(12) 特許協力条約に基づいて公開された国際出願

(19) 世界知的所有権機関
国際事務局

(43) 国際公開日
2013 年 11 月 28 日(28.11.2013)

WIPO | PCT

(10) 国際公開番号
WO 2013/175883 A1

(51) 国際特許分類:
B61L 25/02 (2006.01)

(21) 国際出願番号: PCT/JP2013/060774

(22) 国際出願日: 2013 年 4 月 10 日(10.04.2013)

(25) 国際出願の言語: 日本語

(26) 国際公開の言語: 日本語

(30) 優先権データ:
特願 2012-116723 2012 年 5 月 22 日(22.05.2012) JP

(71) 出願人: 株式会社 日立製作所 (**HITACHI, LTD.**) [JP/JP]; 〒1008280 東京都千代田区丸の内一丁目６番６号 Tokyo (JP).

(72) 発明者: 藤原 正康 (**FUJIWARA Masayasu**); 〒3191292 茨城県日立市大みか町七丁目１番１号 株式会社 日立製作所 日立研究所内 Ibaraki (JP). 伏木 匠 (**FUSHIKI Takumi**); 〒3191292 茨城県日立市大みか町七丁目１番１号 株式会社 日立製作所 日立研究所内 Ibaraki (JP). 大隅 英貴 (**OSUMI Hideki**); 〒3191293 茨城県日立市大みか町五丁目２番１号 株式会社 日立製作所 情報制御システム社内 Ibaraki (JP).

(74) 代理人: 井上 学, 外 (**INOUE Manabu** et al.); 〒1008220 東京都千代田区丸の内一丁目６番１号 株式会社 日立製作所内 Tokyo (JP).

(81) 指定国 (表示のない限り、全ての種類の国内保護が可能): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) 指定国 (表示のない限り、全ての種類の広域保護が可能): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), ユーラシ

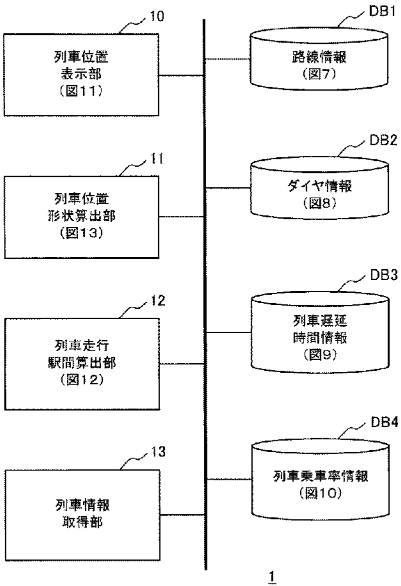
[続葉有]

(54) Title: METHOD FOR DISPLAYING TRAIN AND MOVING BODY, OPERATION ASSESSMENT DEVICE AND OPERATION CONTROL SYSTEM

(54) 発明の名称 : 列車及び移動体の表示方法、運行把握装置、及び運行管理システム

[図1]

図 1



10 Train position display unit (FIG. 11)
11 Train-position-and-configuration-calculating unit (FIG. 13)
12 Train-travel-station-interval-calculating unit (FIG. 12)
13 Train-information-obtaining unit
DB1 Rail line information (FIG. 7)
DB2 Schedule information (FIG. 8)
DB3 Train delay time information (FIG. 9)
DB4 Train occupancy rate information (FIG. 10)

(57) Abstract: The purpose of the present invention is to allow the traveling status of a train to be displayed on a screen on which a plurality of trains traveling throughout a train line region or throughout a plurality of train line regions are displayed at the same time. Accordingly, configurations and display positions of symbols for indicating trains and moving bodies are changed in accordance with the traveling status of the trains or moving bodies. An operation assessment device and an operation control system are provided with schedule information indicating departure times and arrival times for individual trains and for individual stations at which the trains stop, and rail line information indicating the positions of the stations constituting the rail lines according to the order of the rail lines; and in the operation assessment device, which is provided with a train-travel-station-interval-calculating unit for calculating from the schedule information the station intervals over which the trains are traveling, and a train-position-and-configuration-calculating unit for calculating the train position from the schedule information and the rail line information, train positions of two different times relative to a time displayed on the screen are calculated by the train position and configuration calculating unit, the operation assessment device being provided with a train position display unit for determining and displaying display positions and configurations of the trains from the two calculated positions.

