IMPROVEMENT OF THE TRAFFIC PLANNING BUSINESS BY THE TRUNSIS-C

Hideyuki SHOJI
Manager
Central Japan Railway Co.
Tokyo-Japan

Kenichi MATSUKAWA
Engineer
Central Japan Railway Co.
Tokyo-Japan

1.INTRODUCTION

Central Japan Railway Co. is proceeding to constitute computer systems to make the traffic operation planning efficient.

The TRUNSIS-C, which is the abbreviation for the train running simulation system for conventional line, is one of the labor saving systems that we have developed. We took about two years to develop it. It is the system that draws the train operation curve. This paper shows the outline of the TRUNSIS-C.

2.TRAIN OPERATION CURVE

The train operation curve shows how running condition of the train changes as the train goes forward. It consists of the velocity-distance curve and the time-distance curve. The train operation curve is drawn corresponding to the type of train, considering geometric conditions such as curves, grades, turnouts, and so on, track layouts at station yards, signal indications on blocks, and car performance like maximum running speed, acceleration, and so on.

It is used for the following.

2.1.BASIC DATA FOR DRAWING TRAIN DIAGRAM

Planners calculate the standard running time, which means the minimum running time between stations in planning, and the minimum time interval between trains, by means of drawing the train operation curve. The actual train diagram is drawn based on those. The fact that trains are operated very punctually in Japan is attributed to the accuracy of the train operation curve that is used for the train diagram.

2.2.SPECIFICATION OF DRIVING FOR DRIVERS

Since the train operation curve expresses the specification of driving as scheduled, it is used as the driving standard for drivers. The training drivers to drive according to the train operation curve sufficiently keep the punctual operation of trains.

2.3.STUDY OF PLAN FOR TRAFFIC EQUIPMENT AND ROLLING STOCKS

When we study about the construction of a new line, the improvement of traffic equipment for speedup, and the introduction of new rolling stocks, we analyze investments and choose the best one. Then it is indispensable to repeat simulation by means of the train operation curve. Since investment in infrastructure is most expensive in Japan, we have to consider traffic equipment and rolling stocks to be inseparable and seek the maximum of effect with the minimum of investment as a whole. Simulation by means of the train operation curve furnishes us with valuable data for seeking the best investment.

3.BACKGROUND AND PURPOSE OF DEVELOPING TRUNSIS-C

Lately speedup on railroads has been planned one after another and simulation, which is used for the study of investment, has become increasingly important. We plans to operate many kinds of new trains to meet the needs of passengers when we revise a train schedule once a year. Therefore the work of drawing the train operation curve is increasing in quantity. In addition it is demanded to be more accurate than ever.

Since most train operation curves were drawn by hand before, even experts took many hours to draw them. Therefore drawing the train operation curve wasn't efficient and was considered as the problem to be solved. We tried to draw the train operation curve by computers in the past. But this plan didn't come true, because it was too difficult to realize the system that could draw the best train operation curve based on not only physical conditions but also such factors in human engineering as drivers' feeling. Taking this situation into consideration, we have thought it is the most important that the system is easy for planners to use, and have developed the TRUNSIS-C that has a function of modifying the train operation curve by means of the conversational processing as well as drawing it automatically to make drawing the train operation curve efficient and accurate.

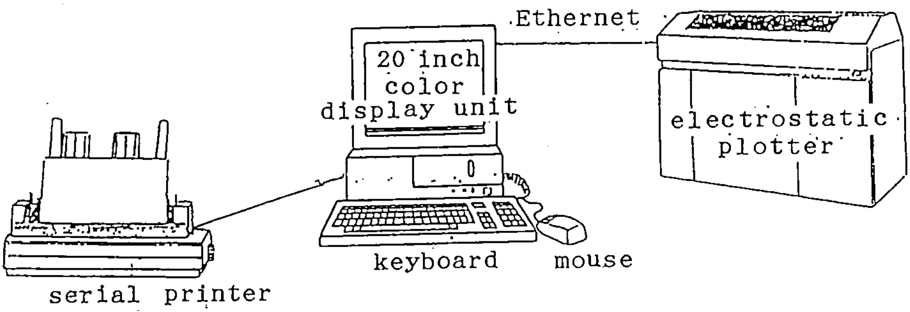
4.OUTLINE OF TRUNSIS-C

The TRUNSIS-C has been developed to draw the train operation curve, but this can also draw the car performance curves and the train headway curve.

