Technology Explanation

# Use of AI Technology in Development of SA Elements

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**Abstract**

Although there has been a third AI（artificial intelligence）boom in recent years, few organizations in the world have been able to gain competitive advantage through the use of AI.

In addition, KYB is focusing on the development of sliding parts for shock absorbers（SA）to achieve both ride comfort and maneuverability at a high level. In order to carry out this development efficiently, we have been providing data-driven support for the development of SA fluid.

This paper introduces the SA Element Development x AI initiative led by Digital Transformation Improvement Dept for these reasons.

When utilizing digital technologies such as AI, it is important to carry out data quality control and provide user-friendly applications. Therefore, we have constructed a platform to safely manage and operate the driving test data collected during the evaluation of developed SA products in auto vehicles, and developed an application to easily search and analyze the data managed by the platform.

With this platform at our disposal, we can now focus on driving tests and data analysis, freeing us from the laborious data management tasks that used to be necessary.

We are already using this platform in some auto vehicle evaluations. Data useful for future SA development is being accumulated in the platform, and we feel that we can realize a sustainable data-driven system to improve development capability.

This paper describes AI-based frequency analysis technology that is the result of joint research with universities, along with the technology and philosophy behind the AI services that utilize such frequency analysis technology for further development, and data analysis platform thus constructed.

## 1 Introduction

We have been experiencing the third AI boom in recent years. Companies and research institutes throughout the world have addressed social implementation [Note 1)] of AI technology to resolve challenges in all fields.

Of the companies who have introduced AI, not less than 60% are still at the stage of Proof of Concept (PoC). An investigation[1)] has revealed that only 12% of organizations in the world have been able to gain competitive advantage through the use of AI.

Major reasons why they have not been able to actively promote the use of AI are:

[1] they have no proper knowledge and technology of AI, and

[2] they have not constructed a platform for AI operation.

Item [1] implies that they cannot step ahead out of the PoC as they are not able to determine whether their challenges should be resolved by AI or not. In KYB, that is why Digital Transformation Improvement Dept is addressing an AI human capital development activity [Note 2)] for employees to learn not only AI technology but also how to set challenges (for more information, refer to “Initiatives to Develop Digital Human Capital” included in this issue of KAYABA Technical Review).

Item [2] above leads to cases where they cannot proceed to the operation phase because the development of AI technology has advanced without establishing a system to collect and manage the necessary data for AI learning. In addition, there may be another case of failing to utilize AI. AI technology can originally prove its worth when combined with other digital technology, which finally resolves issues. However, optimal solutions or services may not be proposed for lack of knowhow on other necessary technologies.

This paper explains the SA Element Development x AI Initiative, rather than describing the human capital development.

Recently, KYB has been focusing on the development of sliding parts for SAs to achieve both ride comfort and maneuverability at a high level [2),3),4)]. Digital Transformation Improvement Dept has provided data-driven support to the development of hydraulic fluids since its foundation in 2019. Specifically, the Department has analyzed the driving test data collected for fluid evaluation using a variety of analysis approaches to compare the developed fluid with conventional ones for verification. Based on the results of the data analyses, the Department has supported the creation of ideas about evaluation techniques and product development.

The analysis approaches that the Department has adopted for trial include frequency analysis using deep learning, which is one of the latest AI technologies. Several analysis approaches including this AI-based analysis method have turned out to be useful for the future development of SA elements. To establish a sustainable data-driven system to improve the development capability, we have developed a “platform”, “application software”, and “AI services”, which will be described in the following chapters.

Note 1) To apply and develop results of research to resolve social issues.

Note 2) KYB prefers to use the term "human capital " instead of "human resources".

## 2 Requirements

In this development activity, we have constructed a platform for implementing centralized management of driving test data including data retrieval and analysis.

The construction of the data analysis platform focusing on “data quality control” and the development of user-friendly data analysis applications were applied with the following requirements.

### 2. 1 Data Analysis Platform

The requirements to ensure data quality control are:

[1] Collected driving test data shall be standardized and able to be saved in the platform.

[2] Records of test conditions and other descriptions on the data in item [1] above shall be standardized and able to be saved in the platform.

[3] Driving test data shall be linked to the test conditions and able to be managed on the platform.

[4] Data pretreatment including the linkage above shall be able to be automated.

[5] No tampering or loss of data under management of the platform shall occur.

The driving test data has been standardized in such a manner that sensor measurements are saved in the same format irrespective of who carried out the measurement by using a dedicated logger that was developed for standardization of vehicle measurement and that automated data processing and permanent data management on the platform have been implemented by effectively using Amazon Web Services (hereinafter "AWS"). We have also developed a test condition recording application with which anyone can record test conditions in the same format using the same wording. Details of the application will be explained in the following chapters.

### 2. 2 Data Analysis Application

Data can deliver its value only after it is analyzed and utilized for decision making. The following describes the requirements for the “automatic analysis reporting application” that has been developed to be generally used for any kind of driving test.

The application shall:

[1] allow for retrieval of data to be analyzed,

[2] allow data analysts to automatically create graphs that may be frequently referred to,

[3] be able to promote the use of AI and Business Intelligence (BI) and to support idea creation,

[4] be able to be intuitively operated, and,

[5] be stably operated.