(57) 要約:

[続葉有]

WO 2013/175883 A1

ア (AM, AZ, BY, KG, KZ, RU, TJ, TM), ヨーロッパ (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

添付公開書類:
— 国際調査報告（条約第 21 条(3)）
— 補正された請求の範囲及び説明書（条約第 19 条(1))

本発明は線区全域または複数線区全域を走行する複数列車を同時に表示させた画面において、列車の走行状態を確認可能とすることを目的とする。　そのために、列車及び移動体の走行状態に応じて、列車及び移動体を表すシンボルの表示位置及び形状を変更する。走行状態として停止状態、走行状態に応じて、列車及び移動体を表すシンボルの形状を変更する。運行把握装置及び運行管理システムでは、列車ごとかつ列車が停車する駅ごとに発車時刻および到着時刻を記憶したダイヤ情報と、路線の順序に従って路線を構成する駅の位置を記憶した路線情報を備え、ダイヤ情報から列車が走行する駅間を算出する列車走行駅間算出部と、ダイヤ情報及び路線情報から列車位置を算出する列車位置形状算出部を備えた運行把握装置において、画面に表示する時刻を基準とする２つの異なる時刻の列車位置を、列車位置形状算出部によって算出し、算出した２つの列車位置から各列車の表示位置及び形状を決定し表示する列車位置表示部を備える。

DESCRIPTION

METHOD FOR DISPLAYING TRAIN AND MOVING BODY, OPERATION ASSESSMENT DEVICE AND OPERATION CONTROL SYSTEM

TECHNICAL FIELD

[0001]

The present invention relates to a train/moving-body displaying method, operation assessment device and operation control system, which are for displaying on a railway route map the positions and running states of railway trains and moving bodies in order to grasp traffic operations of such trains and moving bodies.

BACKGROUND ART

[0002]

Train operations are carried out in accordance with a predetermined diagram. In cases where the train diagram becomes no longer sustainable due to rail vehicle malfunction, bad weather, excessive congestion and others, it is required to perform operation adjustment for revising the operation plan on a case-by-case basis. To perform this operation adjustment safely and reliably, it is necessary to comprehend a train operation situation rapidly and adequately to thereby modify the train operation.

[0003]

Traditionally, train operations have been performed on a per-territory basis or on a per-station basis from a viewpoint of operation/maintenance of railroad business entities; thus, the comprehension of train-running situation has mainly relied on establishment and utilization of a device capable of grasping a train operation situation on a per-territory or per-station basis.

[0004]

For example, Patent Literature 1 discloses therein a device for displaying trains on its screen, which displays the line shape of one part of a train-running railway route.

CITATION LIST

PATENT LITERATURE

[0005]

PATENT LITERATURE 1: JP-A-2005-212633

SUMMARY OF INVENTION

TECHNICAL PROBLEM

[0006]

However, in order to implement the transportation complying with diversification for meeting railroad users' demands, it is necessary to perform train operations covering several track sections. To operate appropriately a train that runs along a route linking between track sections, it is required not only to comprehend trains in units of track sections but also to grasp train operations in a plurality of track sections simultaneously.

[0007]

In the device disclosed in Patent Literature 1, a technique is not considered for simultaneously displaying all of the running or stopping trains in an entire track section or in an entirety of a plurality of track sections. Assuming that it displays train running states in an entire track section or in an entirety of two or more track sections, a number of trains are to be displayed at a time, which makes them indistinguishable over each other, resulting in an appreciable decrease in visibility. This makes it difficult to obtain very important information when performing operation adjustment and passenger guidance services, such as whether a train is presently running or stopping, etc.

[0008]

It is therefore an object of the present invention to enable visual check of a train running state on a screen which displays simultaneously a plurality of trains running in an entire track section or in the whole area of a plurality of track section.

SOLUTION TO PROBLEM

[0009]

In a train position display method of this invention, it modifies the display positions and shapes of those symbols representing a train and a moving body in accordance with the running states thereof. More specifically, the shapes of the symbols indicating a train and a moving body are changed in accordance with running conditions, i.e., stopping/moving states.

[0010]

Additionally, in an operation assessment device and operation control system of this invention, each has a storage unit which stores therein diagram information indicating train departure and arrival times on a per-train basis with respect to each train-stop station and also stores railway route information specifying the positions of stations constituting a route in accordance with the sequence of routes, wherein the operation assessment device has a train-running inter-station calculation unit which calculates an interstation zone from diagram information and a train position/shape calculation unit which calculates a train position from the diagram information and route information, and also has a train position display unit which calculates, by the train position/shape calculation unit, train positions at two different time points with an on-screen display time as a reference and which determines the display position and shape of each train from the two train positions thus calculated and then displays them.

ADVANTAGEOUS EFFECTS OF INVENTION

[0011]

According to this invention, it becomes possible to ascertain the running state of a train from its shape on a screen which simultaneously displays a plurality of trains running in an entire track section or in the whole area of a plurality of track sections.

BRIEF DESCRIPTION OF DRAWINGS

[0012]

[Fig. 1] A drawing which shows a configuration of a train operation assessment device in accordance with embodiments 1 and 2 of the present invention.

[Fig. 2] A drawing showing a configuration of a train operation control system in accordance with an embodiment 3 of this invention.

[Fig. 3] A drawing showing one of on-screen images to be displayed by a train display unit 10, for depicting train running situations in a plurality of track sections.

[Fig. 4] A drawing showing a prior known train display method.

