our core systems for axle counting and wheel detection. Thus, we can provide our customers with massively expanded options.

This exciting and proven technology opens up a wide range of applications with the capability to track trains, monitor asset condition, secure infrastructure and protect personnel in real time using one single solution.

Systems based on Distributed Acoustic Sensing, such as FTS, will significantly improve the way trains are tracked in a way that is unlike any other existing technology in the near future. We are looking forward to being one of the first companies within the industry to provide appropriate solutions and to participate in further developments.

So I hope you enjoy reading this latest fresh look edition of our customer magazine Ultimate Rail.

Yours,



Michael Thiel

CEO

Frauscher Sensor Technology



MIXED NEWS

With innovative technology, we're making railways safer. Our investments in research and development contribute to this. Equally the consistent expansion of production possibilities is creating opportunities to satisfy increasing demands.

8,500,000

EUROS

was the investment in the new Frauscher Innovation Centre and in expansion of our sensor production site at our headquarters in St. Marienkirchen. The Innovation Centre will become the international platform for all our research and development activities. And with the production facilities we have been able to significantly increase our manufacturing capacity – to fulfil customer demands worldwide.

20

SECONDS

are needed to adjust the Frauscher Wheel Sensor RSR110

The sensor's open interface enables quick and simple integration to existing systems.

4.

WHEEL DETECTION FORUM IN VIENNA:

Since 2011 this forum has evolved into a real industry event for leading sensor manufacturers, system integrators, operators and consultants, as well as for representatives from academies and professional associations. Its fourth edition will take place in 2017. Speakers can already submit their papers: marketing@frauscher.com

2,500

LASER PULSES

per second are sent into a fibre optic cable by the optical unit of the newly developed Frauscher Acoustic Sensing. In this issue of Ultimate Rail, discover how this system, which is based on Distributed Acoustic Sensing, will revolutionise the railway industry.

30,000

WHEEL SENSORS

can be manufactured annually in our expanded sensor production in St. Marienkirchen. The 500 m² area provides more than enough space and optimum conditions. The manufacturing of all inductive sensors and almost all evaluation equipment is bundled together here at the Frauscher HQ.

3

SUCCESSFUL YEARS

Our 2013 founded Indian subsidiary Frauscher Sensor Technology India Private Ltd. is celebrating its birthday.

6,500 SENSORS

will be implemented in the Dedicated Freight Corridor West in India.

In order to master this most extensive project in our company's history, Frauscher India is cooperating with Hitachi. This enables us to provide our customers with the best service when realizing their wide-ranging projects.

400

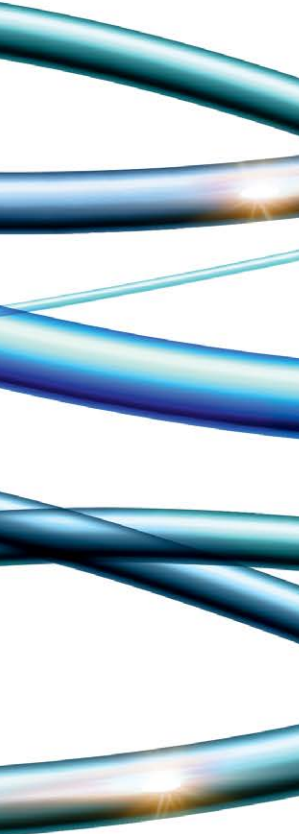
TRACK SECTIONS

will be supplied to METRO in Houston, United States. This project will be realised by our subsidiary in North America, Frauscher Sensor Technology USA Inc.

