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## **Study for Utilization of Delay and Congestion Information -Analysis and Setting Index of Transportation -**

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### **Abstract**

We, East Japan Railway Company, have begun to utilize the collected data for improving our transportation services and supplying good service for passengers. This time, we will introduce our various initiatives that utilize data on the number of passengers. (1) We have developed "Congestion Visualization System" that visualizes the congestion of running trains by using the weight data of the running train, calculating the number of passengers. (2) We have developed "Timetable Revision Effect Analysis Tool" that quantitatively evaluates the effects of the schedule revision by comparing data before and after timetable revision. (3) We decided to formulate new index "Live-Score". Live-SCORE is calculated by focusing on delay time and congestion of trains running on disrupted line, multiplies the two, and takes the sum, can calculate the same index as SCORE in a timely manner.

**Keywords:** Visualization of Congestion, Simulation of Congestion,  
Evaluation of Rescheduling

### **1 Introduction**

With the progress of ICT, more information is integrated in real time than ever before and various data is also collected in the railway business. Many railway company try to utilize these kinds of information for their work and customer services although it's difficult for effective utilization. We, East Japan Railway Company, continuously collects the various data. And we have begun to utilize the collected data for

improving our transportation services and supplying good service for passengers. One of the systems constructed using such information is the “Congestion Visualization System”. Systems that visualize the delay of trains are widely used for train control centers of railway companies and general passengers. But Congestion Visualization System presents not only the delay of each trains but also the congestion to the dispatcher who uses it to determine adjustments to train service. So that, this system is expected to be utilized in a variety of situations to both reduce the impact on passengers when transportation problems occur and review arrangements carried out for a previous situation. There are many other examples of systems we have tried to construct and put to practical use. This time, we will introduce our various initiatives that utilize data on the number of passengers.

## **2 Methods**

### **(1) Congestion Visualization System:**

We measure the weight data of the running train and calculate the number of passengers. We collect that data wirelessly and can get it in real time. Utilizing this information, we have developed "Congestion Visualization System" that visualizes the congestion of running trains.

### **(2) Timetable Revision Effect Analysis Tool**

We have evaluated the effect of timetable revision manually, by counting the number of passengers each station use and reporting the delay of each train when terminal arrived. But now, we can collect data on train delays and the number of passengers day-to-day. So, we have developed "Timetable Revision Effect Analysis Tool" that quantitatively evaluates the effects of the schedule revision by comparing data before and after timetable revision.

### **(3) Designing Live-Score**

We are studying a function that automatically proposes train rescheduling for the purpose of assisting dispatcher. In order to realize it, formulating an evaluation index for traffic rescheduling is needed. We have been conducting basic research to evaluate and learn the traffic control methods that the dispatcher has implemented in the past by using the index “SCORE” that represents the customer's movement loss, and to propose train rescheduling plan. SCORE has a problem that it takes time to calculate, and is difficult to utilize SCORE for timely rescheduling work. To solve this problem, we decided to formulate new index “Live-Score”. Live-SCORE is calculated by focusing on delay time and congestion of trains running on disrupted line, multiplies the two, and takes the sum, can calculate the same index as SCORE in a timely manner. We applied this new index calculation method “Live-Score” to actual cases and verified its effectiveness.

## **3 Results**

### **(1) Congestion Visualization System:**

Fig.1-3 shows examples of the developed screen. This system is compatible with most of our trains traveling in the Tokyo metropolitan area. By using this system in transportation problems that occur on the line, dispatchers can make arrangements for traffic control based on train congestion. The dispatcher also uses this system to review arrangements carried out for a previous situation.