The easy-to-operate application we have developed can provide several functions including “data retrieval”, “analysis reporting”, and “support to idea creation”. With consideration given to the micro service[Note 3)], the application was redesigned not to affect other functions during modification of some functions. This application uses AWS to ensure stable operation. The following chapters provide details of the application.

Note 3) An engineering method that divides a single application into small services to enhance the development efficiency and minimize the affected range.

## 3 Overview of Data Analysis Platform

### 3. 1 System Configuration

Fig. 1 shows an overview of the system we developed. The. system constructed on the AWS cloud is designed to implement data collection, saving, visualization, and analysis.

### 3. 2 Data Collection

For proper analysis of the driving test results, it is necessary to appropriately link and manage measurements of the driving test data to the spreadsheet meta data recording the test conditions. Thus, this system has a data collection line for the driving test data and another line for the meta data.

The driving test data is measured using a dedicated logger developed with KYB's smart road monitoring system[5)]. Unprocessed driving data measured with this dedicated logger is uploaded to AWS by an Edge PC. With consideration given to the expandability of the dedicated logger, Amazon S3 [Note 4)] has been selected as the data upload destination because S3 can save data in various formats including image and audio data sets that are not currently collected.

The meta data can easily be recorded by test personnel just by connecting to a dedicated website from their own tablet or other similar data terminal and then inputting the necessary information there. Information items to be collected as meta data have been standardized through preliminary discussion among those concerned. The dedicated website, particularly the information input screen, has been designed to be user-friendly based on opinions collected through interviews with those who are working on the site. With the aim of reducing the burden of website operation and management as well as the operation cost, the static website hosting function Note 5) of Amazon S3 was introduced. The website is only allowed to be accessed by authorized users who have passed a user authentication through the in-house network, ensuring security as well.

Note 4) A data storage service that can save and protect data with no limit on data type and capacity.

Note 5) A static website can be constructed by uploading web contents to Amazon S3.

### 3. 3 Data Processing

Data measurement by the dedicated logger is automatically started at the time when the logger switch is turned on. This means that even driving data of a vehicle running out of the testing section is measured too. Then, a program to only extract driving data of a vehicle running from the testing section was built as a workflow of AWS Step Functions. Note 6)

With input of the meta data and unprocessed driving data, this workflow refers to the meta data and extracts the driving data collected in the testing section. The extracted data is processed into an easy-to-handle format and then saved in Amazon S3. The meta data can be stored in a relational database (hereinafter the "RDB") linked to the date and time of measurement of the driving test data. This data management allows users to retrieve the driving test data they want to analyze whenever necessary (Fig. 2).

The use of the cloud service has not only enabled the fast processing of the workflow but has also improved fault tolerance and has established a backup environment at low cost. The cloud service can also be used to relatively easily build and operate a workflow in which cost only arises for using the necessary resources. For conventional data processing, the meta data has been prepared in a spreadsheet software application, from which the driving test data has been manually extracted in several days. It has needed a number of man-hours to complete the data processing for organizing the driving test data just for one day. From now on, the established workflow will automatically carry out a series of data process-