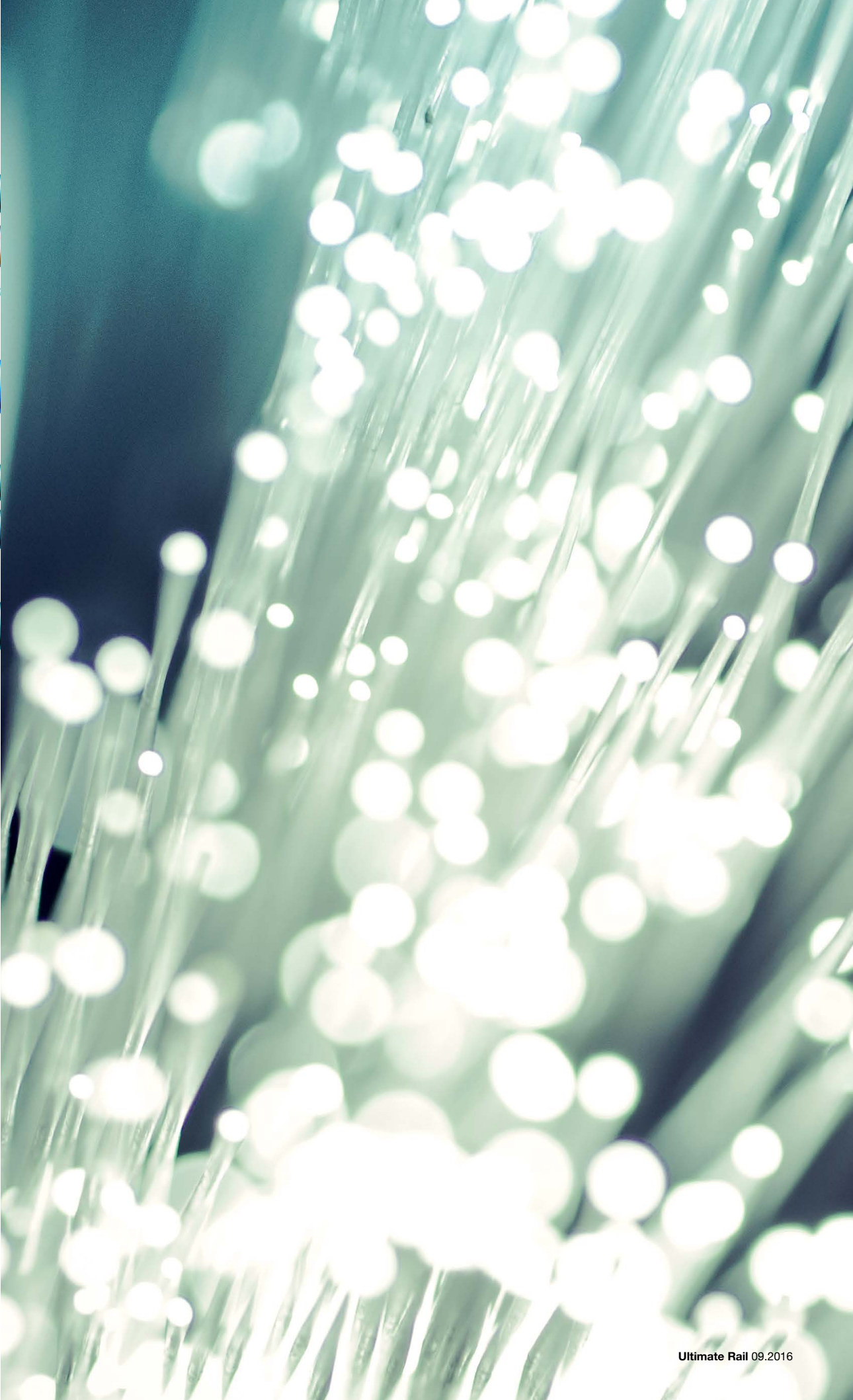
10,000,000

FAIL-SAFE DETECTED AXLES -

this is what the Frauscher Advanced Counter FAdC can achieve on average. The robust design of the hardware and software components forms the basis for this high capacity.



Future network:
Using DAS, glass
fibres become
sensors and
communication
media at once for
tomorrow's train
tracking.



THE NEW GENERATION OF LIVE TRACKING

Technology of the future: Distributed Acoustic Sensing (DAS) transforms fibre optic cables into virtual microphones. What emerges from that is a fascinating potential for monitoring train operations as well as railway infrastructure.

Over the last five years it has become clear that fibre optic acoustic sensing, based on technologies such as Fibre Bragg Grating (FBG) or Distributed Acoustic Sensing (DAS), is attracting increasing interest among railway operators and signalling experts. Together with various suppliers and operators, Frauscher has carried out a number of real-life tests relating to various fields of application and operational availability.

After these comprehensive evaluation exercises, our experts involved in the process stated that DAS would have the greatest potential to become a base technology for numerous railway-specific applications. This conclusion was reached against a massive background of knowledge about signalling technologies.

DAS for railway operation: Possibilities and potentials

Considering the factors relevant to this industry, trains, maintenance vehicles, personnel, trespassers, environmental events and more can be detected. From this emerge applications for railway operations, including the monitoring of components on tracks and trains as well as the securing of infrastructure.

From a technical point of view, it is already possible to track events and components on and near the track over a distance of 40 kilometres using just one DAS based monitoring unit, with whole networks being monitored by multiple connected units.

Innovative algorithms allow for individual categorization of tracked events. On that basis, specific alarms and reports can be generated.

Limitations of DAS for railway operations

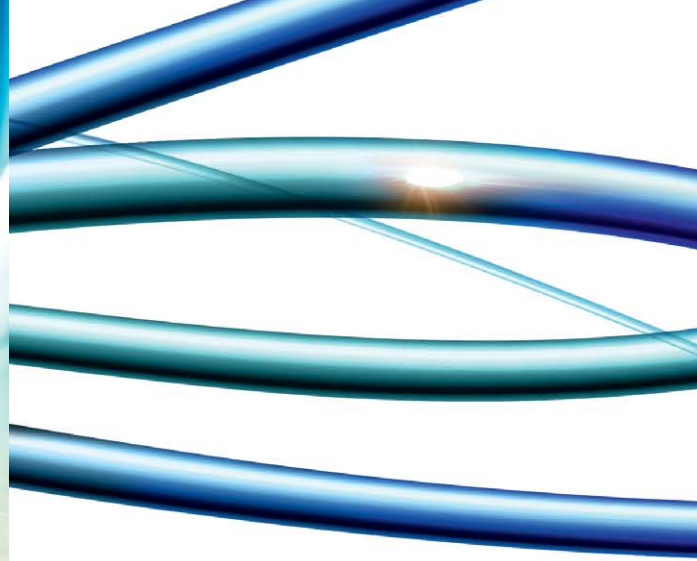
However, the railway industry has its very own requirements and standards, so a comprehensive development of existing approaches is essential. The needs of continuous train tracking in particular will present new challenges to already known DAS based solutions. Looking at the most important factors, the main limitations of using DAS on railways can be described as the following:

- ➔ **Track ID:** Current DAS systems cannot identify whether the indications detected are actually on the track or close to it. It is also difficult to define on which track a train is moving within multi-track areas and nearly impossible in more complex track layouts.
- ➔ **Accuracy:** With the current status of technology, DAS does not yet have the proven capability to detect individual axles in a robust or failsafe manner, which is required for safety-relevant application, such as train integrity along long stretches of network.
- ➔ **CENELEC compliance:** Until now, basic developments and processes have not generally been fulfilled to create a solid foundation for SIL applications based on DAS. Also, the existing limitations regarding the accuracy and location of the occurrence will need to be resolved at least to a certain degree in order to achieve CENELEC compliance.

DAS as a base technology for railway applications

However, these limitations can be overcome. Innovative solutions and intelligent combination of various approaches allows for a use of DAS as a base technology for railway applications. Within this issue of Ultimate Rail you can learn more about how Frauscher is managing these hurdles.

Let us tell you about how DAS will surely revolutionise the nature of railway operations and about how to benefit from undreamed-of possibilities without the need to install additional components on your tracks.



DAS solutions are able to monitor 40 kilometres of track using only one fibre optic cable

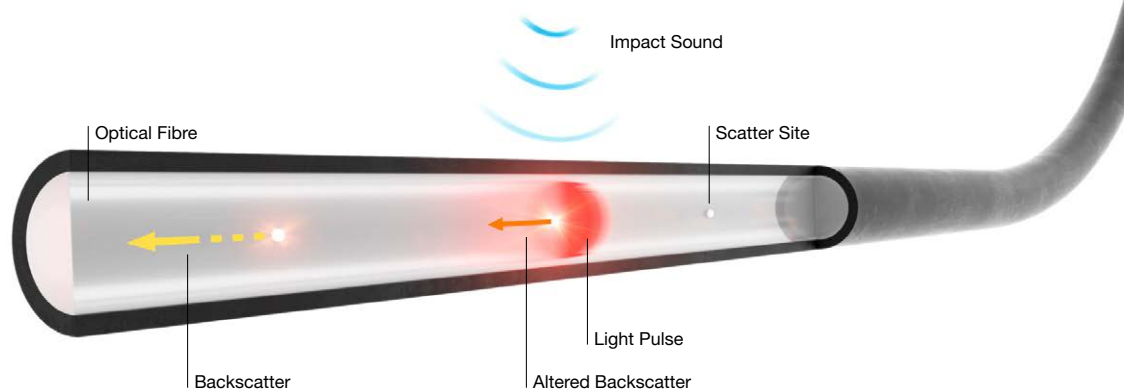
HOW DOES DISTRIBUTED ACOUSTIC SENSING (DAS) WORK?

