Voiceprint Monitoring Technology

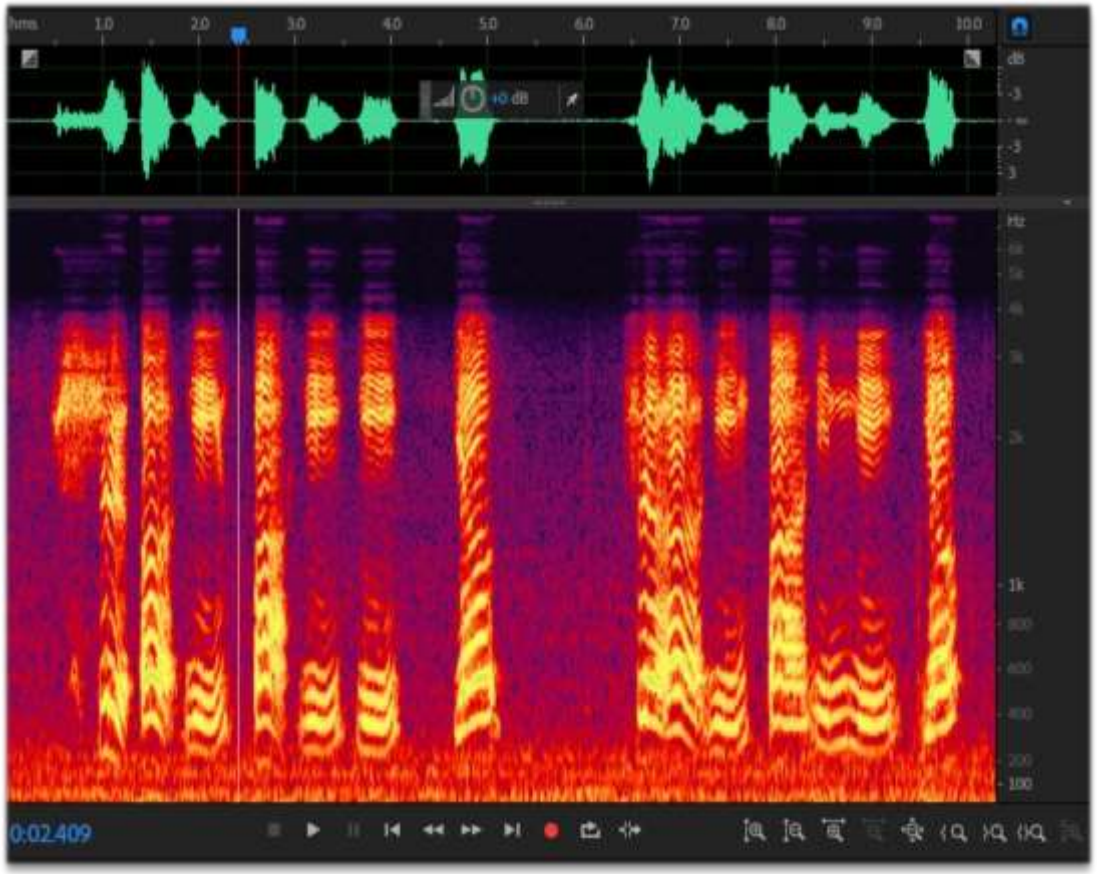
Voiceprint monitoring, Health auscultation,
Intelligent Inspection and Safety Escort

Voiceprint Recognition Field Leader

Industrial Voiceprint Recognition Principle

Equipment Noise

Acoustic spectrograms



Unique vibration acoustic patterns are generated by mechanical vibration during the operation.

The acoustic signal is acquired, digitalized and extracted into frequency spectrum, amplitude, inverted spectrum, waveform, wave peak, probability density, cliff coefficient and other acoustic characteristics. Furthermore, these characteristics will not be affected in the high voltage and strong electromagnetic environment.

Therefore, we make use of this unique sound characteristics to compare the voiceprint information of the detected equipment with the normal voiceprint information, and identify the operation state of industrial equipment, early warning fault and fault judgment.