4.1.CONSTITUTION

The constitution of the TRUNSIS-C is shown in Figure 1. It consists of engineering work station (CPU:68030(25MHz)/ RAM:16MB/ hard disk:640MB/ floppy disk:3.5inch 1.44MB/ streamer:150MB), input devices, which are a keyboard and a mouse, and output devices, which are a 20-inch color display unit, an electrostatic plotter, and a serial printer. Ethernet is adopted as its interface for the future network.

Figure 1



4.2.FUNCTIONS

The system flowchart of the TRUNSIS-C is shown in Figure 2. The TRUNSIS-C has the following functions.

4.2.1.Database (data of geometric conditions, equipment conditions, car performance and running conditions)

The TRUNSIS-C collects and stores various data that are necessary to draw the train operation curve. The Table 1 shows examples of the data stored by the TRUNSIS-C.

These data can be inputted and renewed easily by using the keyboard and the mouse.

Figure 2

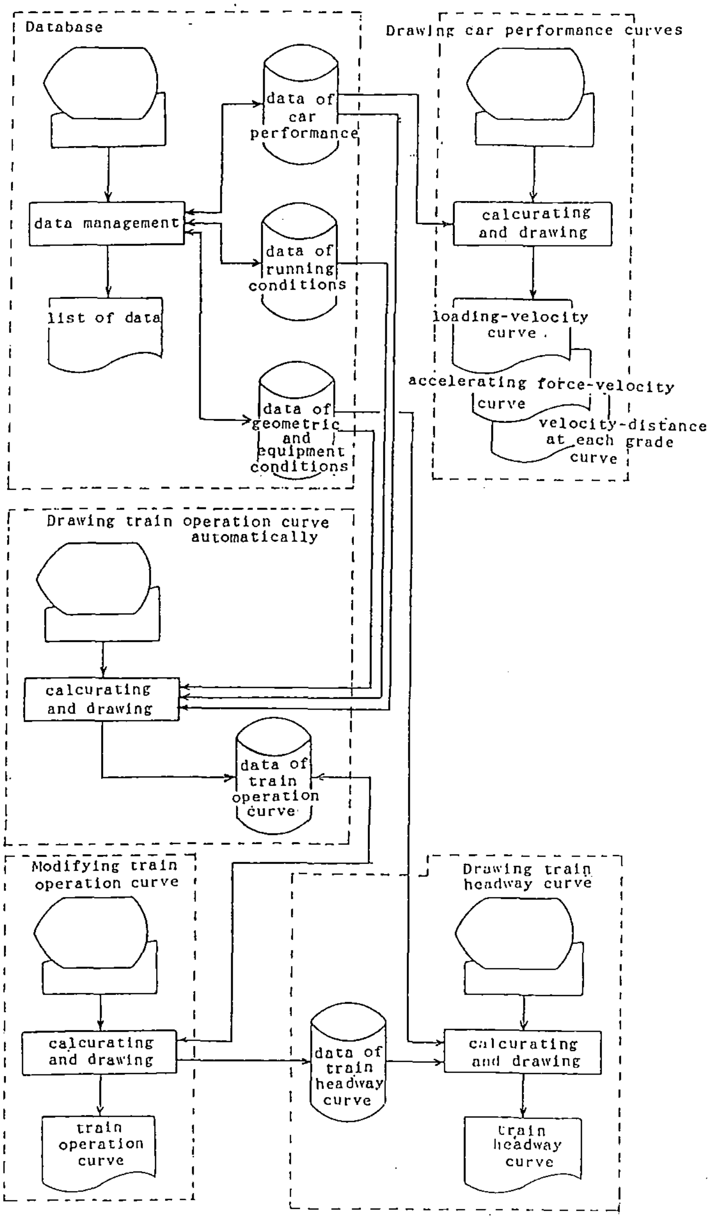

Database
data of car performance
data management
data of running conditions
list of data
data of geometric and equipment conditions
Drawing car performance curves
calcurating and drawing
loading-velocity curve
accelerating force-velocity curve
velocity-distance at each grade curve
Drawing train operation curve automatically
calcurating and drawing
data of train operation curve
Modifying train operation curve
calcurating and drawing
train operation curve
Drawing train headway curve
data of train headway curve
calcurating and drawing
train headway curve