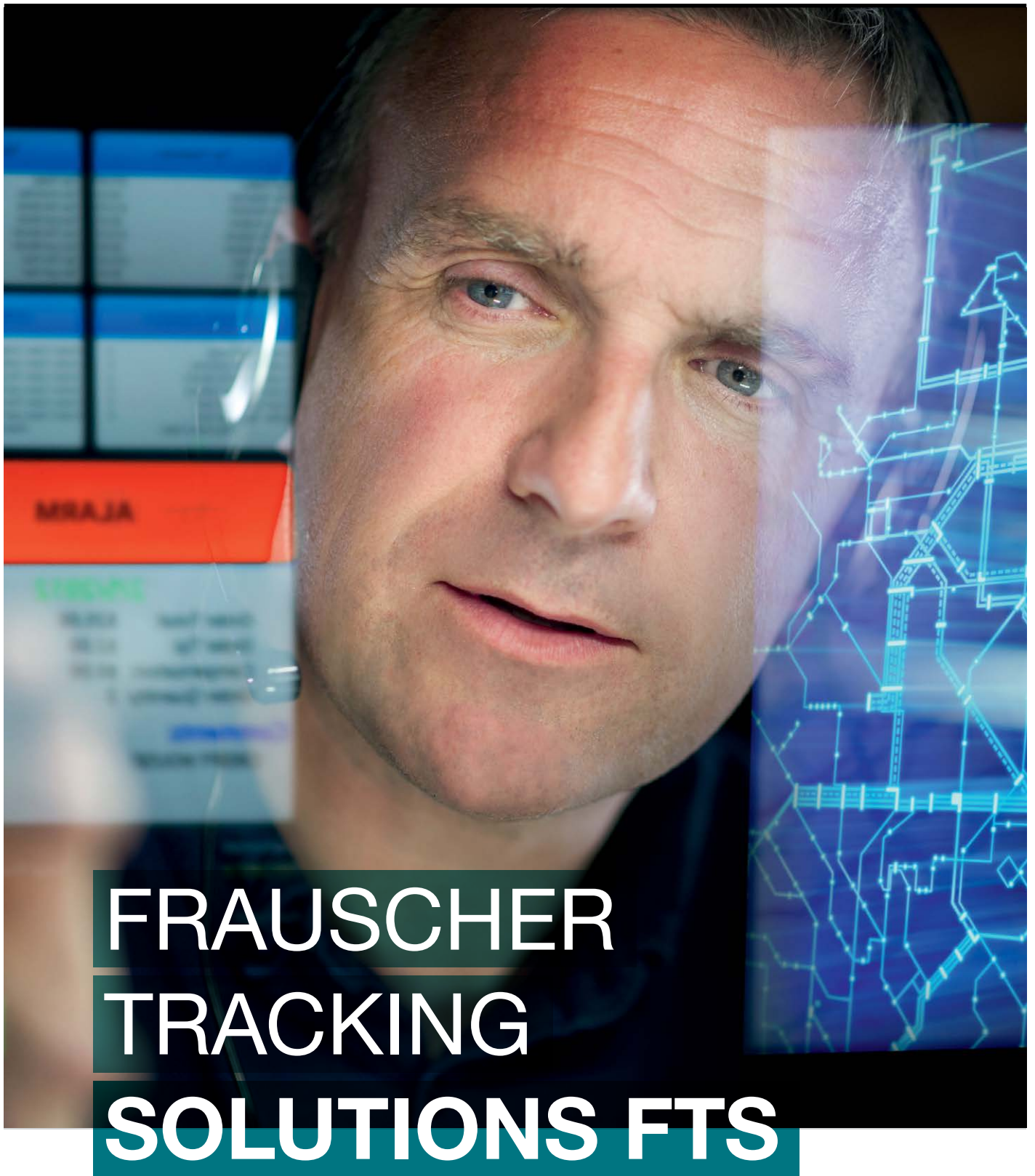
The principle of Distributed Acoustic Sensing is based on changes in the intensity of light reflections caused by sound waves radiating against a single-mode fibre optic cable. These changes can be detected. Using specially developed algorithms it is possible to transform

measurable signatures into valuable information about train movements, people on and near the tracks and additional activities such as manual and machine digging. These DAS capabilities are in use in the oil, gas and border protection businesses. Any single-mode fibre can quickly be turned

into a series of listening devices using DAS with minimal fibre work at either end of the monitored fibre section. Using spare capacity on the existing fibre cables next to a track makes it possible for similar and related applications to be realised for railway-specific requirements.

Laser impulses transform fibre optic cables into virtual microphones that can detect ambient noises





FRAUSCHER TRACKING SOLUTIONS FTS

The best of both worlds:

The combination of Frauscher Acoustic Sensing FAS and axle counters or wheel detection systems creates new possibilities for railways.

A range of tests with DAS revealed that limitations of existing approaches regarding their use on railways can be overcome through intensive research. Frauscher has installed its own expert team to take full advantage of potential that this technology can provide. All members of that working group thus had to bring fundamental knowledge regarding DAS as well as about the needs and standards of the railway industry.