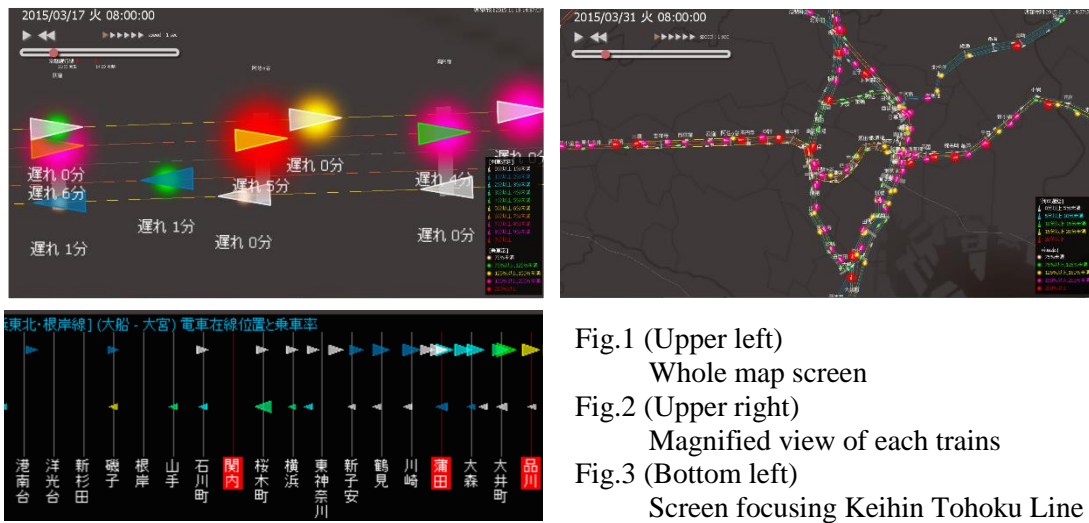


Fig.1 (Upper left)  
Whole map screen  
Fig.2 (Upper right)  
Magnified view of each trains  
Fig.3 (Bottom left)  
Screen focusing Keihin Tohoku Line

Figure.1-3 Examples of the developed screen

(2) Timetable Revision Effect Analysis Tool

Fig.4-5 shows examples of the developed screen. We can compare not only the congestion rate and delay of each train, but also the increase or decrease of travel time. In the future, we are studying how to simulate the congestion rate and train delay at the stage of creating timetable that contributes to create more effective timetable.

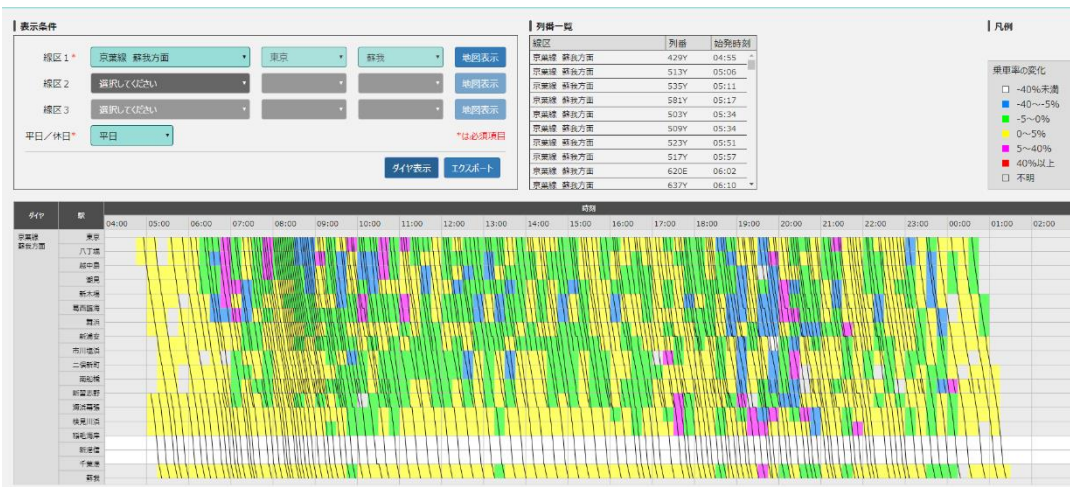


Figure.4 Evaluation of the congestion rate before and after timetable revision in Keiyo Line

