The axle counting system FAdC provides benefits for interlocking integrators and operators

Martin Rosenberger / Christian Pucher

The requirements placed on modern axle counting systems by both interlocking manufacturers and operators are becoming ever more varied and individual. Frauscher Sensortechnik GmbH has met this challenge and developed a completely new generation of axle counters, the Frauscher Advanced Counter (FAdC). The aim was to be able to achieve customer-specific functionalities, optimal integration in various interlocking technologies, and flexible project planning and configuration with the lowest possible life cycle costs.

1 Areas of use

Due to its functional modularity and easy scalability using an Ethernet interface, the FAdC system offers maximum flexibility for the configuration of many different applications. The possibilities range from small central systems with voltage-free relay contacts to complex systems located in decentralised clusters along the track and networked with one another. As the complexity of the systems increases, space, energy and investment cost savings compared with conventional axle counting systems also rise significantly.

This new generation of axle counters meets the requirements of the CENELEC SIL 4 standard. The FAdC can be used in an extremely wide variety of segments, such as high-speed, mainline and secondary railways, metros or light railways and industrial railways, irrespective of the size or complexity of a project (Figure 1).

In addition to safe track vacancy detection, applications such as controlling level crossings or customer-specific switching tasks can be implemented easily and cost-effectively.

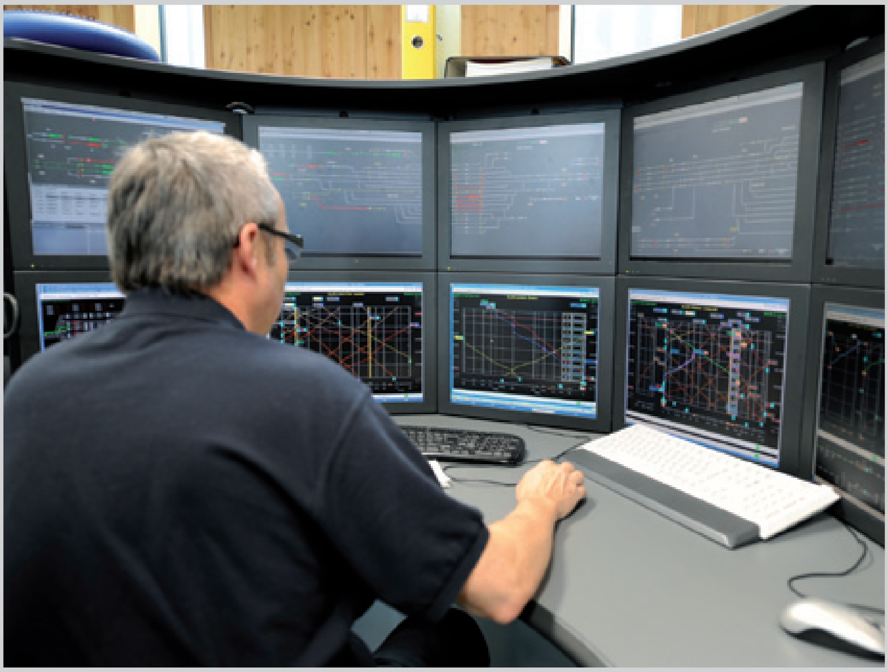

Figure 1: Modern axle counting systems are the basis for safe and efficient railway operation.

2 Structure and functional principle

2.1 Evaluation board AEB

In addition to the evaluation of a wheel sensor, the central evaluation board AEB also carries out axle counting and supplies the clear/occupied indications, which can be output either via a serial protocol or via relay interfaces. Using the evaluation board AEB, up to 16 counting heads can be evaluated per track section. In addition to this counting head information, which can also be used for double and multiple use in other track sections, the evaluation board AEB also provides fail-safe direction information for further use (e. g. the switching of level crossings).

2.2 Communication board COM

The main tasks of the communication board COM are to forward counting head data via an Ethernet interface and to read out and provide configuration data for the AEB boards. In addition, it provides vital axle counting data (clear/occupied indications, counting head data) to the interlocking and/or the higher-level signalling system via a customer-specific protocol.