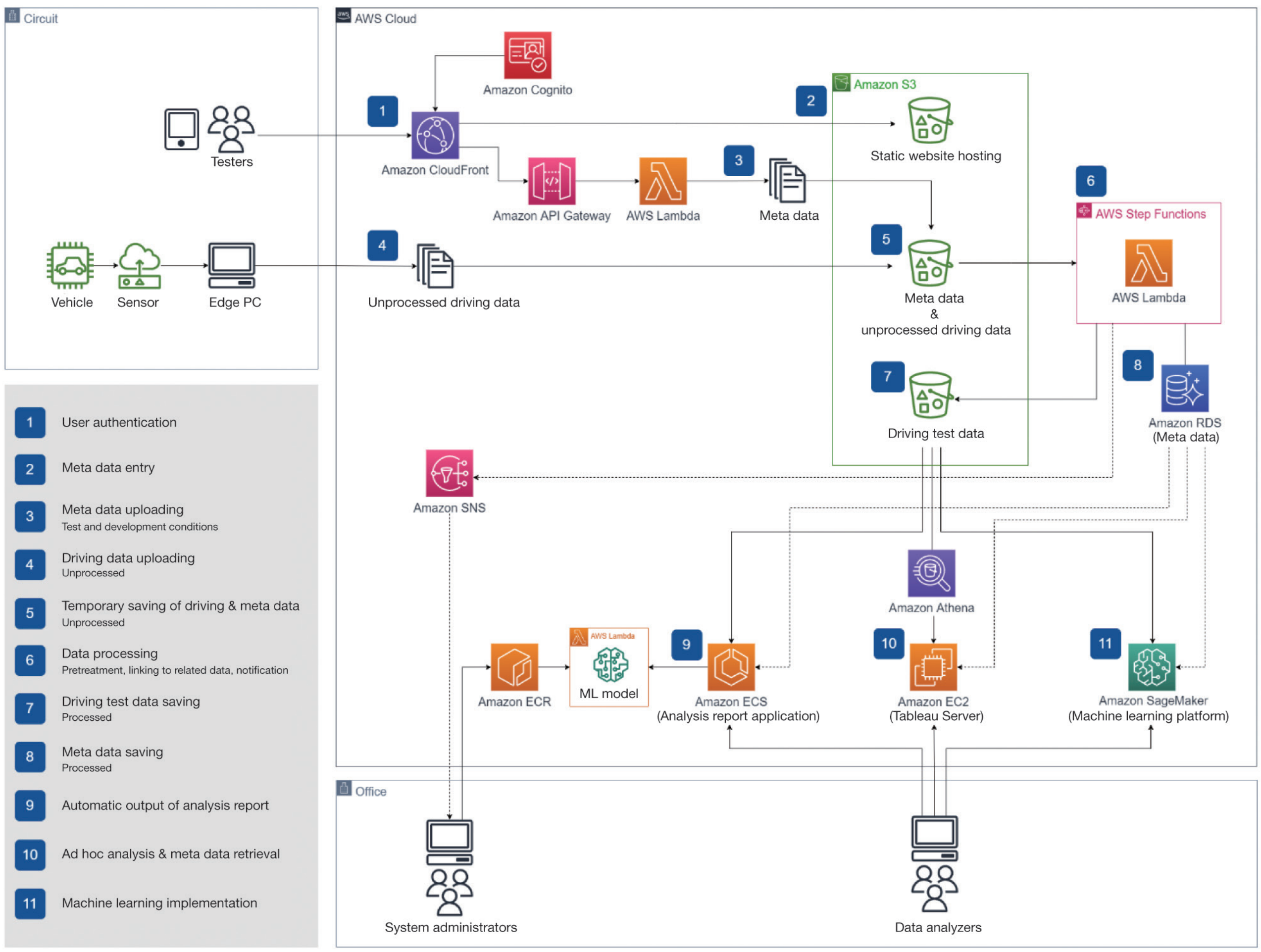



**Fig. 1** Overview of data analysis platform

ing tasks just with manual data entry of test conditions by test personnel, substantially reducing the man-hours for data processing.

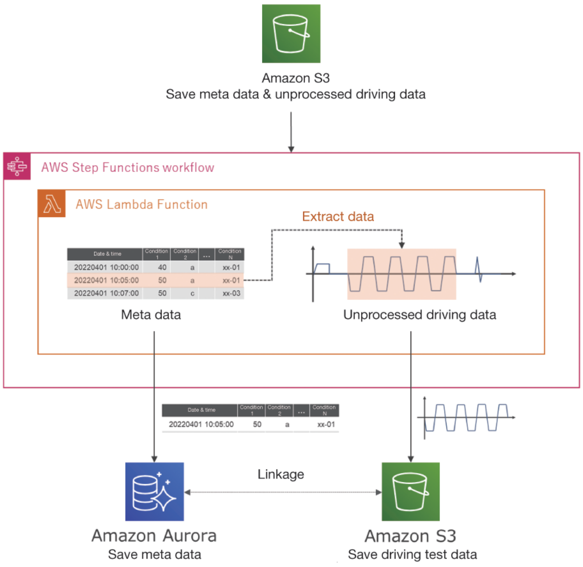



**Fig. 2** Overview of workflow

Note 6) A service with which users can create a series of workflows by allocating two or more AWS services.

### 3. 4 Data Analysis

The data analysis platform provides the following analysis approaches applicable to the managed driving test data, so that analyzers can proceed with the analysis step by step:

[1] Simplified analysis using standard reports
[2] Ad hoc analysis Note 7) using BI tools
[3] Advanced analysis using AI

Note 7) One-off data analysis that is conducted as necessary with no analysis items or details predetermined.

#### 3. 4. 1 Simplified Analysis Using Standard Reports

Once the driving test data is managed on the platform, data analyzers can first view the analysis report automatically output by an internally built web-based application. This web-based application was developed by consulting KYB's analysis techniques. Just by selecting any given driving test data, anyone can easily create a standard report on the test results with the analysis knowhow accumulated in the past. Details of the functions provided by this web-based application will be explained in Chapter 5.

With the web-based application, the creation of standard reports, which was difficult without dedicated tools or well-informed people, has now been standardized. In addition, the safe data management by the platform releases analyzers from management work on data and dedicated tools and allows them to concentrate on analysis, research, and development tasks.

#### 3. 4. 2 Ad Hoc Analysis Using BI Tools

While the analysis reports certainly characterize the driving test data, an ad hoc analysis environment using BI tools is available to enable even deeper analyses. KYB provides a data analysis environment using Tableau not only for this development activity but also across the company.

We have also developed and provided a function whereby anyone can easily retrieve any given driving test data by connecting the RDB managing the meta data to Tableau (Fig. 3). With this search function, analyzers can now efficiently conduct statistical analysis of driving test data sets collected under similar test conditions or comparison and verification of similar driving test data sets that are only different in specific conditions. Another function available is the downloading of search results. This may be useful for sharing the search results or data pretreatment for "advanced analysis using AI", which will be described later.