Conveyor Belt

Background

Currently, coal mine conveyor belts rely heavily on manual inspection and scheduled maintenance, which often leads to delayed fault detection and unplanned downtime. These reactive measures pose safety risks, increase maintenance costs, and reduce overall operational efficiency. The inability to monitor real-time operational data makes it difficult to accurately identify fault locations, assess the severity of mechanical issues, or predict wear and tear trends.

Solution

Voiceprint monitoring technology utilizes the unique acoustic signatures produced by conveyor belt components during operation. With an array of industrial-grade microphones strategically placed along the conveyor system, the system continuously captures audio data. AI-powered deep learning algorithms analyze these voiceprints in real time, comparing them with a database of known fault patterns to detect anomalies such as bearing failures, belt misalignment, or roller damage. The system can not only classify the fault type but also pinpoint its exact location, enabling precise and timely intervention.

Business Value

By implementing voiceprint monitoring, coal mine operators can transition from reactive to predictive maintenance. This results in early fault detection, minimized downtime, reduced labor costs, and enhanced worker safety. The continuous collection and analysis of audio data enable the generation of fault evolution curves, providing insights into degradation patterns and supporting informed decision-making for maintenance planning and lifecycle management.

Power Station

Background

There are multiple state monitoring methods, but these methods often use contact detection techniques. The monitoring method of high voltage power equipment is not mature enough, and there are a wide range of interference sources such as corona discharge, switch action impact and local discharge that may appear in adjacent high voltage electrical equipment.

Solution

The acquisition of voiceprint signal does not contact the power transformer, will not affect its working state, and will not be affected in high voltage and strong electromagnetic field. The voice print power online monitoring system integrates AI + Internet of Things + 5G. At present, it can provide 24-hour online detection of transformers, switchgear, buses and other major equipment. It mainly provides timely warning of various faults of the transformers.

Business Value

The deep learning of artificial intelligence is carried out for the abnormal fault Phenomenon. It providing the monitoring of the whole life cycle of the equipment, and making decision assistance for the operation and relevant research.

NARI 南瑞集团 NARI GROUP CORPORATION
国家电网 STATE GRID
HIKVISION
alhua TECHNOLOGY

Wind Turbine

Background

At present, wind turbines are currently using the traditional after-the-fact maintenance and routine inspection methods, so there are great risks and hidden dangers. The inspection workload is huge, which directly affects economic benefits. Due to the lack of real-time status data of wind turbines, it is difficult to understand their operating status, so it is difficult to diagnose the fault location and degree, and can not accurately predict its deterioration trend.

Solution

When a wind turbine fails, the system can accurately identify the type of failure through the unique sound print spectrum, relying on the deep learning ability of artificial intelligence, and comparing with the database standard. Through the combination of array microphones set in the engine room, the physical coordinates of the fault occurrence point are accurately located, and the three-dimensional fault database is established.

Business Value

By modeling the data of wind turbines, the owner is able to collect and analyze each abnormal information, draw the failure occurrence curve, and describe the historical development and future trend of the fault in details.

国家能源集团 CHN ENERGY　国家电投 SPIC

Hydropower Generation

Background

In recent years, with the continuous improvement of the detection technology (power outage detection and online monitoring), some of the key states of equipment that must be obtained through routine power outage test can now be obtained by means of no power outage, greatly reducing the power outage time.

Solution

This project is applicable to the on-line monitoring sensor for voice print signal acquisition of large hydroelectric transformers, carries out the sample collection of vocal print corpus in field operation environment, constructs the large transformer anomaly identification model based on acoustic fingerprint, proposes the voice print recognition and defect warning method considering equipment operating conditions, develops the on-line monitoring and fault diagnosis system of main transformer, and conducts pilot application in typical application scenarios.

Business Value

It can detect the operation state of the equipment outside the equipment, and there is no electrical connection with the electrical equipment, which does not affect the normal operation of the system.

中国三峡 China Three Gorges Corporation

华电福新能源 HUADIAN FUXIN ENERGY

Power Transmission Tower

Background

Transmission tower normally has long life cycle within power transmission and distribution engineering infrastructure. Long term in the natural environment, the tower may have issues like loose bolts, tower body tilt. With the unique signal characteristics of online voice print, combined with deep learning-neural network algorithm, we can identify the fault type, timely inform operation personnel for prompt maintenance and reduce safety problems and safety accidents.