2.3 Extension board IO-EXB

The extension board IO-EXB is used for the fail-safe output of clear/occupied indications for up to two track sections through voltage-free relay contacts. Furthermore, it displays the number of axles and possible error codes of the track section or the evaluation board AEB. Alternatively, the IO-EXB can also be used to input and output fail-safe digital ar-

Figure 2: The scalability of individual boards means a limited range of components and a high degree of flexibility.

guments. This functionality can, for example, be used for the transmission of block arguments.

2.4 Power supply board PSC

The power supply board PSC provides the necessary internal voltages and protects the FAdC boards from overvoltages (Figure 2).

2.5 Operating principle

All boards of the FAdC conform to a proven format and are housed in 19-inch board racks. Evaluation boards AEB communicate with one another by means of an internal bus. The communication board COM that is also connected to the internal bus provides an Ethernet interface offering vital clear/occupied information for further processing. The clear/occupied information can be alternatively or additionally output through the extension boards IO-EXB connected to the evaluation boards AEB.

Configuration of the track sections can be carried out either using a configuration file or, in the case of smaller systems, using DIP-switches on the configuration board CO-EXB. The interaction between the communication boards COM takes place via the Ethernet, the link to which can be set up using LWL or DSL modems, for example. Existing communication networks can also be used, as long as they correspond to Class 5 or lower, in accordance with EN50159-2. With additional external measures, transfer of the FAdC data via networks of up to Class 7 is also possible.

In addition, the communication board COM offers the option of connecting the Frauscher Diagnostic System FDS to the Advanced Counter FAdC. Thus corresponding data can be logged, evaluated and displayed through a web browser, or passed to higher-level diagnostic centres via an XML interface.

3 Architecture

Integration into modern signalling installations, amongst other things, is crucial for the future capabilities of axle counting systems. Implementation in both centralised and decentralised architecture must be fully mastered. Due to the scaleable and modular design of the FAdC system, there are tremendous possibilities when it comes to configuration.

3.1 Centralised architecture

The block diagram (Figure 3) of a station with centralised architecture shows the simple structure and limited use of hardware components. All the data from the individual evaluation boards can be ex-

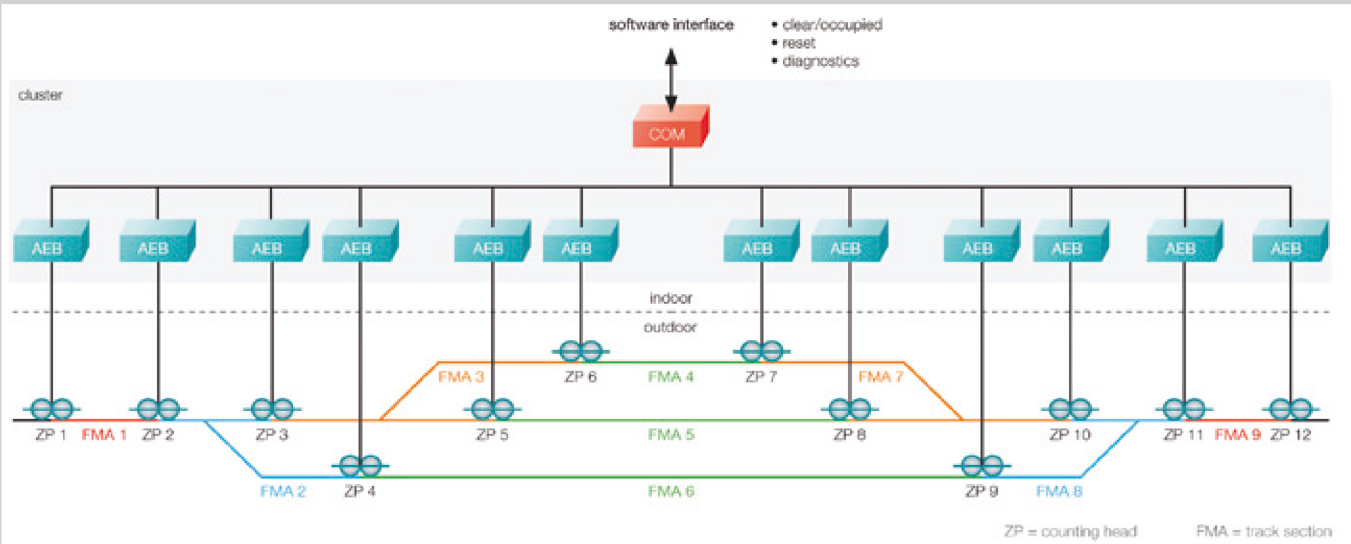

Figure 3: Centralised architecture: simple structure and limited use of hardware components.