[Fig. 5] A drawing showing a train display method embodying the present invention.

[Fig. 6] A drawing for explanation of display shapes and colors of trains.

[Fig. 7] A drawing showing an example of train position data held by a railway route information database DB1.

[Fig. 8] A drawing showing an example of train diagram information held by a diagram information database DB2.

[Fig. 9] A drawing showing an example of train delay time information held by a train delay time information database DB3.

[Fig. 10] A drawing showing an example of train occupancy information data held by a train occupancy information database DB4.

[Fig. 11] A flowchart of train display processing to be performed by the train display unit 10 of the embodiment 1.

[Fig. 12] A flowchart of train-running inter-station calculation processing performed by a train-running interstation calculation unit 12.

[Fig. 13] A flowchart of train position/shape calculation processing performed by a train position/shape calculation unit 11.

[Fig. 14] A drawing showing a train display method embodying the invention.

[Fig. 15] A drawing showing the shape of a stopping train immediately prior to departure at a time point T1 of Fig. 14.

[Fig. 16] A drawing showing a train shape just before departure at a time point T2 of Fig. 14.

[Fig. 17] A drawing showing a train shape in process of running at a time point T3 of Fig. 14.

[Fig. 18] A drawing showing a train shape just before arrival at a time point T5 of Fig. 14.

[Fig. 19] A drawing showing a train shape just after the arrival at a time point T6 of Fig. 14.

[Fig. 20] A flowchart of train display processing performed by a train position display unit of the embodiment 2.

[Fig. 21] A drawing showing a train position display example in an operation control system 2.

[Fig. 22] A sequence diagram of operation control tasks to be done by a dispatcher.

[Fig. 23] A drawing showing a configuration of train operation assessment device 3 which employs a train display method of an embodiment 4.

[Fig. 24] A flowchart of train display processing of a train position display unit 10b.

[Fig. 25] A drawing showing data stored in a train run information database DB5.

DESCRIPTION OF EMBODIMENTS

[0013]

Embodiments of the method for displaying trains and moving bodies, the operation assessment device and the operation control device of the present invention will be described using the accompanying drawings below. It should be noted that in the description below, a train and a moving body will be simply referred to as trains.

EMBODIMENT 1

[0014]

First of all, an explanation will be given of some features of the train display method of this invention. Fig. 4 is a drawing for explanation of one prior known train display method. Fig. 5 is for explanation of the train display method embodying the invention. Firstly, an explanation will be given with reference to Fig. 4; thereafter, the display method unique to this invention will be explained using Fig. 5 in a comparative way.

[0015]

Fig. 4 depicts a prior art method of displaying the positions and shapes of trains based on physical train shapes. The lateral axis represents time, and vertical axis represents position. Reference numerals 1003 to 1006 indicate train positions and shapes at a certain time point. In the example shown herein, the stopping or running trains that are placed on a rail track between a station α and station β are indicated by the same symbol. These trains are displayed by pentagon-shaped symbols with the same size, wherein a solid line L1 connecting together base portions (flat sides) of pentagonal shapes is a movement locus of train tail position whereas a dotted line L2 coupling together end portions (sharp sides) of train shapes represents a movement locus of train head position.

[0016]

This drawing shows that those trains indicated by symbols 1003, 1005 and 1006, which trains have base portions that are displayed at positions in parallel with the stations α and β, are stopping at these stations. It can also be seen that a train designated by symbol 1004, which is depicted to exist between stations α and β, is a stopping or running train which is located on a rail track between these stations. Note here that in Fig. 4, a station position is representatively indicated by the trail position of a train stopping at this station, which is the locus of a train position calculated from its departure and arrival times of a railway timetable.

[0017]

Fig. 5 shows train positions and shapes which are displayed based on the train display method of this invention. In a similar way to Fig. 4, it represents time along the lateral axis and represents position in the vertical axis. Symbols 1014 to 1019 indicate train positions and shapes at a time point. Similarly to Fig. 4, L1 designates the locus of a train tail position whereas L2 is the locus of a train head position.

[0018]

Although the foregoing indications are the same as those of Fig. 4, this invention comes with further notational arrangements which follow. A first point is as follows: a moving train is indicated by a pentagonal symbol with its head sharpened in a similar manner to Fig. 4; but, during stopping, this train is indicated by a quadrangular symbol. 1014 and 1019 indicate such stopping trains. With this scheme, the trains that are stopping at stations are indicated by quadrangles and are thus distinguishable from trains running between stations.

[0019]

A second point is that the running state is reflected on the length of such pentagonal shape. In departure and arrival events, the length of pentagonal shape increases and decreases in response to acceleration and deceleration, respectively; during running between stations, it is indicated by a fixed length. A third point is that L3 is defined in addition to L1 and L2 to indicate the locus of a representative position calculated from departure and arrival times of a train diagram. As for other characteristic display contents, explanations will be given as the need arises.