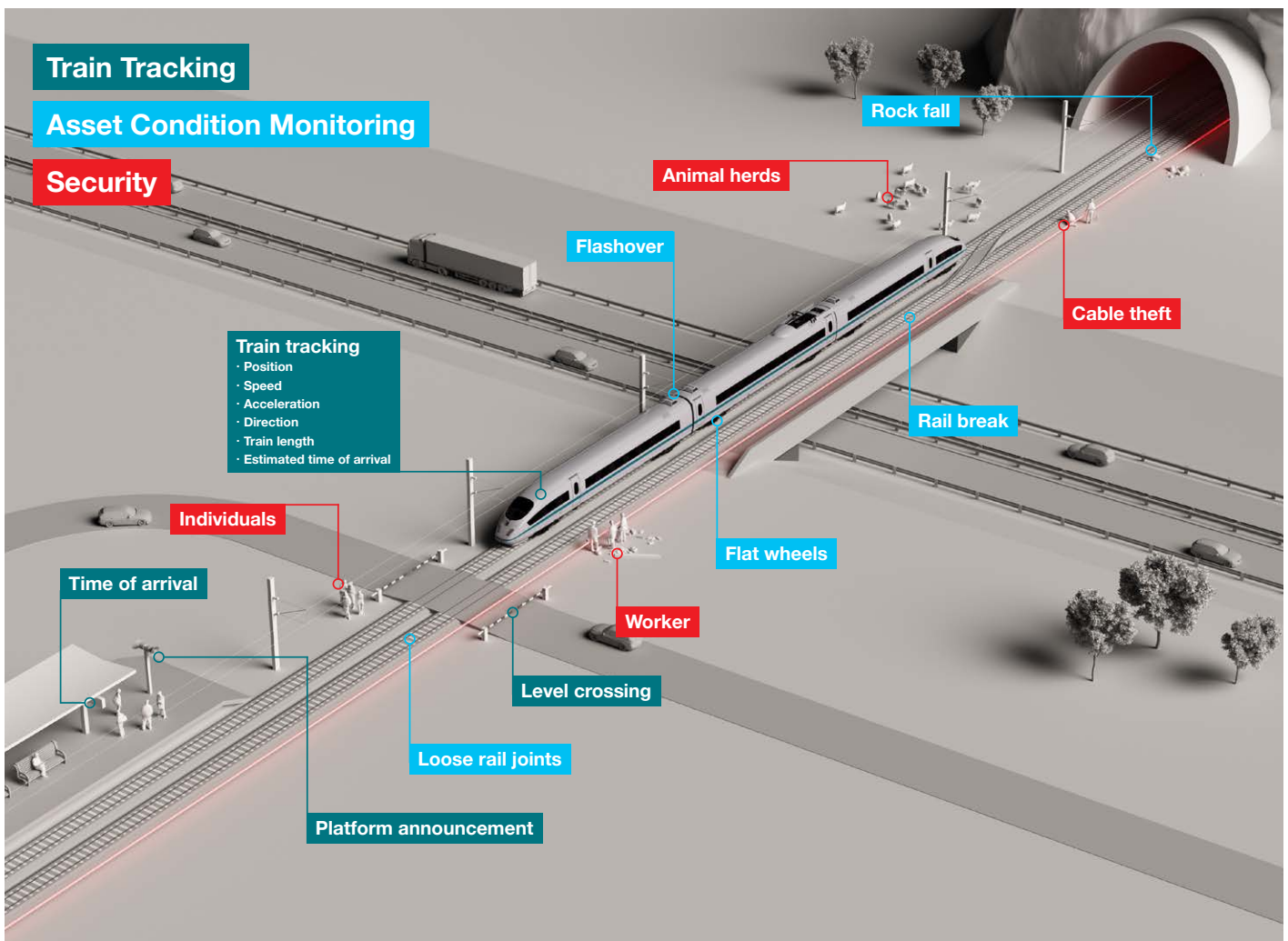
operators who gave valuable inputs regarding some important criteria. These affected, for example, the system resolution that is needed to carry out various applications as well as transmission and storage of data. In a subsequent step, the research group developed some prototype-algorithms to enable detection and classification of specific events.

The outcome of this process, Frauscher Acoustic Sensing (FAS), is now available for some basic applications. These include train tracking in non-safety relevant areas, monitoring of infrastructure components, for instance by detecting wheel flats, rail breaks or people and activities, such as digging on and near the track.

←
Operators benefit from real-time information from FTS which is provided through a Display Unit

FTS-FAS: Frauscher Acoustic Sensing – a railway specific DAS

A railway specific DAS based solution has now been developed in close cooperation with interested railway



i DATA

Even the initial pilot installations have revealed a range of additional application areas. Now we plan to make further revisions to hardware and software, to evaluate further potentials within these specific fields.

Integration with detection systems:

FTS-FAS+

In an early combination, FAS is used together with proven wheel detection systems and wheel sensors: overlaying data from both approaches increases the possibilities of applying such information significantly. Trains can be assigned to tracks and their length can be determined more exactly. Furthermore, detected events and asset conditions, such as wheel flats, can be localised accurately. Thus an integrated solution with wheel detection systems enables the use of FAS on multi-track lines, where several rails are connected by numerous switching points.

Information from FAS

- Train position
- Direction
- Speed
- ETA
- Headway
- Rail break
- Wheel flats
- Rockfall
- Catenary flash
- Trespassing
- Cable theft
- Vandalism etc.

Information from axle counter

- Clear/occupied indication including track identification (SIL 4)
- Number of axles
- Speed
- Direction
- Diagnostic data

FAS provides additional information for modern axle counters: FTS-FAdC+

The most advanced combination consists of FAS and a modern axle counter, such as the Frauscher Advanced Counter FAdC. In this configuration, the FAS provides valuable data to support complex and safety-relevant applications, given that the axle counter operates on a CENELEC SIL 4 level.