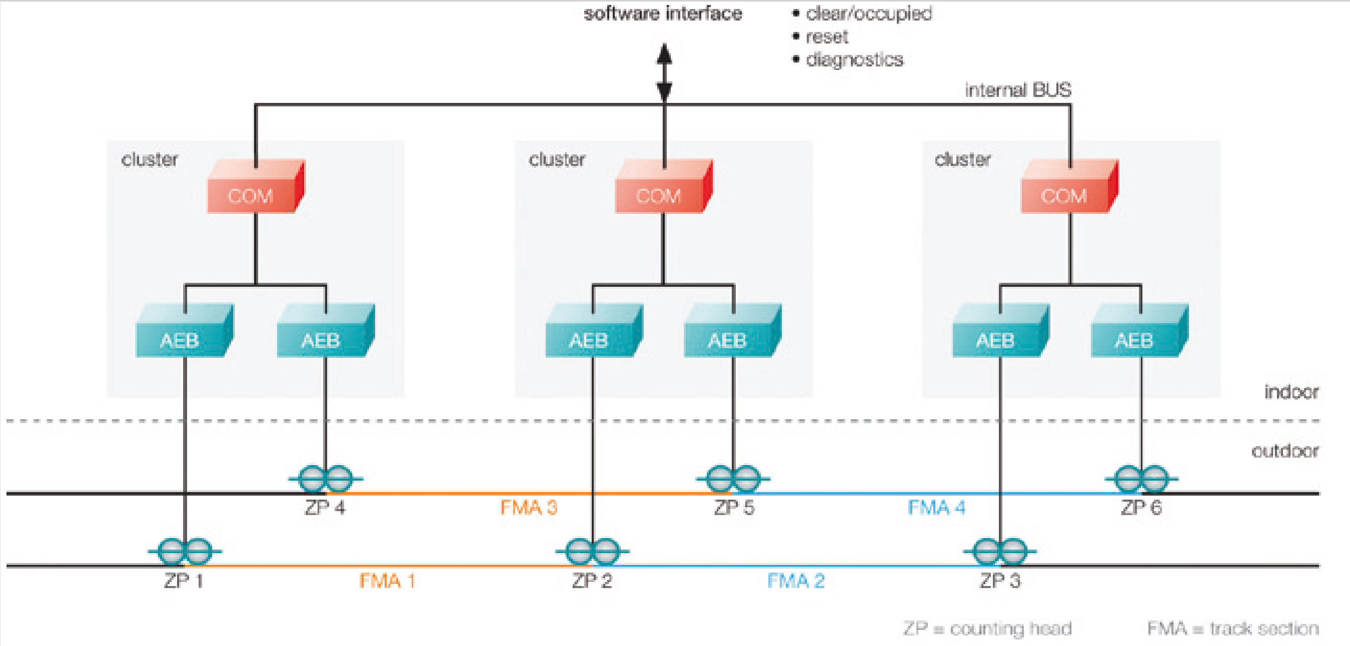

Figure 4: Decentralised architecture: individual clusters communicate efficiently with each other using Ethernet.

changed via the internal bus and made available via the Ethernet. The FAdC is impressive in this case with its simple structure and limited use of hardware components.