[0020]

Additionally, it can be said that the unique arrangements of the first and second points are the ones that represent the train's running state changes by the shapes being displayed. In the representation examples given herein, the train running states are displayed in such a way that several different conditions, such as stopping, running between stations, approaching a station, leaving a station, etc., are distinguished from one another. This causes the head and tail positions of a train to have a time difference Δt at all times to thereby enable determination of the train's display shape by a movement locus of time width Δt of from the tail position to the head position, thus representing a change in train running state by the display shape.

[0021]

Fig. 3 shows train operation situations of a plurality of track sections simultaneously by using the train display method of this invention shown in Fig. 5. A train position-indicating screen image of Fig. 3 is displayed, for example, at a monitor in a train operation management room. In this drawing, black circles ST indicate stations, and M designates a railway route between stations. Symbols Tr1, Tr2, Tr3 and Tr4 indicate trains which are display-modified depending on train running states. Train running states are determined by a train diagram and a display time 907 owned by a user or apparatus.

[0022]

With this representation, a stopping train Tr2 (displayed as a rectangle) is distinguishable from running trains (displayed in pentagon); in addition, a change in train running state, such as velocity or else, is perceivable from the length of a train symbol so that an approximate inter-station location is comprehensible from such the position. In this representation, it is also possible to readily grasp the overall situation of train operation at the time point.

[0023]

The train display method of this invention causes the displayed shape to vary depending on the running state of a corresponding train. Thus, it is possible to ascertain a present running state from the train's display shape even where a number of trains are displayed simultaneously. Even in the case of displaying trains in the whole area of a track section simultaneously, the display shape of each train is altered depending on its running state, thereby making it possible to check the running states of a plurality of trains simultaneously.

[0024]

Fig. 1 shows a configuration of a train operation assessment device having the train display method of this invention. Using Fig. 1, the configuration of the train operation assessment device will be explained.

[0025]

The train operation assessment device 1 has an arithmetic part made up of a train position display unit 10, train position/shape calculation unit 11, train-running inter-station calculation unit 12 and train information acquisition unit 13. The device also has storage units of databases storing therein input and processed information for use in arithmetic operations, including a railway route information database DB1, train diagram information database DB2, train delay time information database DB3 and train occupancy information database DB4. The arithmetic operation units and storage units are interconnected together.

[0026]

Among them, the train position display unit 10 acquires from the route information database DB1 an array of stations in each track section and locations of these stations, and displays a railway route map. For example, assuming that the route configuration of Fig. 3 is visually displayed on the monitor screen, the route information database DB1 is arranged to have route information data shown in Fig. 7.

[0027]

Fig. 7 shows data recorded in the route information database DB1. TB1 is a route information table of a track section 1; TB2 is a route information table of track section 2. In these tables TB, station names ST and station positions 512 in a corresponding track section are stored. In this example, the track section 1 includes stations A, B, C, D, E and F allocated in this order of sequence; the track section 2 includes stations G, H, C, I, J, K disposed in this order. In addition, the locations of respective stations are stored by use of their coordinates, for example.

[0028]

In this manner, the table TB1, TB2 stores therein the locations of route-constituting stations per track section in accordance with the order thereof, which contains at least station names and station locations. The location of each station may be defined by latitude/longitude or by a simplified coordinate system for on-screen representation of stations. The station names are words or codes capable of identifying stations in a one-to-one correspondence way.

[0029]

As the location of a neighboring station is graspable from the route information database DB1, the train position display unit 10 is able to display station locations and interstation routes out of the monitor screen image of Fig. 3.

[0030]

Fig. 8 shows an example of data of train diagram information stored in the diagram information database DB2. In Fig. 8, TB3 and TB4 are per-train diagram information tables. Note here that the diagram information is the information that stores departure and arrival times with respect to each train-stop station.

[0031]

TB3 stores in a table form respective station-arrival and departure times of a train, i.e., train with its train name 316 of "A701." Similarly, TB4 stores in a table form respective station-arrival and departure times of a train with its train name 316 of "A702." In the example of Fig. 8, record numbers are saved in a column 320; in column 311, station names indicated in an order of nonstop stations in the track section are saved; in column 312, arrival/departure distinction is saved; in 313, respective arrival/departure times are stored.

[0032]

In case of the train "A701," this train is scheduled to arrive at a station A at a time point 07:10:00, depart at 07:10:32, and reach a station B next thereto at 07:15:25. Optionally, for a station C at which the train does not stop, departure and arrival times may be deleted as in a column 319.

[0033]

Various kinds of ones are usable for the train diagram information stored in the diagram information tables TB3, TB4. For example, there is usable either an actual train diagram with a record of operation results of already operated trains or a predictive diagram with a record of predicted future train operations at a given prediction time. Alternatively, the actual and predicted diagrams may be used in combination in such a way that the former is used before a present time point and, thereafter, the latter is used.