Solution

The projects adopt CMFMC 3.0 engine for tower noise signal identification, with parameter analysis method and waveform analysis method, to assess the tower bolts loose and tower tilt safety. It can accurately find the bolt loose position and tower tilt, and give timely alarms, establish the tower health status assessment.

Business Value

The tower online monitoring system based on voice print recognition technology is developed, which can realize the 24-hour online monitoring of the transmission tower tilt degree and bolt loosening. Establish the life-cycle safety graph, solve the disadvantages brought by manual maintenance, effectively improve the efficiency of transportation and inspection, ensure the operation safety of the whole tower, and reduce economic losses and safety acciden

国家电网 STATE GRID　NARI 南瑞集团　ZHIYANG 智洋创新

Thermal Power Generation

Background

More than 70% of the main source of electricity in China depends on thermal power generation, especially coal-fired power generation. There are three major components in thermal power generation units: pot Furnaces, steam turbines, and generators. During the operation of these unit equipment, coal powder, heat, steam, machinery and other media will continuously friction with the main equipment and auxiliary equipment. These frictions will generate a lot of noise, and also produce friction loss, which will cause great safety hazards, and even accidents such as steam leakage.

Solution

ZhongKeHaoyin has developed an online monitoring system for water cooling wall, which can monitor the sound in the pipeline, and provide the owner with complete thickness information of the furnace wall through four-dimensional values of time and space.

Business Value

Provide remote online monitoring, liberate manpower, make the monitoring work more intelligent and more efficient. At the same time, prepare for following activities to monitor the boiler status, steam turbine surge, generator failure, etc.

大唐国际发电股份有限公司 DATANG INTERNATIONAL POWER GENERATION CO., LTD.

中国华能集团有限公司 CHINA HUANENG GROUP CO., LTD.

Petrochemical Production Equipment

Background

There are many kinds of petrochemical equipment: the production process is complex; the operation environment is usually relatively bad; and the continuous operation with high workload is quite normal. There are some important and sensitive equipment. Once equipment failure occurs in the production process, it will affect the production efficiency, or lead to unplanned shutdown of the whole system, production interruption, causing serious economic losses, and even safety accidents, endangering life. At present, the enterprises adopts online instruments to monitor and alarm for large equipment, but the potential trouble caused by wear and deformation of equipment parts cannot be predicted in advance, and the subsidiary damage is hard to control.

Solution

ZhongKeHaoYin voiceprint online monitoring system can provide comprehensively the equipment status evaluation, intelligent reasoning and fault diagnosis, which enables timely grasp of the operation status of the equipment.

Business Value

Voiceprint monitoring in three sections of electricity, power and pipeline in the petroleum system.

Water Conservancy: PCCP Broken Wire

Background

The XXX water transfer pipe network project is divided into three parts, with about 600km single pipe in Province 1, about 1000km in Province 2 and about 30km double pipe in Province 3. Due to various reasons, there have been many pipe explosion incidents in these areas, and the situation is very serious.

Solution

Based on acoustic fiber monitoring technology, acoustic monitoring technology can detect PCCP broken wires in real time, which is suitable for continuous and automatic monitoring in PCCP operation stage. It is a non-invasive PCCP status evaluation method without emptying pipe.

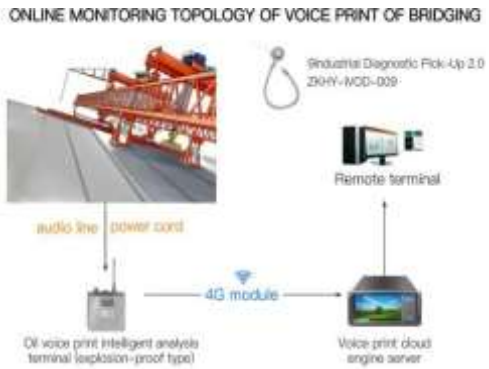
Business Value

Provide accurate positioning and broken wire information for early warning of pipeline hazard and prevent safety accidents.