3.2 Decentralised architecture

Decentralised arrangements are gaining in importance with modern transmission technologies, which keep the costs for the cable infrastructure low. Unlike centralised architecture, the axle counting logic here is decentralised, distributed across several, freely-selectable locations. Here individual interlocking clusters are arranged along the track (field controller, area controller, object controller). The components of the FAdC system are suitable for use in compact outdoor cabinets close to the track (temperature range from −40 to +70 °C). These clusters communicate with each other through existing or new network infrastructures (open networks in accordance with EN 50159-2, Class 5). These are operated and maintained in a decentralised manner from a superior position (Figure 4).

4 Interfaces

The FAdC is constructed so that data can be exchanged safely both through a modern, serial software interface as well as through hardware interfaces.

4.1 Hardware interface

Here, the "clear/occupied" information is generally transferred through a relay interface as an output variable and the "reset" transmitted through an optocoupler interface as an input variable of the axle counting system. Using these proven, voltage-free hardware interfaces, axle counting systems can be integrated in electromechanical, relay and electronic interlockings. In this case, the COM board is only used for configuring the evaluation board AEB (Figure 5).

4.2 Software interface

Compared to a hardware interface, a modern, series software interface allows the exchange of a series of additional information. The serial connection and flexible configuration of the axle counting system open up almost unlimited opportunities. In addition to customer-specific protocols for various

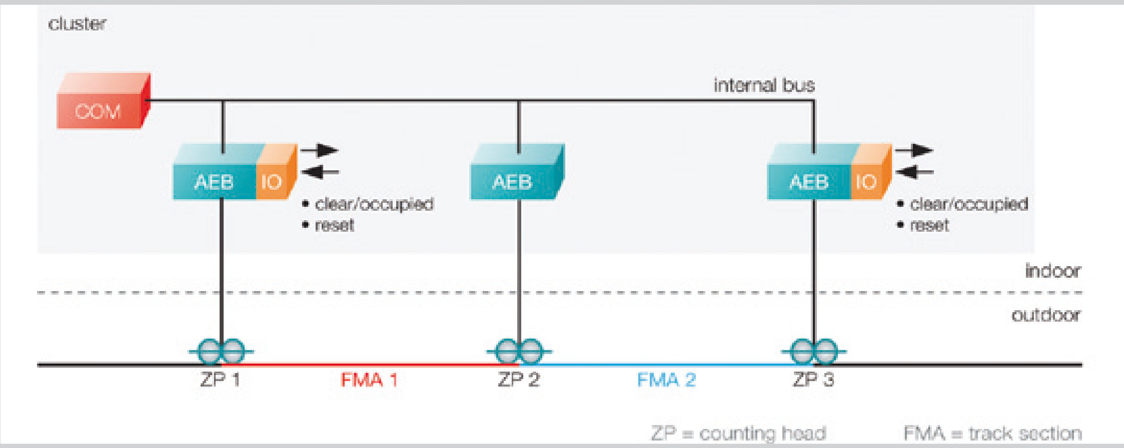

Figure 5: In the case of a FAdC with a hardware interface, the clear/occupied information and/or reset is exchanged using relay contacts.

interlocking types, the FAdC also offers a Frauscher standard protocol for those applications that have not yet implemented a vital Ethernet interface. The software interface of the FAdC allows a clear cost reduction when networking the interlocking and axle counting system (Figure 6).

5 Functionalities

In addition to basic information on whether a defined track section is "clear" or "occupied", the axle counting system FAdC provides a series of additional information that is important for highly-available and safe railway operation.

Due to its scalability and versatile functions, the FAdC offers a number of advantages, especially with regard to design and project planning. The system is so simple that customers can take on project planning and configuration themselves after brief training.

5.1 Reset variants

Due to the wide range of possible applications and operating routines, individual reset variants are required. In the FAdC, there are 14 different reset combinations to choose from.

Automated resets are increasingly in demand using "supervisory track sections". Here the FAdC offers the opportunity to combine several track sections into a higher-level supervisor section. If this supervisor section is "clear", then the lower-level subsections must also be "clear". Therefore in the case of an occupied indication for a lower-level section, this will be automatically reset by the supervisor section. Under certain conditions, this functionality may lead to a further increase in availability.

5.2 Partial traversing management

From an operative point of view, including the safety of the complete system, the operator can request that the axle counting system has to permit several partial traversings without outputting an occupied indication. In the FAdC, the number of permitted partial traversings can be set according to specific instructions through the customer.