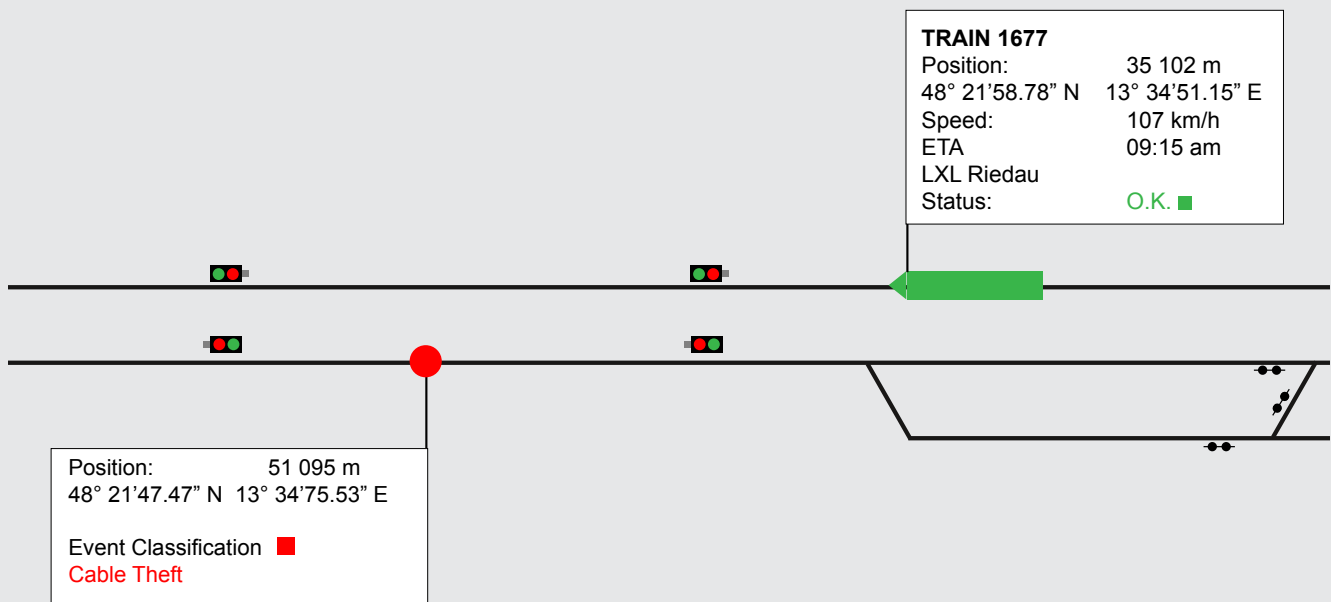
Using FTS-FAdC+, the axle counter can be used as a failsafe system for track vacancy detection, while data input from FAS, such as dynamic train location or estimated time of arrival (ETA), can be added.

Human Machine Interface HMI

True to the motto “track more with less” we have also developed a specific Human Machine Interface (HMI) for making access

FAS Display Unit

The HMI provides information and alarms in a clearly arranged way.



**"WE CREATE THE BASE FOR
INTEGRATED FTS-SOLUTIONS TO CARRY
OUT COMPLEX AND SAFETY
RELEVANT APPLICATIONS."**



to and handling of all generated data as simple as possible: the FAS Display Unit. This provides clearly arranged delivery of all information as well as accurate classification of tracked events as a basis for planning and implementing appropriate activities.

Furthermore, information can also be provided to mobile devices through text messages or even drones that can be sent to appropriate locations according to precise GPS data. Additionally, interfacing with IT networks is enabled.

Whichever option is chosen, FTS allows for immediate response, either as a stand-alone or as a combined solution.



CLEAR GOALS FOR FTS

Our task force's concept provides two steps in parallel: First, we are developing a railway-specific DAS system which is able to carry out non safety relevant basic applications. Second, we are already focusing on creating a basis for combining this new system with proven axle counters and wheel detection systems in order to be able to develop-safety relevant applications.

Martin Rosenberger,
Product Management Director, Frauscher Sensortechnik GmbH



TRAIN TRACKING: LOCALISATION IN REAL TIME

Frauscher Tracking Solutions FTS will be a full train tracking system that enables applications beyond all expectations and brings forward new ideas for train control and traffic management.

With the development of FAS, we have successfully adopted the DAS principle. Already the system can be used as a stand-alone solution for train tracking in non-vital applications as well as on single-way tracks. Nevertheless, as experts in track vacancy detection with many years of signalling experience, Frauscher has its focus set on vital applications in accordance with CENELEC.

Information²

When used as a stand-alone train tracking solution, FAS provides information on a train's position, speed, acceleration, direction, length and more. The data generated can serve as a basis for optimising schedule management, train announcements, exact train positioning and for improving the speed profile. For

train tracking to Safety Integrity Level 4 (SIL 4), FAS can be combined with well-proven technologies. This is possible due to the smart system architecture of all Frauscher products: an axle counter takes care for track vacancy detection, while FAS generates additional information. In most cases such a design needs only minimum investments in infrastructure, because usually the required fibre cable is already running along the tracks.

Combined knowledge for efficient train tracking in new markets

The coherent integration of both systems in FAdC⁺ enables new possibilities for train tracking and track monitoring. For instance, when providing track vacancy detection on long and remote block sections in areas with challenging environmental conditions:



Technology for highest safety:
Frauscher has its focus set on
tracking trains on a SIL 4 level.

TRACK MORE WITH LESS

- ➔ **Continuously track trains** on the whole railway network with a system combination
- ➔ **Track vacancy detection** on a SIL 4 level in combination with train localisation
- ➔ **Additional possibilities** for securing infrastructure
- ➔ **Reliably monitor** up to 40 km with only one fibre cable on track
- ➔ **Readily obtain various** additional data such as rail breaks or wheel flats

in such a scenario, the axle counters within the FAdC+ system guarantee fail-safe track vacancy detection, while FAS detects rail breaks and other events. This illustrates the combined solution's outstanding potential for markets where axle counters aren't approved exclusively because of their inability to detect rail breaks.

Efficient train localisation

In contrast to other approaches like ETCS, GNSS or 5G solutions, FTS require no on-board components. This makes it possible to detect all rail vehicles with a minimum of components, which significantly improves efficiency and interoperability. At the same time, the system's operation costs and complexity will decrease.