Reference

South-North Water Diversion; Long River-Huai River Water Diversion

Bridge and Road Infrastructure



Background

The quality of prefabricated bridge beam is relevant to the transport safety. Because the concrete coarse aggregate particle size is too large, there are concrete cracking hole and other phenomena. If not timely investigated, it may affect the overall life and safety of the bridge. Bridging erecting machine is an important mechanical production equipment for infrastructure construction.
Equipment and mechanical failure or improper operation of the drivers can also lead to bridge erecting machine collapse and other accidents.

Solution

ZhongKeHaoYin voiceprint detection system can comprehensively evaluate
the quality state, provide intelligent reasoning and fault diagnosis, provide an important basis for judging the quality decision of prefabricated beam. At the same time, through the monitoring of bridge locomotive key parts (such as engine, motor) with high sensitivity voiceprint sensor, we can also monitor their working condition.

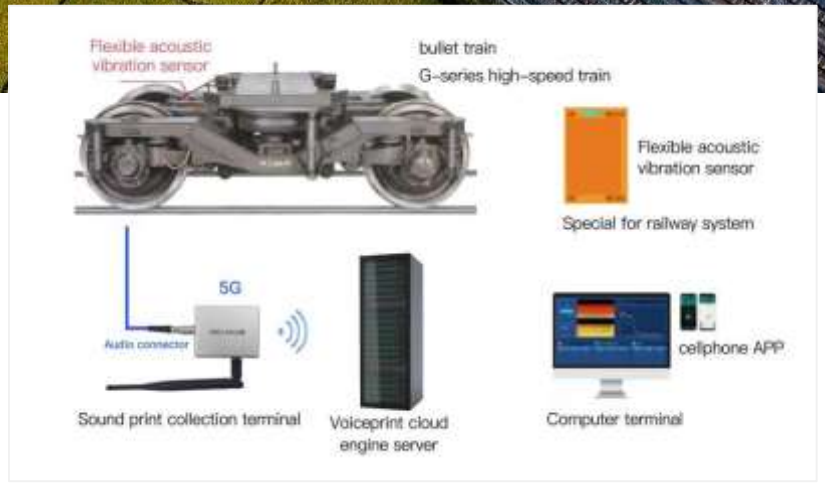
Business Value

Through the voiceprint technology to help the engineering personnel with the prefabricated beam detection, and improve the overall firmness of the bridge engineering structure.

中国建筑
CHINA STATE CONSTRUCTION

Transport Bureau
of Fujian Province

High Speed Railway



Background

The running gear of the high-speed train means that the lower part guides the vehicle to run along the track and passes all the weight of the locomotive to the part of the rail. It is composed of wheel pair, axle box, side frame, rocker and spring vibration damping device, etc. Its quality is directly related to the operation safety of the whole train.

Solution

Real-time monitoring of the status of the bullet train running gear, capable of running DoA (Boda direction positioning technology), BF (beam forming), powerful function, superior performance and high integration. At present, the noise monitoring device of the running gear can identify a variety of fault types of the running gear and upload the alarm information to the application software.

Business Value

Improve the efficiency of maintenance, improve the fault detection rate and accuracy, real-time fault detection, timely report, reduce the labor cost.