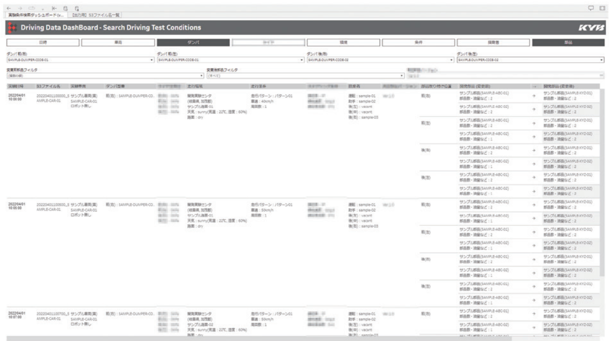



**Fig. 3** Driving test data search screen

#### 3. 4. 3 Advanced Analysis Using AI

An environment to implement machine learning Note 8) is available to support more advanced analysis approaches for the driving test data. Digital Transformation Improvement Dept is promoting an activity to develop AI human capital capable of effectively utilizing Amazon SageMaker. Note 9) In liaison with the promotion work, the Department has also advanced the development of this system.

Currently, the Department provides SageMaker Notebook Note 10) as a data analysis environment in the test phase. In the development phase with the aim of proceeding to the product phase including machine learning implementation, the Department recommends carrying out development from local PCs using a dedicated Software Development Kit (SDK) for AWS. Not only by simply providing an environment for machine learning implementation but also by distributing sample codes already organized and actively disclosing the know-how for Amazon SageMaker use accumulated in the company, the Department supports the promotion of AI utilization. The environment provided by the Department allows human capital who have already utilized Amazon SageMaker to quickly obtain any given driving test data managed by the platform and conduct advanced analysis by leveraging various analysis technologies including AI.

Finally, the AI that was developed in this activity has been incorporated into an AI service, which is now available. The AI service includes a function with which anyone with no knowledge about AI can freely obtain analysis results given by AI so long as data is available. Details of the AI that was developed as well as the AI service will be described in Chapter 6 onward.

Note 8) A technology with which a computer can learn rules and patterns from a variety of data including numeric values and text to determine the current condition and prospect the future.

Note 9) A service that provides an environment to quickly develop, learn, and distribute machine learning models.

Note 10) A service that can interactively implement a series of tasks including data visualization and machine learning model building.

## 4 Effort for Establishing an Appropriate Development and Operation System

### 4.1 Development Taking Expandability Into Account

We carry out system development using Infrastructure as Code (hereinafter "IaC") taking subsequent expandability and maintainability into account. IaC provides a way of managing the configuration of infrastructure using source codes. It uses source codes to define server environments and application settings. When building a system, IaC can be used to reduce the man-hours, increase efficiency in reutilization, and reduce human errors in manual operation. This system uses Serverless Framework for AWS Step Functions and other applications (including the workflow described above) and HashiCorp Terraform for network- or security-related infrastructure.

### 4.2 Scheme for Team Development

Besides IaC, we use another scheme for team development in various applications. That is the source code version management tool GitLab with which we can promote daily development jobs safely and quickly. Source codes created by development personnel are reviewed by well-informed people before being merged into the production environment. Once a service is formally released under a CI/CD Note 11) environment, the latest version of source codes is tagged, which is one of the GitLab functions. The use of this rule ensures that, should a service release fail in future, the service can be swiftly rolled back to the last version that has proven to provide normal operation (Fig. 4).

Note 11) Refers to a system that automates the build, test, and development processes. CI and CD are acronyms for Continuous Integration and Continuous Delivery respectively.

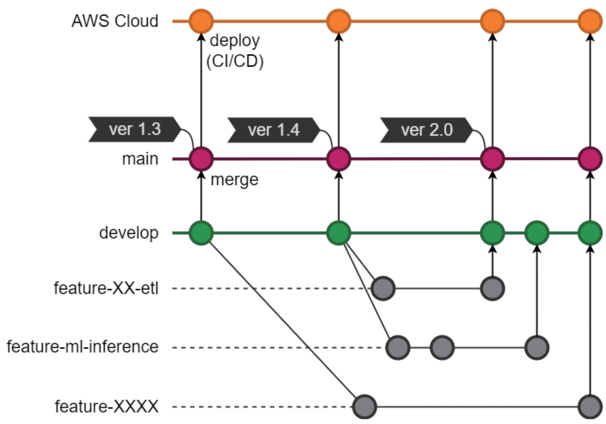



**Fig. 4** System development using tagging

### 4.3 Multi-account Cloud Operation

As the number of systems running in the company increases in future, it will be necessary to establish an appropriate operation rule for AWS accounts. KYB is promoting a multi-account operation that uses the single sign-on method to switch over multiple AWS accounts depending on the type and environment of the system (Fig. 5). Developers and maintainer are only allowed to access specific operations according to their own set of authorizations invested to individual service accounts.

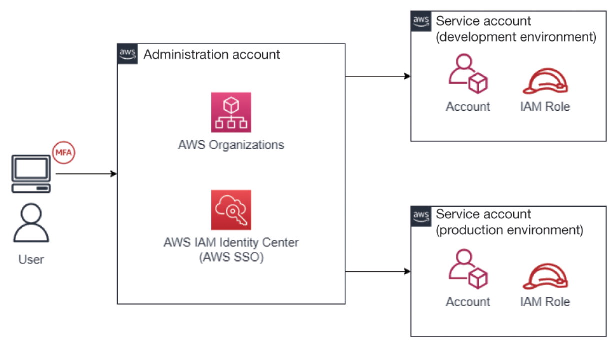



**Fig. 5** Overview of multi-account operation

Distribution of authorizations for services and functions to different accounts can help control cloud security and eliminate the need of setting maximum usage of each account. This can be expected to reduce the burden of AWS administrators and users. This operation rule is also applied to the construction of this system.