Table 1

Geometric conditions and equipment conditions railway division station grade curve turnout speed limitation for special conditions tunnel signal
Speed limitation speed limitation at each curve radius speed limitation at each down grade
Car performance type of tractive unit velocity-tractive force curve at each regulating step adhesive coefficient running resistance curve resistance inertia coefficient train make-up train weight initial speed in braking for stop
Running conditions type of train deceleration of braking initial speed of re-powering minimum powering time minimum coasting time minimum braking time running speed at the section which has speed limitation

4.2.2.Drawing car performance curves

The TRUNSIS-C has the function to automatically draw the car performance curves, that are the loading-velocity curve, the accelerating force-velocity curve, and the velocity-distance at each grade curve. Figure 3 shows an example of the loading-velocity curve. Figure 5 shows an example of the accelerative force-velocity curve. Figure 6 shows an example of the velocity-distance at each grade curve.

4.2.3.Drawing train operation curve automatically

The TRUNSIS-C has the function to draw the best train operation curve based on the database and calculates the standard running time. An example of the train operation curve drawn by the TRUNSIS-C is shown in Figure 7.

The best train operation curve is defined as the one that shows how to drive the train at as high speed as possible at each point under the constraint taking all conditions into consideration. However it is often impossible to draw the train operation curve with perfect satisfaction. Therefore the TRUNSIS-C automatically suggests a curve to planners by means of getting rid of the condition with latter priority one by one.

4.2.4.Modifying train operation curve by means of conversational processing

The train operation curve that is calculated and drawn by computers can be modified by means of conversational processing. Generally the train operation curve is modified by means of repeating the following procedure.

(1)Planners display the part of curve they would like to modify on the screen. (Any part that is less than 12 kilometers long can be displayed at a time.)

(2)They draw velocity-distance curves in form of transient curves by the mouse.

(3)They replace the present velocity-distance curve with the transient curve and change the velocity-distance curve.

(4)The time-distance curve is changed automatically corresponding to the new velocity-distance curve.

It has functions of revising the standard running time, showing the states of each curve that are ways of driving, distance, time, and so on, and drawing plural transient curves. Planners can draw the train operation curve easily as they want to.

4.2.5 Drawing train headway curve

The TRUNSIS-C also has the function to draw the train headway curve that shows the minimum time interval between the trains that can run according to the train operation curve, and calculates the minimum time interval. An example of the train headway curve is shown in Figure 4.