[0034]

The train position display unit 10 further has the information of display time point t. In the apparatus of Fig. 1, it is possible, by reference to the diagram information table TB3, TB4 based on a designated display time point, to find on-track positions of respective trains at this time point. This makes it possible to display respective train positions at this instant while letting them be superposed on railway route information (station locations and interstation railway routes) with its display information having already been obtained.

[0035]

In this regard, however, the diagram information stored in diagram information table TB3, TB4 is based on a plan or past results; thus, it is necessary in reality to call into account a delay at this instant. Concerning this point, reference is made to the train delay time data being recorded in the train delay time information database DB3.

[0036]

Fig. 9 shows the train delay time data stored in the train delay time information database DB3. The train delay time information database DB3 has a train delay time table TB5 with a record of train delay times on a per-train basis with respect to each track section and each train-stop station. The train delay time table TB5 of Fig. 9 stores delay information of track section 1; accordingly, for other track sections also, similar and appropriate train delay time tables are prepared and stored.

[0037]

In this drawing, cells 406, 407, 408 in the lateral direction are train names, which represent "A701," "A702," "A703," and "A704," respectively. A column 402 in the vertical direction is with a description of station names in the track section 1 in a passing order. In cells at cross-points of the train names in the lateral direction and the station names in the vertical direction of a matrix of the drawing, delay time values of corresponding trains are indicated at corresponding stations.

[0038]

According to this train delay time table TB5 of Fig. 9, it can be seen that a train having its name 406 of "A701" for example was operated with an increasing delay in the following way: although this train departed a station A at the fixed time, the train has a delay of five seconds at a station B, an increased delay of ten seconds at a station C next thereto, and a further increased delay of fifteen seconds at the next station D.

[0039]

Note that when the diagram information database DB2 is an actually achieved diagram, the value of each train delay time to be recorded is a delay time of departure time of the train operation result relative to the departure time of a previously planned operation. When the diagram information database DB2 is a predictive diagram, the value of each train delay time being recorded is a delay time of the departure time of train operation predicted relative to the previously operation-planned departure time. Regarding nonstop stations, train delay times thereof may be omitted as shown at cells 409.

[0040]

In the train position display unit 10, when displaying the graphic image of Fig. 3 on the monitor screen, it is possible to perform more accurate present position display in the process of displaying train positions at the time point due to the fact that each train's delay information of the train delay time table TB5 is added to the diagram information stored in the diagram information table TB3, TB4.

[0041]

In the train position display unit 10, when performing monitor display of the image of Fig. 3, it is preferable to further consider the data recorded in the train occupancy information database DB4 of Fig. 10. The train occupancy information database DB4 holds as a train occupancy table TB6 the train occupancy information with a record of train occupancy rates with respect to each track section, each train and each train-running interstation zone.

[0042]

In the train occupancy table TB6 of Fig. 10, interstation is recited in the vertical direction whereas train names are written in a row of cells 606, 607, 608 in the lateral direction. A column of interstation 602 indicates departure stations on the left side and indicates arrival stations on the right side to thereby represent train-running interstation zones. At cross-points of rows and columns of a matrix, train occupancy rates corresponding to train numbers are recited. Additionally, train occupancies of nonstop stations may be omitted as shown by 609.

[0043]

According to the example of Fig.10, it can be seen that a train A701 exhibits the highest occupancy in a zone between stations A and B and tends to decrease in occupancy as it goes away from the station A.

[0044]

The operation assessment device 1 of Fig. 1 utilizes the information stored in the above-stated various types of databases to obtain train head and tail positions from the train position/shape calculation unit 11 based on the designated display time and acquires train delay times and train occupancy rates from the train information acquisition unit 13. Additionally it calculates display positions, shapes and display colors of trains while inputting head/tail positions, train delay times and train occupancy rates and then displays the train operation situation shown in Fig. 3 on the screen.

[0045]

To achieve such on-screen image display, respective parts of the operation assessment device of Fig. 1 operate in the following way. For example, the train position display unit 10 receives an input(s) from the user and makes the display time modifiable arbitrarily. In addition, it advances repeatedly the display time t from the previously displayed time t at given time intervals in an automated manner and, simultaneously, causes the screen-displayed train operation situation also to be updatable.

[0046]

The train position/shape calculation unit 11 calculates train head/tail positions while inputting train-stop stations or train-running interstation zones obtained from the train-running interstation calculation unit 12, display time data and the route information database DB1.

[0047]

The train-running interstation calculation unit 12 receives as input data the display time and diagram information database DB2 from train position display unit 10 and returns, as its outputs, train-running interstation zones or stop stations to train position display unit 10.

[0048]

The train information acquisition unit 13 receives, as inputs, uniquely train-identifiable train numbers and train-running interstation zones or stop stations from the train position display unit 11, acquires train delay times from the train delay time information database DB3, and returns as its outputs the train occupancy rates from the train occupancy information database DB4 to the train position display unit 10.