## 5 Development of Automatic Analysis Reporting Application

As amounts of data increase, data visualization requires more time and more man-hours. Then, we have developed a web-based data analysis application that can quickly visualize the results of the analysis of driving test data and then automatically output a report (hereinafter the "web-based analysis application") without the laborious tasks that used to be necessary.

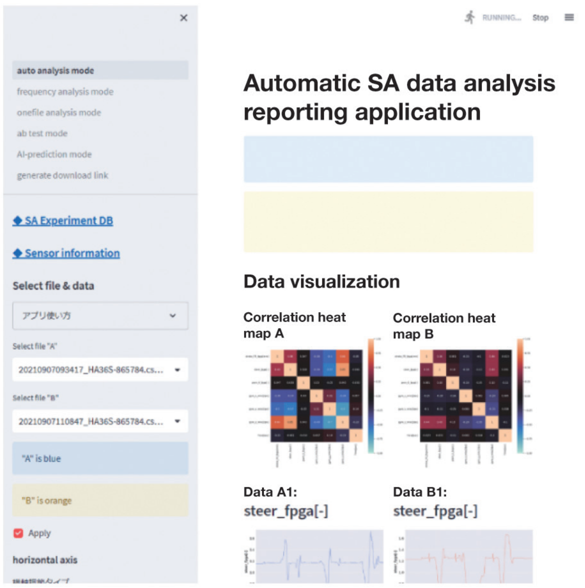



**Fig. 6** Screens of the web-based analysis application

Using the web-based analysis application, you can easily access the driving test data uploaded in the cloud (Fig. 6). Just by selecting a set of driving test data you want to analyze, the web-based analysis application automatically visualizes the data set, eliminating the need for complicated setting or operation. You may also extract data you want to analyze in detail (for example, a data set collected for a certain period immediately after the start of a test) as necessary, and then view the data in different scales. The driving test data may also be filtered by test conditions, which also serve as a description of the data to be analyzed, on the Tableau screen shown in Fig. 3, Chapter 3. Data retrieved in this way will also be automatically visualized on the application. We assume that the web-based analysis application will be used in these ways.

There are three modes in the web-based analysis application as described later. You can select the desired mode depending on the application.

### 5. 1 General Analysis Mode

General analysis mode is available for the typical visualization formats, which data analyzers frequently use to create drawings. Through hearing from those concerned who were involved in data analysis, data visualization formats that were popular among them were selected. Specifically, these formats include line graphs, scatter diagrams, and histograms. In addition to these views, the application is designed to be able to output sensor measurement statistics, correlation maps, and other relational data just with a simple mouse operation on the web-based application.

Fig. 7 shows an example of the visualization of the driving test data collected for the evaluation of SA fluids using actual auto vehicles. The use of the web-based analysis application made it possible to quickly identify the characteristics of the data obtained from more than one sensor, substantially reducing the time needed to complete the process from data collection to visualization.

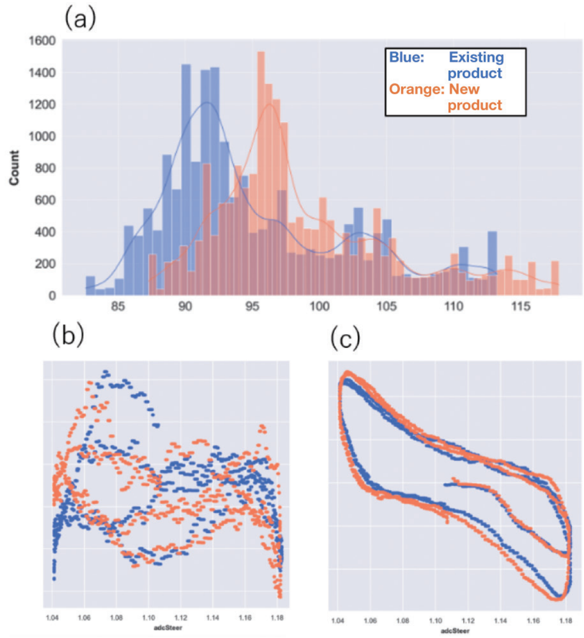



**Fig. 7** Case example of using the web-based analysis application (general analysis mode): (a) Histogram of Sensor A, (b) Scatter diagram with X-axis for Sensor A and Y-axis for Sensor B, (c) Scatter diagram with X-axis for Sensor A and Y-axis for Sensor C

### 5. 2 Frequency Analysis Mode

Frequency analysis mode allows users to view spectrograms of power spectra and time-frequency analysis. Detailed parameters for creating frequency analysis graphs can be individually set. Basically, the web-based analysis application automatically sets parameters in response to the data input, allowing users to easily visualize the data without paying attention to detailed settings.

### 5. 3 AI Analysis Mode

AI analysis mode is where all users can easily carry out frequency analysis with AI. Detailed information about the AI-based approach we developed will be described in the next chapter.

### 5. 4 Downloading of Driving Test Data

A function that allows users to separately download the driving test data selected on the web-based analysis application as CSV files is also available. A signed URL with an expiration date is issued to target users so that they can download the data just through a simple mouse operation.