Figure 4

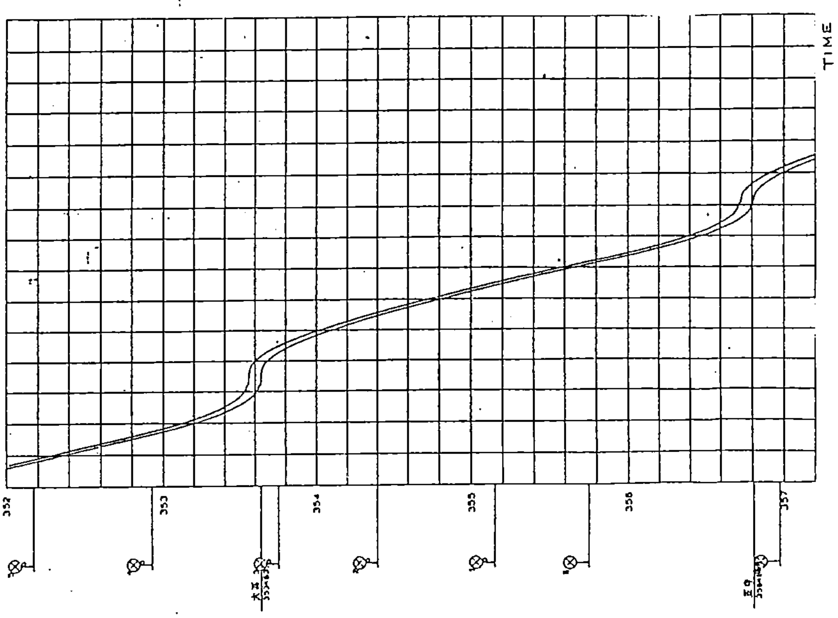


Figure 3

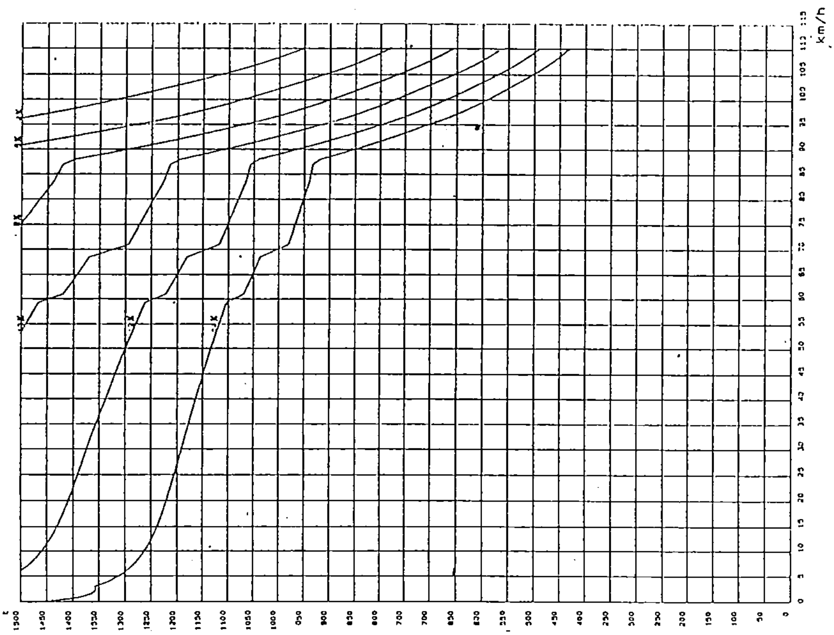


Figure 5

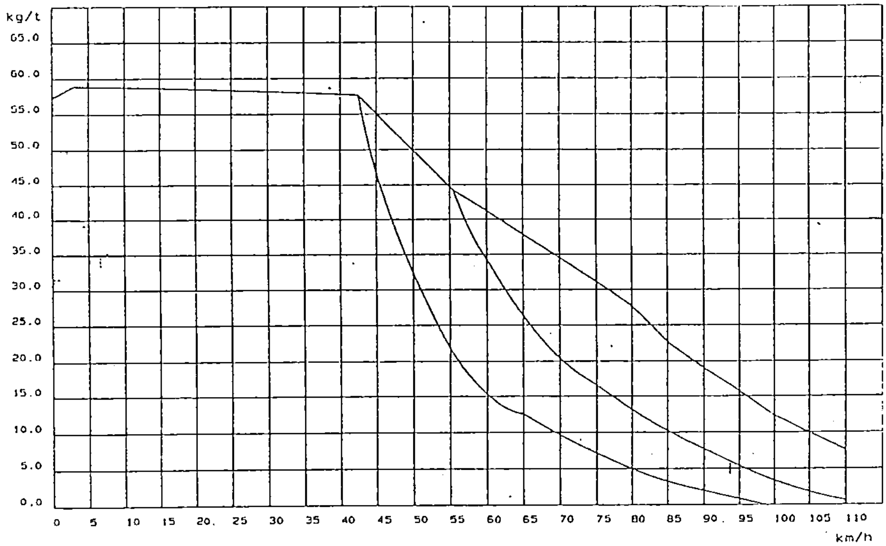


Figure 6

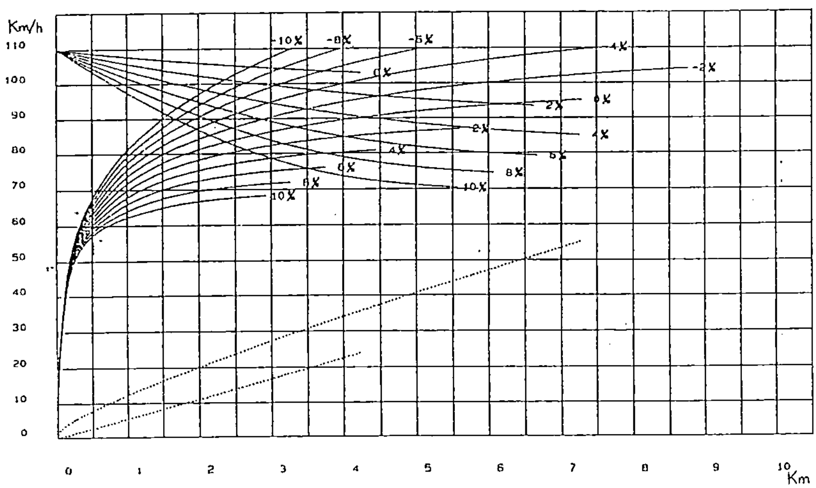
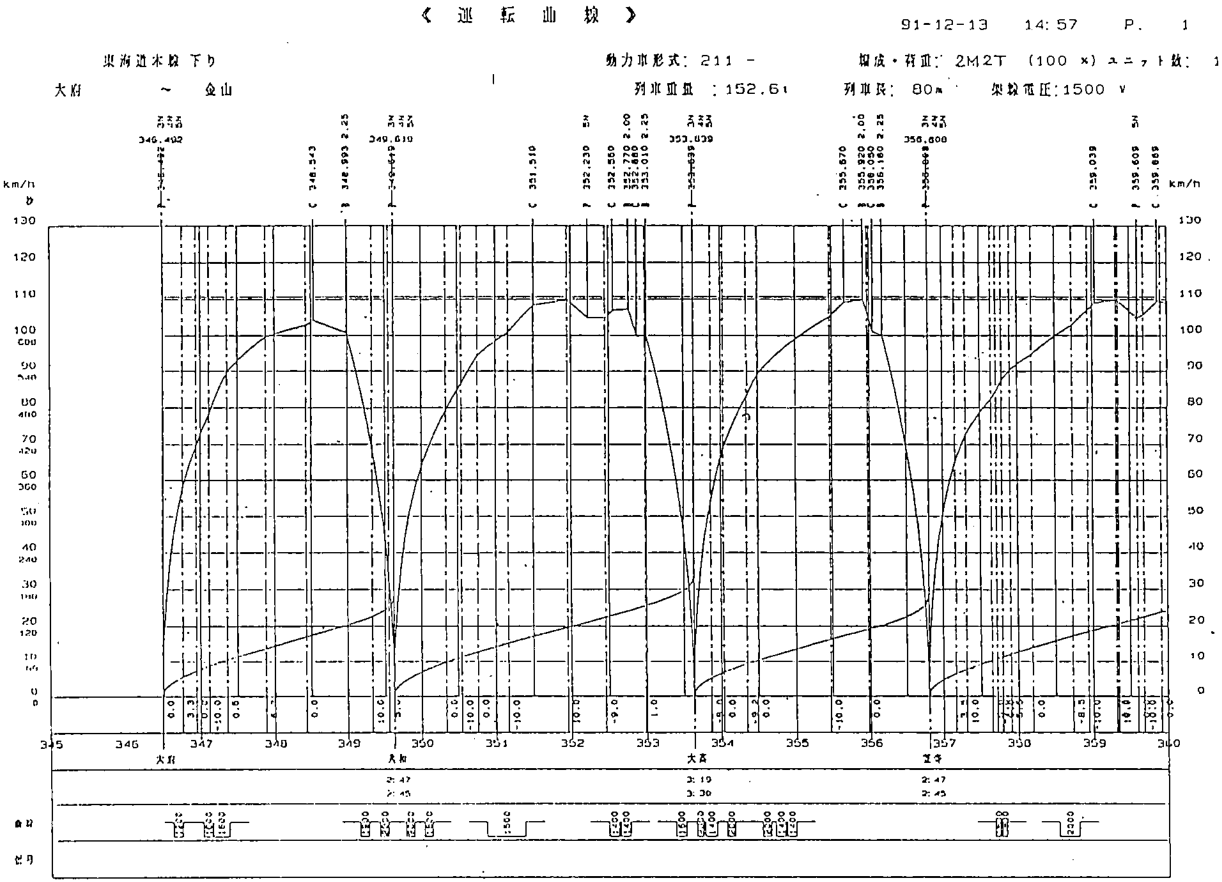


Figure 7


《 運 転 曲 線 》
91-12-13 14:57 P. 1
東海道本線 下り
大府 ~ 金山
動力車形式: 211 -
編成・荷重: 2M2T (100 ×) ユニット数: 1
列車重量 : 152.6t
列車長: 80m
架線電圧: 1500 V
km/h
大府
大高
2:47
2:45
3:19
3:30

5.CONCLUSION

The accomplishment of the TRUNSIS-C has led to the result that is as good as we expected in point of rationalization of the traffic operation planning.

We have a plan to connect the TRUNSIS-C with others, to unify data management, and to use mutual data.

We intend to make all the traffic operation planning more modern and more efficient.

6.ACKNOWLEDGMENT

The contribution of the Asic International Co. to the development of the TRUNSIS-C and valuable advice of many persons in our company is greatly acknowledged.