[0049]

Next, a processing flow of each part of the operation assessment device 1 in this embodiment will be explained using Figs. 11, 12 and 13. First, Fig. 11 is a flowchart of train position displaying processing of the train position display unit 10.

[0050]

A step S101 is loop processing. In this loop 1, target steps of the following steps S102-S112 are repeated for all track sections while setting a target track section with S.

[0051]

It is noted that the processing of this loop 1 is such that steps S101 and S113 become a pair (start and end points), which means repeated execution of processing therebetween. Similar loop processing is also defined as a loop 2 in the same drawing, wherein steps S103 and S112 are paired for repeated execution of processing therebetween.

[0052]

In step S102, the track-section information of a track section S is read in. Here, a track section 1 is read first. Upon completion of the processing at all steps of the loop 2 as to the track section 1, the track section 2 is next selected to execute processing until similar open-loop processing is completed. The track section information of the track section 1 is held in the route information database DB1 of Fig. 7, permitting acquisition of location information of a plurality of stations which are disposed in the order of stations B, C, D, E and F from station A.

[0053]

Next, in the loop 2 of step S103, target steps of from the following steps S104 to S111 are repeated for all trains of the track section S (here, the first selected track section 1 is regarded as the target object) while setting the train of interest as n.

[0054]

At step S104, the diagram information of the train n is read from the diagram information database DB1. More specifically, concerning the diagram information database DB1, reference is first made to the diagram information table TB3 to read diagram information of the train A701. There are other trains running in the track section 1, and the table of Fig. 8 has been established on a per-train bases; so, the table is sequentially referenced to read diagram information of every train.

[0055]

At step S105, train-running interstation calculation processing is performed by inputting a display time t and train n. As an output of this processing result, the train-running interstation calculation unit 12 calculates stations α and β, which represent either a stop station or an interstation in which the train n runs at time t, along with time points Tα and Tβ.

[0056]

Note here that the station α is set to the nearest departure or arrival station before the time t of train n, and Tα is the nearest departure or arrival time which is before the time t of train n. The station β is the nearest departure or arrival station after the time t of train n; Tβ is the nearest departure or arrival time after the time t of train n.

[0057]

Explaining using an example which draws attention to the train A701 of Fig. 8 while setting the time point t as 07:12:00, the station α is the nearest departure station A before the time t, and Tα is the nearest departure time of 7:10:32 before the time t. The station β is the nearest arrival station B after the time t; Tβ is the nearest arrival time 7:15:25 after the time t. This results in the station α ≠ station β, which indicates that the train A701 is in process of running, thus revealing that the train A701 is running in an interstation zone between the station α (station B) and station β (station A).

[0058]

Similarly, explaining using an example which focuses on the train A701 of Fig. 8 while setting the time point t as 07:10:20, the station α is the nearest arrival station A before the time t, and Tα is the nearest arrival time of 7:10:00 before the time t. The station β is the nearest departure station A after the time t; Tβ is the nearest departure time 7:10:32 after the time t. This results in the station α (station A) = station β (station A), which indicates that the train A701 is in process of stopping at the station A, revealing that the stations α and β represent stop stations.

[0059]

Additionally, when the time point t is designated to a time point before 07:10:00, this results in the station α=indefinite or station β=indefinite. In this case, the display time t is before a first departure time of the train or after its final arrival time, indicating that the train n is out of operation.

[0060]

In step S106, when the train is in operation, that is, in the case of the station α≠indefinite and the station β≠indefinite, the system procedure proceeds to step S107. On the other hand, when the train is out of operation, i.e., in the case of the station α=indefinite or station β=indefinite, the procedure goes to step S112, followed by completion of the processing with the train n being the object to be processed.

[0061]

At step S107, the train n's head position p1 at the time point t is represented by p1, and its tail position p2 is by p2; then, a respective one of the head position p1 and tail position p2 is calculated by the train position/shape calculation unit 11. To reflect a movement change of a time width Δt (i.e., train speed) on the train shape, the head position p1 and tail position p2 are arranged to have a time difference Δt therebetween. The processing at the train position/shape calculation unit 11 will be described later.

[0062]

At step S108, the train information acquisition unit 13 acquires a train delay time u and a train occupancy rate v of the train n at station α, β representing either interstation or stop station. The train delay time u is acquired from the train delay time information database DB3; the train occupancy v is obtained from train occupancy information database DB4.

[0063]

As the train delay time information database DB3 stores data on a per-station basis, the train delay time u corresponding to the station α is acquired. As the train occupancy information database DB4 has its data recorded per interstation, train occupancy rates corresponding to the stations α, β are obtained. Note however that when α=β, a train occupancy with the departure station (left) of interstation 602 being identical to the station β.

[0064]

In step S109, the train n's display color c is calculated from the train delay time u or from the train occupancy v. A method for calculating the display color c will be described later.

[0065]

At step S110, the train n's display size is calculated from the train delay time u or the train occupancy v. A method of calculating the display size w will be described later.