This function can meet the needs of users who want to visualize data in their own way, using familiar analysis tools.

## 6 Use of AI and Setting-up of Challenges

Deep learning is one of the latest AI technologies and a general-purpose method to be utilized to resolve any challenge. On the other hand, in comparison with conventional proven technologies, deep learning delivers just equivalent or possibly inferior performance depending on the challenge. Therefore, it is important to discuss the following questions before starting to develop an AI-based technology:

[1] Is the use of AI is the best way of resolving the challenge?

[2] Can the challenge be adjusted so that the use of AI is the best solution?

You can easily answer question [1] if you have proper knowledge about AI. You may hardly be able to answer question [2] unless you have general knowledge and experience in interpreting challenges in addition to knowledge about AI. The following describes specific examples of setting up challenges:

### 6. 1 Background and Challenges

KYB has promoted the development of SA sliding parts to achieve both ride comfort and maneuverability at a high level. It was known that sensory factors including ride comfort would be substantially affected by a change of SA fluids only. However, the relationship between the fluid and the vehicle behavior had not been fully clarified.

At first, we had the existing product and a new product that was identical to the existing one except for an improved fluid. These products were tested on actual auto vehicles for evaluation and frequency analysis (Fig. 8). A comparison of the results of fluid analysis between the existing and new products only identified a minor difference between the two. Was this minor difference attributable to the fluids or to any environmental factors such as road noise? Or might it be caused by differences in driving manner? Note 13) There arose the problem that the cause of the minor difference was difficult to determine.

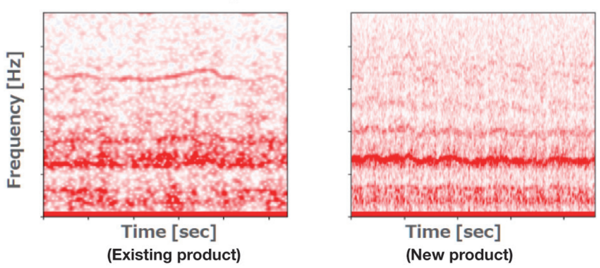



**Fig. 8** Results of analysis of SA sprung frequency for different fluids Note 12)

Note 12) The spectrograms were generated with Fourier transform to visualize vibration. Part of the information is confidential and has been intentionally deleted or blurred.

Note 13) Even under the same test conditions, the operation of the accelerator and/or steering wheel of auto vehicles may slightly vary.

### 6. 2 Setting up Challenges for AI

KYB has addressed the development of advanced anomaly detection technologies[6),7)] utilizing deep learning, which is one of the latest AI technologies, including “appearance inspection through image processing” and “poor weld detection”. By effectively using insights from this experience, we decided to treat the acceleration information, among the driving test data items related to the SA fluid, as follows:

[1] Acceleration of existing product: Reference data

[2] Acceleration of new product: Comparative data

The AI-based anomaly detection technologies were applied to develop a technology to only learn the acceleration information (reference data) of the existing product and detect what is new in the new product. Note 14)

In short, the challenge of "detecting what is new in the new product" was interpreted as "comparing the results of frequency analysis between the existing and new products and only detecting the differences attributable to the fluids". The latter was further replaced by the challenge of "anomaly detection for which the use of AI is effective". These considerations were made in the initial stage of the development phase before the full-scale development was launched.

Note 14) An AI-based technology that compares acceleration between the existing and new products and identifies frequency bands with substantial differences.

## 7 General AI-based and Proposed Approaches for Anomaly Detection

The newly developed approach is an application of AI-based encoder and decoder. The approach is generally used to input image or other data that is dense with information to an encoder where the information is compressed and then further input the compressed information to a decoder where given data can be reconfigured. This approach has the following two major advantages:

[1] Difficult-to-handle high dimensional data can be converted into low dimensional data, which can be used as a feature value for machine learning.

[2] The data compression/reconfiguration process is expected to deliver a noise removal effect. (In other words, only distinctive data can be reconfigured).

If the encoder and decoder learn to reconfigure input data Note 15), determining the difference between the reconfigured data (output data) and the input data can locate noise. This noise corresponds to flaws or stains that are found in appearance inspections. Thus, this approach is often used at sites requiring anomaly detection (Fig. 9).

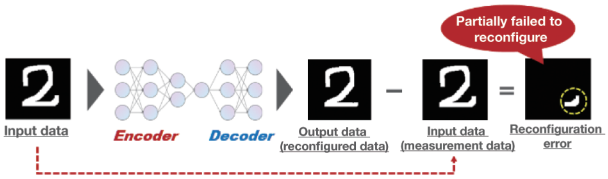



**Fig. 9** AI-based approach for fault detection of hand-written text

Note 15) An approach for an encoder and a decoder to learn to ensure that the input data is identical to the output data is called an autoencoder.

### 7.1 Proposed Approach

In the proposed approach, the encoder learns to receive input of spectrograms of the unsprung acceleration of the existing product and the decoder learns to output (or reconfigure) spectrograms of the sprung acceleration (Fig. 10).