5.3 Diagnostic information

Preventive maintenance, the optimisation of fault rectification, unrestricted online access to data from the axle counting system, the minimisation of maintenance work, tailoring of maintenance cycles based on track conditions, and the reduction of life cycle costs are important aspects that are possible using modern diagnostic systems. With integration in a higher-level system, diagnostics play an increasingly important and system-critical role. The Advanced Service Display ASD offers a simple way of reading out diagnostic information from the FAdC through a laptop on site. No access to the central diagnostic system is required.

5.4 Counting head control

In some countries, trolleys (as hand trucks for tools) are not to be recorded; however, maintenance vehicles, special vehicles and regular vehicles are to be counted correctly. Depending on the railway operator, the requirements here may vary enormously. Special evaluation algorithms and functionalities of the axle counting system are required for this.

Counting head control allows higher availability through suppression of disturbances through trolleys during maintenance or track work. The principle of counting head control is based on the fact that counting heads whose adjacent track sections are "clear" are put into a type of standby mode. In this standby status, a configurable number of inadmissible dampings (such as through tools, trolleys, pedestrians, vandals, etc.) can be suppressed and thus unwanted occupied indications from the track section can be avoided. Regular approaching vehicles switch off the standby mode and are therefore safely detected and output.

5.5 Additional information

The high-quality Frauscher wheel sensors [1, 2] consist of two sensor systems. One is triggered by the clear detection of the direction of the vehicle, and the other on reaching the safety level (CENELEC SIL 4). Thus additional information such as traversing direction, speed or wheel diameter can be determined and output.

The information on the traversing direction can be used for fail-safe (SIL 4) triggering of level crossing control systems, but also for controlling points and shunting installations in shunting and industrial areas. A combination or integration of the axle counting system FAdC in

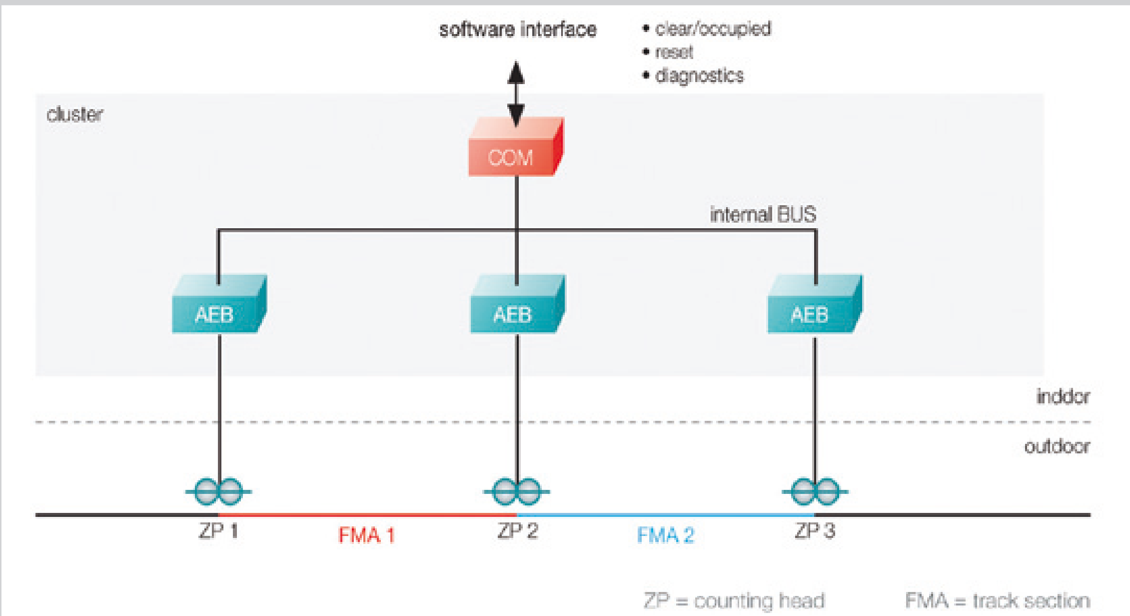

Figure 6: The software interface of the FAdC allows optimal networking of the interlocking and axle counting system.

such installations allows further optimisation through the use of additional information such as traversing speed and wheel diameter, as well as the number of passing axles.