[0066]

At step S111, the display size w, display color c, head position p1 and train position p2 are used to display the train n on the screen.

[0067]

At step S112, the processing with the train n being the target object is completed; then, the procedure returns to step S103, followed by repeated execution of the processing for all trains in the track section S until all of the trains are completely processed.

[0068]

At step S113, the processing with the track section S being the object is completed; then, the procedure returns to step S101, for repeated execution of the processing until all track sections are completely processed.

[0069]

With that, the explanation as to the train display processing is over.

[0070]

Next, a technique for determining the display color and shape of a train will be described in detail. Fig. 6 shows a color model for train display shape/color determination.

[0071]

In Fig. 6, numeral 1020 designates a train display shape in the case of the train's head position p1 being not the same as its tail position p2; 1021 indicates the head position p1; and, 1022 indicates the tail position p2. 1020 is the symbol of a running train.

[0072]

Numeral 1026 designates a train display shape when the train's head position p1 is the same as its tail position p2.; 1025 indicates the head position p1 and tail position p2. 1026 is a symbol of a stopping train.

[0073]

Numeral 1024 denotes a display size w of train. The display size w is calculated on a per-train basis so that it becomes larger in proportion to the train occupancy v or the train delay time u.

[0074]

1023 and 1027 denote regions to be painted by display color c. The display color c is determined from either a color model 1031 of train delay time or a color model 1034 of train occupancy. The color models 1031 and 1034 are for determining the display color c by setting the chromaticity and brightness with 100% based on a well-known HSB color space model and causing the hue to vary from 66% to 0% in accordance with the train delay time or the train occupancy.

[0075]

In the case of determining the display color c by the train delay time u, when the delay time is 0 minutes as shown by 1032, the color is set to blue with its hue of 66%; the color is made larger in hue value with an increase in train delay time u, and is set to red with its hue of 0% when the train delay time u is greater than or equal to 60 minutes as shown by 1033.

[0076]

In the case of determining the display color c depending on the train occupancy v, when the train occupancy is 0% as shown by 1035, the color is set to blue with its hue of 66%; the color is made larger in hue value with an increase in train occupancy v, and is set to red with its hue of 0% when the train occupancy v is more than or equal to 300% as shown by 1036.

[0077]

In the display of Fig. 6, in the case of the train display size w being determined by the train occupancy v for example, the display color c is defined by the train delay time u. Adversely, in the case of the train display size w being determined by the train delay time u, the display color c is defined by the train occupancy v. An on-screen image displaying scheme of the monitor may be arranged to use either one of them consistently.

[0078]

The detailed explanation on train display shapes is now over.

[0079]

In the train display method of this invention, it causes the display shapes and colors to vary depending on movement states of trains. With this scheme, it is possible to ascertain a train's running state from its display shape even where a number of trains are displayed simultaneously. Even when displaying trains in the entire area of a track section simultaneously, display shapes are caused to vary depending on respective train running states. Thus, it is possible to check or verify the running states of a plurality of trains simultaneously.

[0080]

Fig. 12 shows a flowchart of train movement calculation processing of the train-running interstation calculation unit 12.

[0081]

Firstly in step S201, initialization processing is performed for setting the record No. of diagram information to a variable i=1 and for making indefinite all of the stations α and β and time points α and β to be outputted upon completion of this train-running interstation calculation processing.

[0082]

At step STM, it is defined as a repeat condition that the variable i is less than the record number of the diagram information (the diagram information database DB2, the diagram information table TB3, TB4 of Fig. 8), i.e., i is included in the record No. of diagram information; while satisfying the repeat condition, steps STM to S206 are repeated with all records being target objects.

[0083]

At step S203, a time point at which the record No. of diagram information is i-1 is represented by Ti-1, and a time point at which the record No. of diagram information is i is given as Ti. For example, when setting the record No. i with "3" of the diagram information table TB3 of the train A701 and setting i-1 with "2" of the same table, the time point Ti-1 of i-1 is set to 07:10:32, and the time point Ti of i is to 07:15:25.

[0084]

At step S204, when Ti-1, Ti becomes a departure or arrival time which is before or after a given display time t and which is the nearest thereto in the diagram information of train n (A701), i.e., when Ti-1<t<Ti, the procedure exits from the loop 1 and proceeds to step S207; otherwise, go to step S206.

[0085]

At step S207, when the step 204 is satisfied, the station of the record No. i-1 satisfies the condition of station α (the nearest departure or arrival station before time t); thus, the name of a station with diagram information No. of i-1 is set to α, and its time Ti-1 is set at Tα. The station of the record No. i-1 also satisfies the condition of station β (the nearest departure or arrival station after time t); thus, the name of a station with diagram information No. of i is set to β, and its time Ti is to Tβ. After having outputted the stations α, β and time points Tα, Tβ, the procedure is completed.