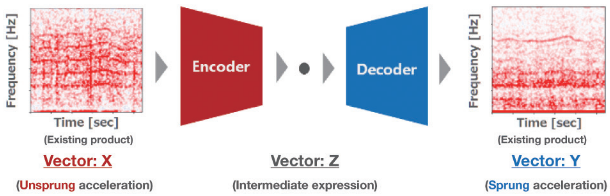



**Fig. 10** Overview of proposed approach

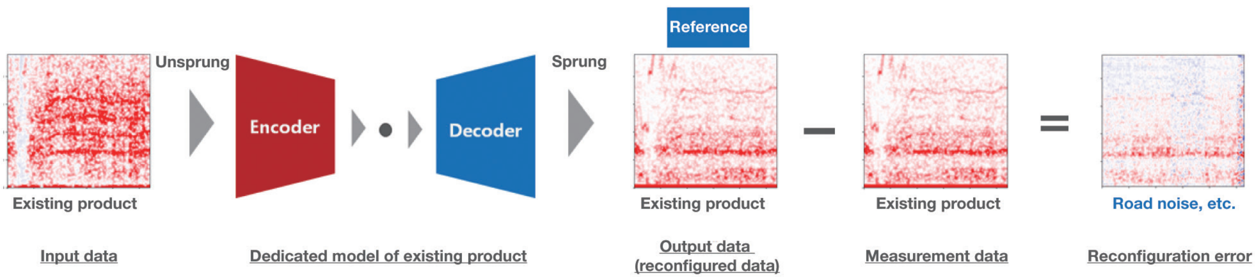
Learning huge amounts of data from the existing product alone can generate a dedicated model for the existing product. The model here means a computing unit that outputs the sprung spectrogram of the existing product after being input with its unsprung spectrogram.

If part of the existing product data that was not used for learning is input to this model, the sprung acceleration with noise removed can be output. Identifying the difference between this output data and the actual measurement data allows visualization of the noise (Fig. 11(a)). This visualized noise is expected to be able to be interpreted as "test errors including road noise".

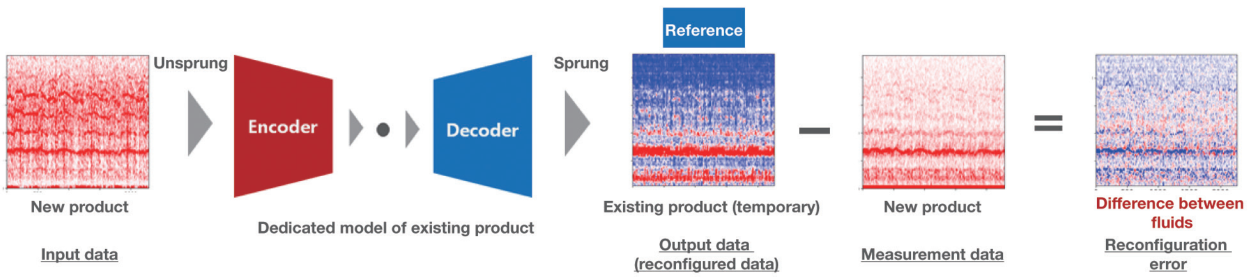
If data from the new product is input to this model in turn, only the frequency bands that correspond to those of the existing product data can be output. Identifying the differences between this output data and the actual measurement data allows observation of the frequency bands that failed to be reconfigured well as noise (Fig. 11(b)). This visualized noise is expected to be able to be interpreted as "differences in frequency bands attributable to the fluids".

When visually checking the spectrograms for reconfiguration errors, however, users may discover minor variations in color by unavoidably relying on their subjective determination. Then, we have proposed another plotting method that averages spectrograms out in the direction of the axis for frequency and visualizes shifts in frequency bands using a line graph (Fig. 12). We believe that this plotting method allows users to determine the differences between fluids regardless of users' expertise.

Another advantage of this proposed approach is that only a relatively small amount of data from the new product is needed while large amounts of learned data (the existing product data in this case) need to be available. This means that, as long as large amounts of driving test data to be benchmarked are collected in the initial stage of the development phase, AI-based frequency analysis can be made even with small amounts of data from the




(a) Learned model with existing product data as input




(b) Learned model with new product data as input

**Fig. 11** Overview of proposed approach

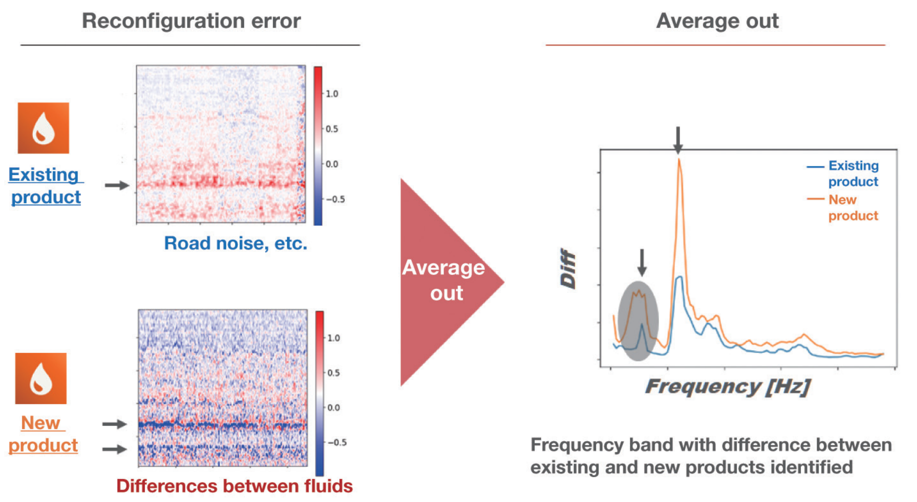



**Fig. 12** AI-based visualization of differences in sprung frequency bands between existing and new products

new product. Note that the model generated in this proposed approach is a black box. The grounds on which the data was reconfigured is unknown. It must be remembered that analysis results should be used for reference purpose only.