The future of train tracking

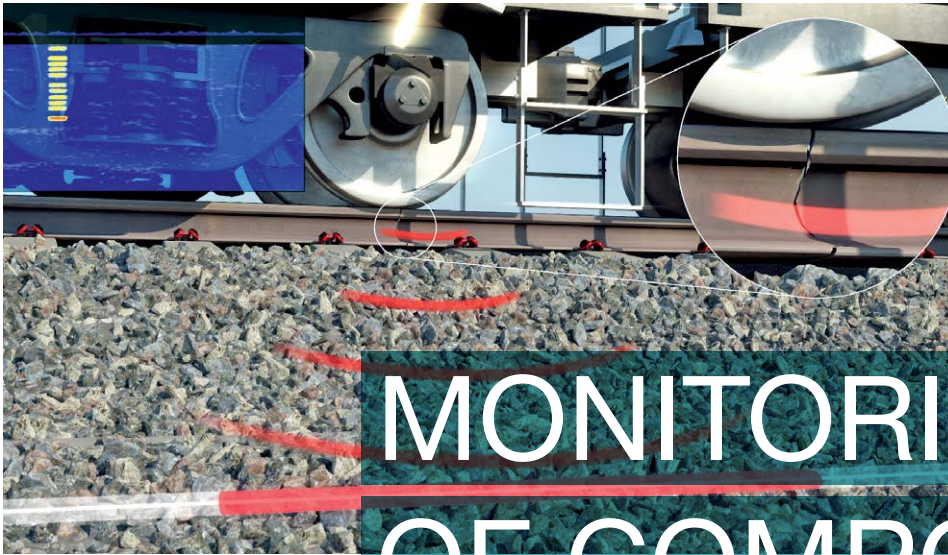
FTS will become a complete system for train tracking, which meets all requirements for quality, availability and security. It will open up new applications and ideas in train control and traffic management – beyond all expectations.



"DISTRIBUTED ACOUSTIC SENSING CAN BECOME A FUNDAMENTAL TECHNOLOGY FOR TRAIN DETECTION."

"We have done a large number of tests with DAS on our railway networks – and gained fascinating results that give us an idea of the potential of this technology. However we recognise that railway-specific hardware with high resolution and range has to be developed in order to meet specific requirements and railway standards. On that basis, DAS can for sure become a fundamental technology for train detection."

Max Schubert,
Project Leader Distributed Acoustic Sensing, DB Netz AG



Everything at a glance:
FTS enables highly
efficient train operations
by monitoring vehicles
and infrastructure

MONITORING OF COMPONENTS ON TRAINS AND RAILS

+ TRACK MORE WITH LESS

- ➔ **Monitor** complete railway networks and all trains using one single solution
- ➔ **Monitoring** of trains and infrastructure components (e.g. wheel flats)
- ➔ **Events are tracked in real-time** and can be precisely assigned to a single rail
- ➔ **Detection** of environmental influences, such as rockfall, landslide or fallen trees

One single solution for tracks and trains: Frauscher Tracking Solutions FTS combines DAS technology and wheel detection systems, forming a powerful complete system. This facilitates new possibilities for monitoring even complex railway networks.

Smooth railway operations depend on maximum availability across the entire infrastructure. Therefore consistent monitoring of every component on all trains and tracks is needed.

Today, a wide range of monitoring systems is available that provides various solutions to this requirement. These highly specific systems, e.g. for wheel flat or hot box detection, allow for punctual monitoring of train components. Precise wheel sensors with high availability from Frauscher are frequently used to trigger appropriate

track side equipment for measuring and monitoring. Due to this, our company has been able to acquire comprehensive knowledge on carrying out such applications during recent decades.

Detecting events all along the track

In light of these experiences, the newly developed Frauscher Acoustic Sensing FAS provides an ideal solution, as it enables monitoring of both trains and infrastructure components.

By using FAS it is possible to monitor whole railway networks including their

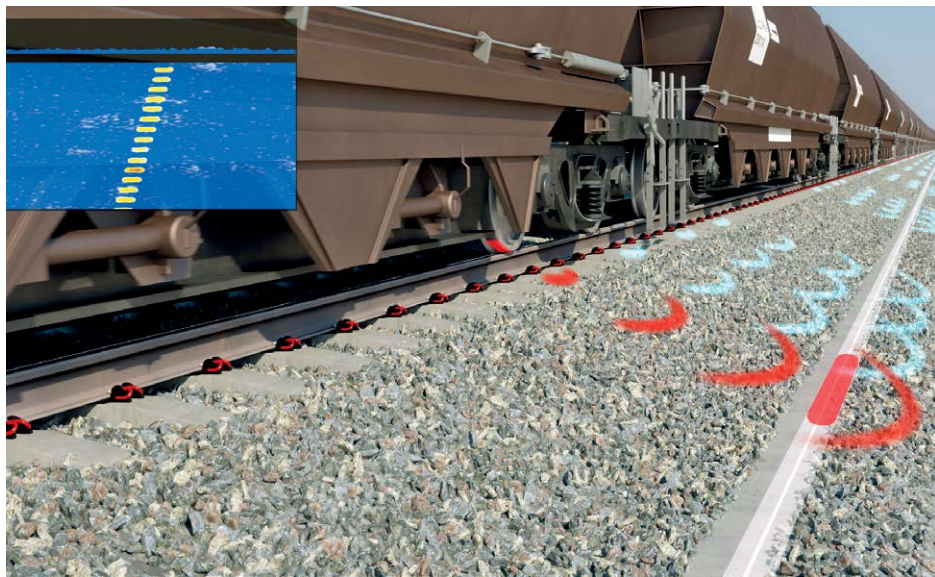
complete environment. Even events which are unforeseeable and hard to detect are tracked in a reliable way. This includes rail breaks, which are known to be a major risk along the track. The system also detects catenary flash-overs, floods, rock and tree falls as well as landslides. This enables a significant reduction in the number of highly expensive operational restrictions.

Minimising costs – maximising the output

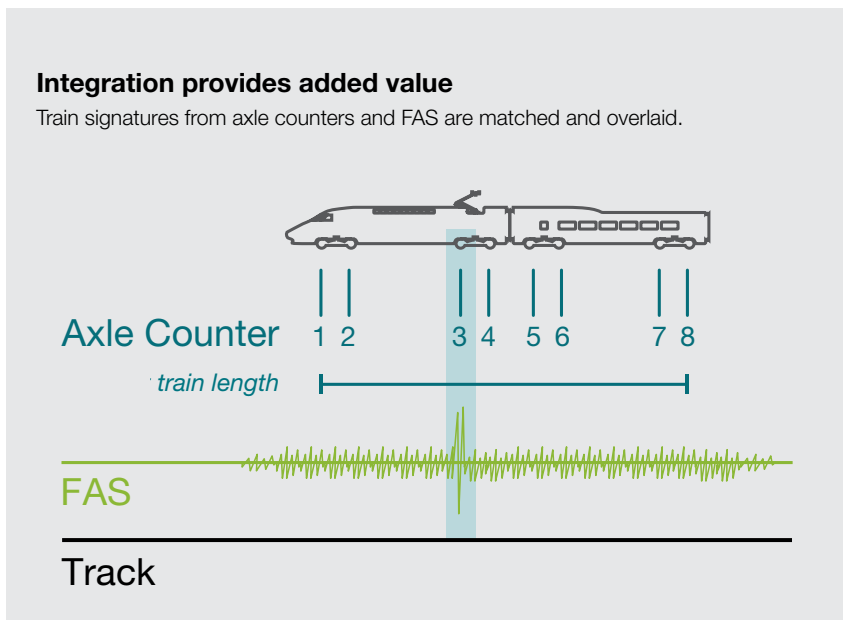
DAS based Frauscher Tracking Solutions FTS offer a solution to monitor an operator’s complete infrastructure in real-time. So far, we have developed a range of prototype-algorithms to detect and classify specific events, including rail breaks and loose track joints as well as vibrations from catenary flash-overs, rockfalls and landslides.