6 Performance features

The new axle counting generation FAdC is characterised by the following performance features:

- Fail-safe track clear/occupied indication of up to two track sections per AEB through a conventional hardware interface and a modern software interface
- Fail-safe output of traversing information (direction of travel)
- Flexible and scalable architecture (decentralised and centralised)
- Use of existing network infrastructure (EN 50159-2, Class 5)
- Vital transmission of digital arguments between IO-EXBs (without additional external hardware)
- Central and local diagnostics possible
- Additional functions can be configured without additional hardware or software
- Automated adjustment process of the wheel sensor can be triggered from indoor equipment
- Wheel sensor interface connection via cable possible up to 10 km
- Two-year traversing and maintenance cycle

The FAdC can be used on high-speed, mainline and local railways, metros, light railways and industrial railways. Use is not limited through traction (diesel, diesel-electric, AC or DC), sleeper type (wood, steel or concrete sleepers or solid rail track) or the length of the track section.

Figure 7: The components of the FAdC are suitable for use in compact outdoor cabinets along the track.

7 Initial practical experience

Currently, the first project using the new FAdC axle counting generation is being carried out together with a renowned system integrator at Network Rail, UK. The field trial at Network Rail was successfully concluded. This is the first project carried out using the newly developed “Modular Signalling System”, i.e. based on a decentralised architecture. In this concept, the signalling technology, so-called object controllers for point drivers, signals and/or axle counting systems, are positioned along the track and communicate with the interlocking through fast Ethernet-based networks (Figure 7).