## 8 AI Support for Development of SA Elements

Digital Transformation Improvement Dept uses Python Note 16) for development of AI-based technologies including the proposed approach described in Chapter 7. Therefore, expertise on AI and Python as well as a dedicated operating environment are needed for effective use of the proposed approach. We thought that, in fact, many people faced a hurdle to obtain expertise and prepare the operating environment. We then developed an application embedded with AI (the proposed approach) to establish an environment where anyone can try the AI-based frequency analysis.

Note 16) One of the general-purpose programming languages. Python is the de facto standard language for AI development.

### 8. 1 Case Example of Utilizing Internally Built AI Services

The AI service we developed is available as one of the functions of the “automatic analysis reporting application” described in Chapter 5. One thing that is different from the other functions is that the AI service also supports data that is not managed by the platform Note 17) Any users can temporarily upload their own data via the web-based application to analyze the data using the AI service.

This AI service has the following objectives:

[1] To allow users to use the AI service only with the test data available even if they are unable to easily carry out a driving test, lowering the hurdle for AI technology.

[2] To implement AI-based analysis of virtual driving test data generated by simulation, based on the assumption that a high-precision physical SA model including fluid will be created in future.

[3] To allow expanded usage of the AI service to take place by not limiting users or data types.

Finally, Fig. 13 shows an example of using the AI service for any given driving test data. The accuracy of detecting what is new in the new product is expected to rise through comparison of analysis results between the conventional and proposed approaches.

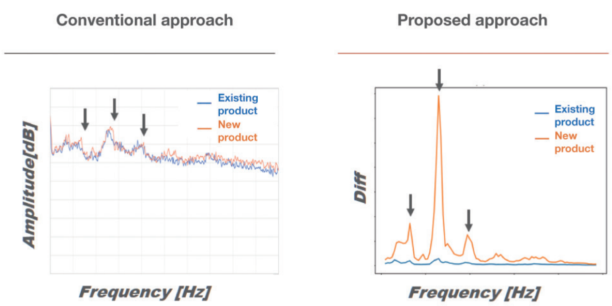



**Fig. 13** Comparison of results of frequency analysis between conventional and proposed approaches

Note 17) Must be in a specified data format.

### 8. 2 Technologies Supporting the AI Service

The development of this AI service has used Container, which is a virtualization technology. Container technology specifically refers to the method of collectively managing and operating AI applications and its operating environment in a single package. A Container containing applications and operating environment can be started up either locally or in the cloud, minimizing environment-dependent problems. Note 18)

AWS provides many different Container-related services. Users can freely select these services according to their needs.

We do not actually use the AI service (the proposed approach) so often in our daily development activity. So, we selected the AWS Lambda service for which we only pay for what we use. Although it takes several minutes to complete the start-up process with AWS Lambda, containers can be started and used at minimum cost, implementing the operation and management of an environment where anyone can use AI services safely whenever needed (around No.9 in Fig. 1).

Note 18) In some cases, modification is needed depending on the container start-up environment.

## 9 Outlook

Under this development project, the construction of a data analysis platform for improved capability for SA development has been completed. In fact, it is difficult to determine whether the platform has contributed to improved development capability or not at this moment because the platform has little track record of operation yet. Still, the platform did provide users with the following value:

[1] Users have been released from data management work.

[2] An environment where users can focus on driving tests and data analysis has become available.

The platform has been constructed to be able to manage and operate a variety of driving test data. If a driving test that cannot be assumed at this moment is carried out in future, however, the platform may fail to cope with the analysis. So, we would like to develop a maintenance system ensuring that the platform can be operated over a long time and can handle even unexpected problems.

The “AI service” described in this paper was developed by applying the results of the joint research of Gifu University and Digital Transformation Improvement Dept of KYB. The service is available in a user-friendly manner even to users who are not AI experts. From now on, we would like to introduce AI-based technologies and algorithms developed not only by Digital Transformation Improvement Dept but also by other functions into the service. To achieve this as well, we plan to establish a scheme to respond to inquiries on how to use the platform or the development environment from AI human capital or advanced IT human capital in various functions.

## 10 Concluding Remarks

This development project has constructed a system to effectively use driving test data. We understand that some employees may have inhibitions on the Work Style Reform using digital technology. Still, we will promote digital transformation (DX) by adequately explaining the full value of accepting DX.

The know-how accumulated in this development project can be also applied to building platforms for types of data other than driving test data. Any functions facing difficulties with data utilization can collaborate with us for resolving their challenges.

Finally, I would like to take this opportunity to sincerely thank all those concerned in the related functions who extended great support and cooperation to this development project.

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