Combining this new approach with proven wheel detection systems also enables monitoring of components mounted on trains as well as precise localisation of detected events. For this purpose signals from FAS are extended by data from wheel sensors and evaluation boards. These include precise position of the first and the last axle of a train. On that basis, a train can be uniquely assigned to a track and its length can be determined more exactly.

By merging and overlaying signals from both systems, it will be possible to precisely localise status information from train components – such as wheel flats that can then be assigned to a specific axle. This allows for the use of FAS within complex railway networks that include numerous lines running in parallel and connected by several switching points.



↑ Railbreaks and wheel flats have already been detected successfully in initial test installations. To reach the next level of data quality when using DAS in the railway industry, FAS has been designed to enable combined solutions consisting of optical sensors and position sensors





SECURITY APPLICATIONS

Efficient railway operations depend on a high level of safety in various areas. To that end, FAS provides a comprehensive solution ranging from work safety to protection against vandalism.

↑ Vandalism directed at trains and infrastructure can be expensive. It ranges from graffiti to destruction of components.

Guaranteeing safety is a multifaceted major challenge of railway operations: at a material level, components of the infrastructure, such as cable systems, cabinets as well as trains must be protected against theft and vandalism. The safety of all persons who are involved in a railway system is another factor that must be considered. This ranges from employees to passengers and trespassers.

Huge costs, short ranges

As a result, security solutions for railway stations and other facilities along the tracks have to deal with complex requirements in order to be able to contribute to increased efficiency of railway operations. These include reliable detection of activities, transmission of appropriate information to the user in real-time and constant availability.

The solutions currently used mostly provide a single point of surveillance. To meet the requirements mentioned above,

a range of complex security systems has been developed. Their architecture often complicates their integration into higher processes. Moreover, high maintenance costs arise from the numerous components that are needed to run those installations. Furthermore, security patrols are often employed to conduct random checks at all points on the network, although these systems should actually simplify their work.

Safety that comes from one source

Using DAS is quite common in the oil, gas and border protection business, where it is a proven concept for monitoring infrastructure and for carrying out various security applications. Based on experiences from these industries, Frauscher has extended the application areas of its products beyond train tracking.

Frauscher Acoustic Sensing FAS offers main lines and mass transits the opportunity to install an all in-one security system which can expand the reach of rail network surveillance.

FAS transforms measurable signatures,

+ TRACK MORE WITH LESS

→ One Single solution to detect various events

- Vandalism
- Cable theft
- Trespass
- Other events

→ Safe coordination of track workers

→
Access prohibited:
FAS tracks
trespassers in
sensitive areas

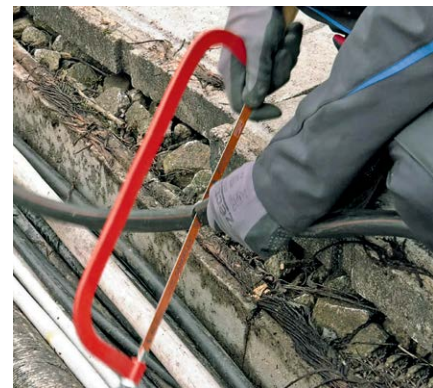


caused by events such as movements of vehicles or footsteps of persons, into valuable information that can be used to generate alarms and reports about the presence of trespassers, objects and more. Furthermore, a concrete classification makes it possible to recognise activities such as digging.

Providing information in the right areas

Information generated by the FAS is

combined with accurate GPS data, transmitted to the Display Unit and can be handled according to individual requirements. For example, it is possible to send personnel to the site and to switch off power in the right areas or to determine the most effective escape route in case of train evacuation. The data generated can also be provided to mobile devices or even drones that can be sent to the operation site.



↑ Beware of theft: Sawing and digging are tracked and transformed into an alarm in real-time

i SECURITY APPLICATIONS

➔ **Trespass**

FAS can track trespassers in dangerous or restricted areas in real-time. Furthermore, animal flocks can be detected and approaching trains advised to reduce their speed.

➔ **Working groups**

With the FAS monitoring range capability, maintenance of way and work-crews can be more closely coordinated and better protected for rail operations, which increases productivity and can improve operational efficiency.

➔ **Cable theft**

The sensitivity of FAS allows identification of different types of activities and can be a powerful tool to protect against vandalism and theft. This naturally shortens response times for front-line security to suspicious activities.

➔ **Vandalism**

By targeting security patrols to the FAS location alerts, their effectiveness can be significantly increased. A paradigm shift in vandalism prevention will save tremendous amounts of time and resources in reducing damage remediation.



FAdC[®] TOOLS

Clear, flexible and efficient: Frauscher provides new tools to users of its Frauscher Advanced Counter FAdC, further increasing the axle counter's versatile application possibilities once again.

Rapid installation, high availability and easy handling: the requirements on signalling systems are increasing continuously. Frauscher already established a convincing platform with its Frauscher Advanced Counter FAdC some years ago. Since those days this axle counter has been constantly refined. In close cooperation with operators and system integrators, a complete tool environment has been developed which meets a broad variety of

different requirements. The two latest tool developments are the Frauscher Alarming and Maintenance Systems FAMS and the Frauscher Configuration Tool FCT.

Frauscher Alarming and Maintenance System FAMS

The new Frauscher Alarming and Maintenance System FAMS offers operators a compact solution for monitoring all their Frauscher axle counter components at a glance. Diagnostic information generated by one or more Frauscher Diagnostic Systems FDS can be managed via this interface, enabling detailed planning of preventive as well as regular maintenance tasks.