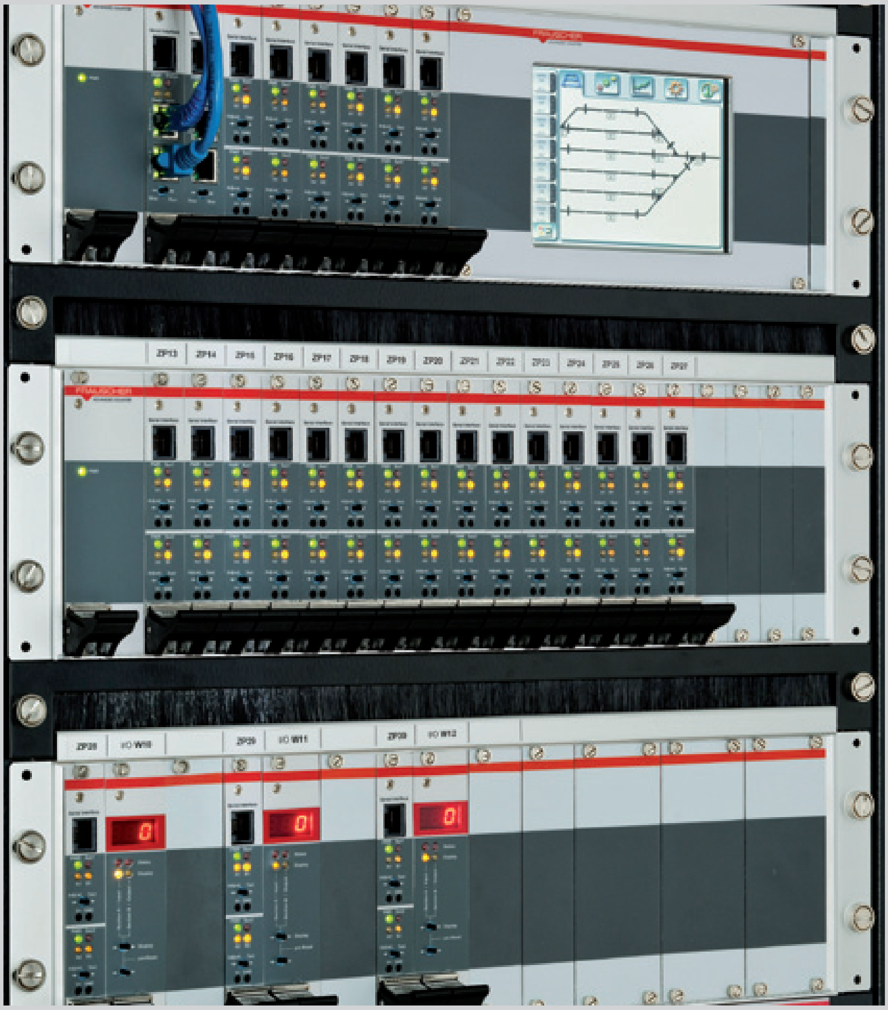

Figure 8: Through flexible multiple use of the components, the space required is very small even in the case of extensive, complex installations.

8 Outlook

With the development of the axle counting system FAdC, a milestone has been set regarding modularity, flexible modern interfaces and comprehensive yet optimal configurability. The easy scalability and modern configuration tools allow not only simple and efficient adaptation to specific customer requirements but are also a precondition for meeting future challenges [3].

By incorporating the FAdC in powerful electronic interlockings, the benefits of this modern axle counting system become clear: minimal equipment requirements, vital, future-proof communication and maximum flexibility in configuration. The development of customer-specific interfaces takes place individually with the relevant systems provider, based on the stipulated interface environment. The more complex the system, the greater the savings with regard to space requirements, energy and investment costs compared to standard axle counting systems (Figure 8).

Preconditions for a high level of safety and availability in modern axle counting systems and for the evaluation and use of additional information include extremely highly-available, interference-tolerant and innovative wheel-detection systems. All Frauscher wheel sensor types are compatible with the FAdC. The ability to retrofit the FAdC in existing outdoor installations is thus guaranteed.

The authors

Martin Rosenberger M.Sc.
Sales, Head of Product Management
Frauscher Sensortechnik GmbH
Address: Gewerbestraße 1,
A-4774 St. Marienkirchen
E-Mail: martin.rosenberger@frauscher.com

Christian Pucher
Head of Marketing
Frauscher Sensortechnik GmbH
Address: Gewerbestraße 1,
A-4774 St. Marienkirchen
E-Mail: christian.pucher@frauscher.com

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ZUSAMMENFASSUNG

Das Achszählsystem FAdC bietet Vorteile für Stellwerksintegratoren und Betreiber

Die Anforderungen an moderne Achszählsysteme werden sowohl seitens der Stellwerkshersteller als auch der -betreiber immer vielfältiger und individueller. Um diese Herausforderung hinsichtlich kundenspezifischer Funktionalitäten, optimierter Integration in verschiedene Stellwerkstechnologien sowie flexibler Projektierung und Konfiguration bei möglichst geringen Life Cycle Costs erfüllen zu können, entwickelte die Frauscher Sensortechnik GmbH eine völlig neue Achszählgeneration, den Frauscher Advanced Counter (FAdC).

Mit der Entwicklung des Achszählsystems FAdC ist es gelungen, einen Meilenstein hinsichtlich der Modularität, flexibler, moderner Schnittstellen und einer umfassenden, aber optimalen Konfigurierbarkeit zu setzen. Die einfache Skalierbarkeit sowie moderne Konfigurationstools ermöglichen es nicht nur, kundenspezifische Anforderungen einfach und effizient anzupassen, sondern sie sind auch die Voraussetzung, um zukünftigen Herausforderungen begegnen zu können.

Bei der Einbindung des FAdC in leistungsfähige Elektronische Stellwerke werden die Vorteile dieses modernen Achszählsystems deutlich: minimale Geräteanforderungen, sichere zukunftsfähige Kommunikation sowie maximale Flexibilität bei der Konfiguration. Die Entwicklung kundenspezifischer Schnittstellen erfolgt individuell mit dem jeweiligen Systemanbieter auf Basis der vorgegebenen Schnittstellenumgebung. Je komplexer eine Anlage ist, desto größer sind die Einsparungen bezüglich Platzbedarf, Energie- und Investitionskosten im Vergleich zu herkömmlichen Achszählsystemen.