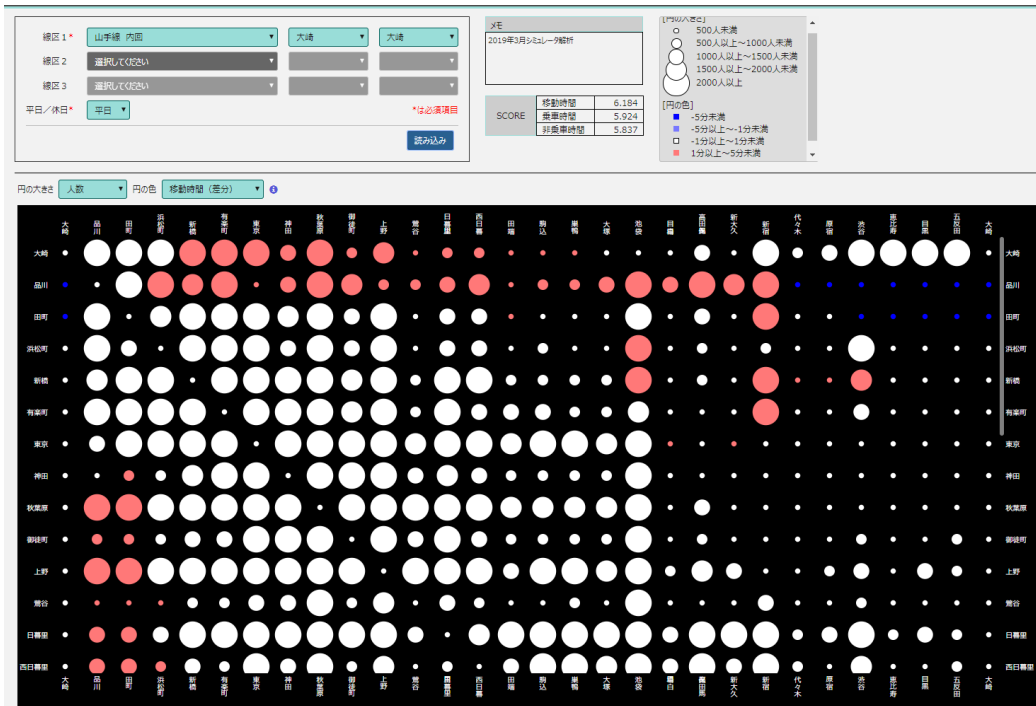


Figure.5 Evaluation of changing traveling time before and after timetable revision in Yamanote Line

### (3) Designing Live-Score

As a result, it was confirmed that results close to SCORE were obtained for all cases. Fig.6 shows correlation between SCORE and Live-SCORE. In addition, we learn the advantages of Live-SCORE as below that SCORE don't have such as below: We can easily calculate results and separately calculate the results with each line. We have analyzed the change in the number of passengers before and after train rescheduling by using the information of passengers made in the process of calculating Live-SCORE. Based on the analysis, we created a model of the change in the number of passengers on the entire route using actual data on the Keihin Tohoku Line, and created a prototype tool capable of calculating Live-SCORE and predicting passenger flow.

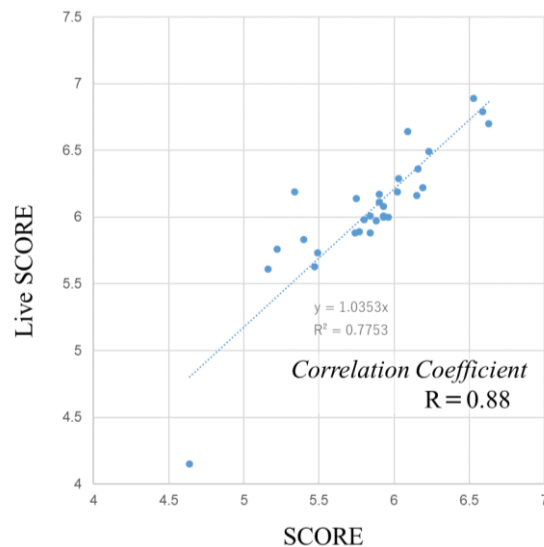


Figure.6 Correlation between SCORE and Live-SCORE

## 4 Conclusions and Contributions

We have introduced our various initiatives using data on the number of passengers. Congestion Visualization System, Timetable Revision Effect Analysis Tool and Live-Score all are efforts to visualize flow of passengers and made possible to understand the flow quantitatively. And we created a model of the change in the number of passengers on the entire route using actual data, and created a prototype tool capable of calculating Live-SCORE and predicting passenger flow. Now we are studying how to use these systems practically. In the Future, for the purpose of supporting our work, we are considering practical use as below.

### 【Automatically train rescheduling】

We are studying a function that automatically proposes train rescheduling for the purpose of assisting dispatchers. Employing this function will shorten the time it takes to make rescheduling plan and lighten dispatcher's workload.

### 【Simulation of congestion rate and train delay when train timetable change】

We are studying how to simulate the congestion rate and train delay at the early stage of creating timetable. In the current system, we can understand the effect of timetable revision only once a year because timetable revision takes places once a year. But if we can simulate the effect of timetable revision, we can get chance to understand various results of timetable revision. And simulating the effects of timetable revision at an early stage contributes to create more effective timetable and shorten creation time.

We will continuously utilize various data to further improve convenience.

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