As a result FAMS increases the efficiency of the existing tool environment: different information can be gathered and forwarded to higher ranking systems at various levels. Not least because of this, FAMS can contribute to a significant increase in the cost efficiency of train operations.



FAMS supports operators with efficient planning of maintenance works.

Frauscher Configuration Tool FCT

System integrators can speed up configuration of components in their projects by using the Frauscher Configuration Tool FCT. This new software supports different experienced user groups and allows intuitive usage for beginners as well as fast and direct configuration for experienced users. It provides immediate live information during configuration processes, in case an error occurs. For double-checking the configuration, an overview table can be displayed instead of individual text files. Additionally, the software allows project templates for common system layouts to be saved and reused. As a result, the FCT will facilitate significant savings throughout the configuration phase of a project by reducing working times during commissioning of a system to a minimum.

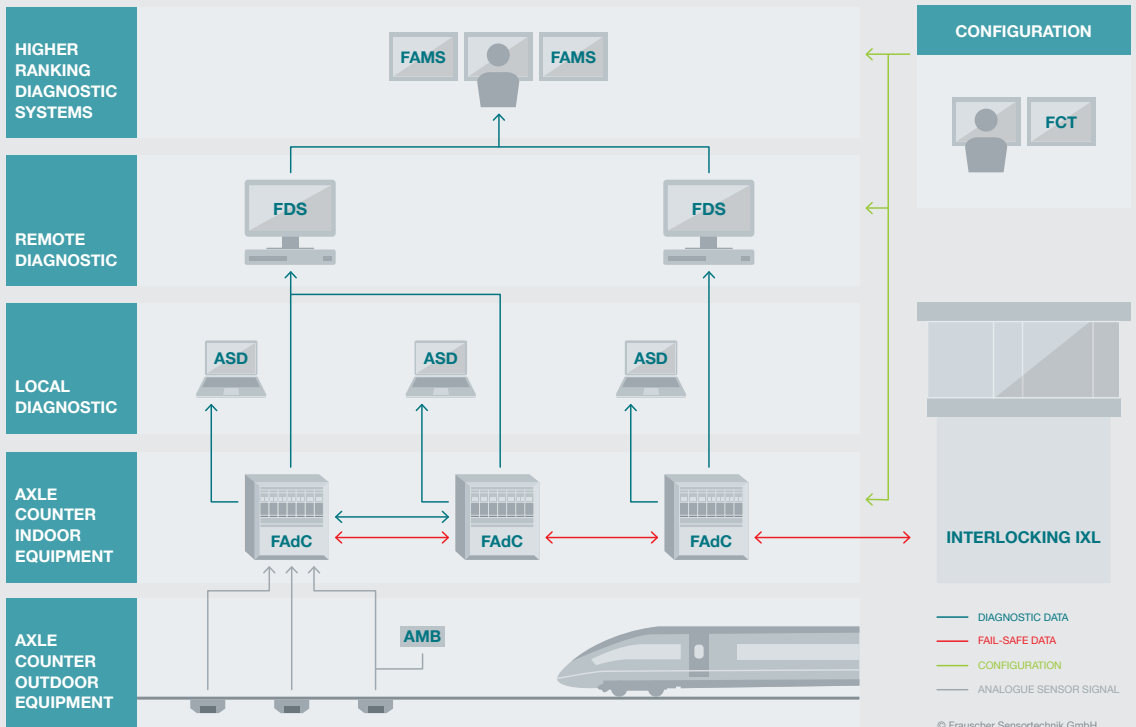
+ TRACK MORE WITH LESS

- ➔ **Preventative maintenance** ensures availability
- ➔ **Clear presentation** of data
- ➔ **Quickest possible** availability of information
- ➔ **Increased efficiency** by quick configuration
- ➔ **Simple error analysis** and targeted fault rectification

Frauscher Diagnostic System FDS

Furthermore, using FDS can minimise maintenance costs: important information about wheel sensor current, for example, can be read from a central service area. Disturbances can be prevented, since they can be identified before they even occur. However, if a disturbance does happen, it is possible to minimize its actual duration by simplified error analysis and targeted error rectification. FDS thus contributes to a higher availability of axle counters and wheel detection systems.

FAdC tool environment



CONTACTS & DATES

We are at your service: Our contacts are available at our subsidiaries all around the globe, within our dedicated FTS-team, on all most important railway trade shows – and of course at our Wheel Detection Forum in Vienna.

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DATES

➔ **GLOBAL RAIL INFRASTRUCTURE**
9–10 March 2017 | Frankfurt, Germany

➔ **RAILTEX**
9–11 May 2017 | Birmingham, UK

➔ **RAILWAY INTERCHANGE**
17–20 September 2017 | Indianapolis, USA

➔ **TRAKO**
26–29 September 2017 | Gdansk, Poland

➔ **WHEEL DETECTION FORUM**
4–6 October 2017 | Vienna, Austria

ULTIMATE RAIL

Issue
September 2016

Owner and publisher
Frauscher
Sensortechnik GmbH
Gewerbestraße 1
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AUSTRIA

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Editorial Design
KD1 Designagentur, Cologne

Frauscher Sensortechnik
GmbH: Eva Hellenbroich

Pictures
3D Pictureworks, Brenn-
weiten Media, Frauscher
Sensortechnik GmbH, Foto
Resch, iStockphoto, Q2
Werbeagentur GmbH, Max
Schubert, shutterstock

Printing
Wambacher Veas e. U.

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WHEEL DETECTION FORUM 2017

4TH WHEEL DETECTION FORUM THE FUTURE OF TRAIN TRACKING

▶ 4-6 OCTOBER 2017 | VIENNA, AUSTRIA



CALL FOR PAPERS

To be considered for a presentation at the forum, please submit an abstract in English. The streams of the conference focus on the these topics:

- ▶ **Wheel detection**
- ▶ **Axle counting**
- ▶ **Distributed Acoustic Sensing (DAS)**
- ▶ **Further tracking technologies (FBG, GNSS, ...)**
- ▶ **Interfaces and communication**

Presentations should outline future challenges, latest research results, improvement of RAMS or best practice cases. A structured and factual abstract in English – 200-350 words – is required.

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