CHSR 神州高铁

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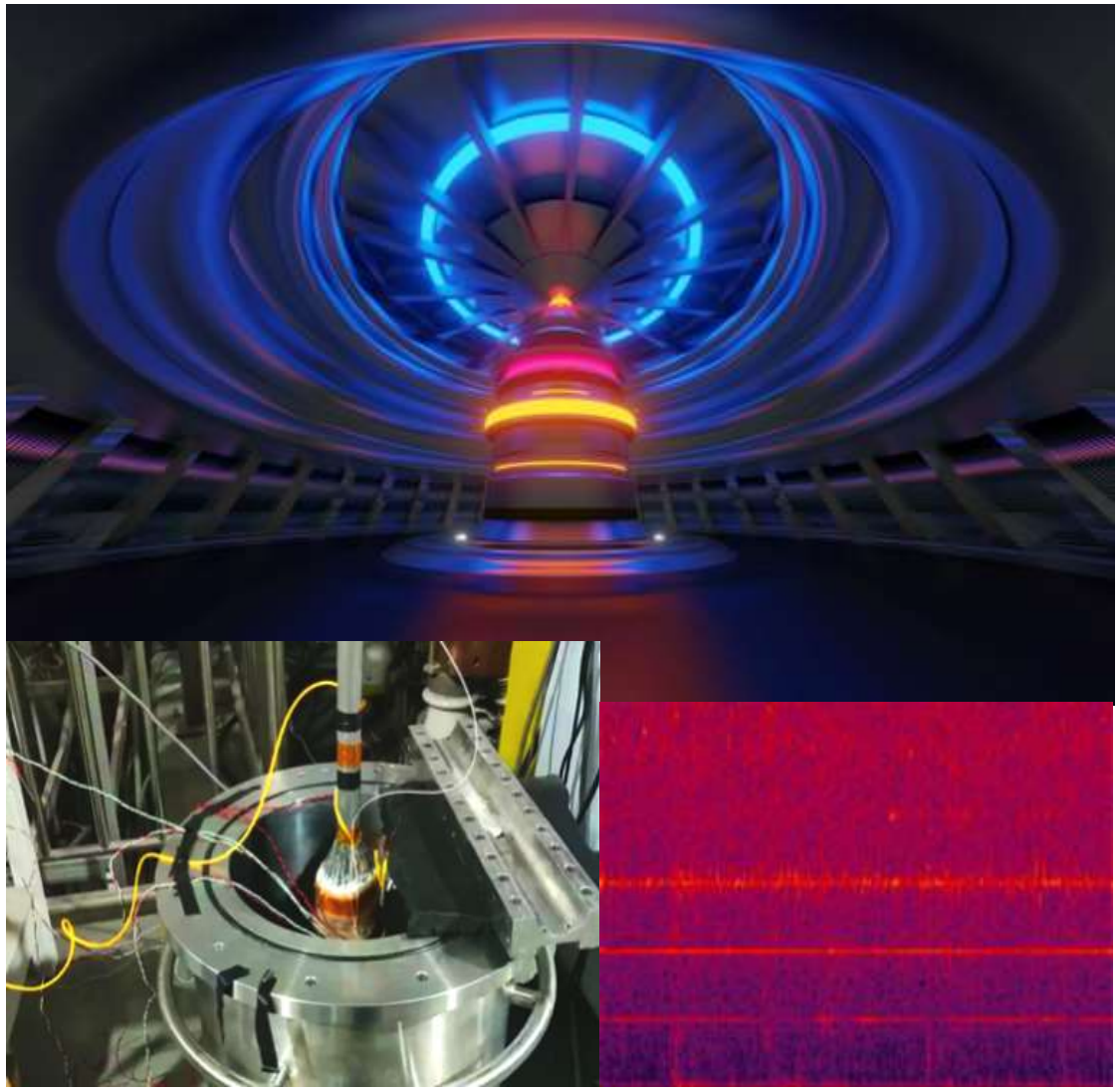
Tokamak



Background

Tokamak systems, which are at the forefront of nuclear fusion research, involve highly complex and sensitive equipment operating under extreme physical conditions. Currently, monitoring and maintenance of critical components such as cryogenic systems, vacuum pumps, and magnetic coils are heavily reliant on periodic checks and physical sensors. This traditional approach may fail to detect subtle anomalies in real time, making it difficult to preemptively address system degradation or failures. Even minor undetected issues can escalate into costly delays or safety risks in fusion experiments..

Solution

Voiceprint monitoring leverages the unique acoustic signatures generated by various subsystems within the Tokamak during operation. By installing high-sensitivity microphones in key areas—such as near cooling systems, vacuum chambers, and magnet power supplies—the system continuously captures sound data. Artificial intelligence, trained on known audio patterns of normal and faulty states, analyzes these voiceprints to detect deviations. This enables early identification of issues such as mechanical resonance in magnets, coolant flow irregularities, or pump malfunctions. The AI can localize faults in three-dimensional space and map them to a fault signature database for real-time diagnostics.

Business Value

Incorporating voiceprint monitoring into Tokamak operations provides a non-invasive, real-time diagnostic tool that enhances safety and efficiency. Researchers and engineers gain immediate insight into abnormal behavior, allowing for preventive maintenance, reduced experiment downtime, and improved equipment longevity. The accumulation of audio data also enables historical analysis and predictive modeling of component failures, supporting the long-term goal of stable, continuous fusion operation and accelerating the path toward commercial fusion energy.