[0086]

According to this judgment, in the case of a practical example of the step S204 for example, the following determination is made: the station α is a station A, the station β is a station B, the time point Tα is 07:10:32, and the time point Tβ is 07:15:25.

[0087]

At step S205, set i=i+1, and add 1 to the value of record i.

[0088]

At step S206, in the case where the repeat condition of step STM is met, the procedure returns to step STM. In case the repeat condition of step STM is not met, exit from the loop 1. Since there is no data corresponding to the stations α and β, the processing is ended while remaining all of the stations α, β and time points Tα, Tβ indefinite.

[0089]

The explanation of the train-running calculation processing is now over.

[0090]

Fig. 13 is a flowchart of train position/shape calculation processing of the train position/shape calculation unit 11. The train position/shape calculation unit 11 performs processing for calculating a train head position p1 and tail position p2 so that it becomes a train movement locus with a time width Δt.

[0091]

In step S301, a time point t1 of the head position and a time point t2 of the tail position are calculated with the display time t being as a reference, resulting in t1=t and t2=t-Δt=t1-Δt.

[0092]

At step S302, respective positions of the stations α, β are obtained from the railway route information, setting the position of station α as Pα and setting the position of station β as Pβ.

[0093]

At step S303, when the train is in process of running, i.e., when α≠β, the procedure goes to step S304; when the train is stopping, i.e., when α=β, go to step S305.

[0094]

At step S304, the running train's head and tail positions are respectively obtained from Equation (1) given below. Here, these head and tail positions are computed from two different time points t1 and t2 with the display time t as a reference.

[0095]

[Math. 1]

$$p(n,t) = \begin{cases} \dfrac{P_\alpha\left[\left(T_\beta - \Delta t\right) - t\right] + P_\beta\left(t - T_\alpha\right)}{T_\beta - T_\alpha - \Delta t} & T_\alpha \le t \le T_\beta - \Delta t \\ P_\alpha & t \le T_\alpha \\ P_\beta & T_\beta - \Delta t \le t \end{cases}$$

Equation (1)

[0096]

Calculation is performed by setting the head position at display time t as a position p(n,t1) at time point t1 and setting the tail position at display time t as a position p(n,t2) at time point t2. Equation (1) defines a relationship between the display time t and head position to ensure that it becomes a train movement locus with time width Δt, defining t2=t1-Δt so that the time t2 is at a position delayed by Δt from the time point t1. A detailed explanation of Equation (1) will be given later. Thereafter, the processing is terminated.

[0097]

At step S305, the head and tail positions of the train that is stopping at a station are set to the station α's position Pα. Thereafter, the processing is ended.

[0098]

Note that the running train's symbol obtained by the processing of step S304 is the one having a pentagonal shape indicated by 1020 in Fig. 6: the head and tail positions of the running train were determined. Also note that the stopping train's symbol obtained by the processing of step S305 is the one having a rectangular shape shown by 1024 in Fig. 6: the head and tail positions of the running train were determined to be the position Pα of station α. With that, the explanation of the train position/shape calculation processing comes to the end.

[0099]

Details of the display shapes of trains to be displayed on the screen of the train position display unit 10 in this embodiment will be explained using Fig. 14.

[0100]

Fig. 14 shows a display form of train positions and shapes based on the train display method of this invention. Time points are plotted in the lateral axis; positions are in the vertical axis. Note that L1 designates a locus of train tail position, L2 indicates a locus of train head position, and L3 denotes a locus of a position calculated from departure and arrival times of a railway timetable.

[0101]

It is apparent from viewing this drawing that at a time point T1, a train is in the state that it is stopping at the station α, a detailed display shape of which is shown in Fig. 15. At a time point T2, the train is in the state that it is just after departure from the station α, a detailed display shape of which is shown in Fig. 16. At time points T3, T4, the train is in the state that it is running in an interstation zone between stations α and β: its detailed display shape at the time point T3 is shown in Fig. 17. At a time point T5, the train is in the state that it is right before arrival at station β, a detailed display shape of which is shown in Fig. 18. At a time point T6, the train is in the state that it is stopping at station β, a detailed display shape of which is shown in Fig. 19. These will be described below in sequence.

[0102]

Fig. 15 shows a display shape at the time point T1 just before departure as the stopping train's display shape. The term "stopping" refers to the state within a time span of from a train diagram-defined arrival time to departure time. The stopping train's head and tail positions are at station α 3100; so, its display shape is set to a quadrangle 3101. Like the symbol 1026 shown in Fig. 6, it becomes a rectangle having its display size corresponding to the width and height with the station's location being a center. By this shape, it is possible to represent the stopping state.

[0103]

Fig. 16 shows a display shape at time point T2 as the display shape of the train that is just after its departure. The term "just after its departure" refers to the state in a time span of from the train diagram-defined departure time to an instant after the elapse of Δt seconds. Although the head position just after the departure becomes 3002 which begins to move from the station α, the tail position becomes 3003, which does not start moving from the station α. Therefore, as shown by 3102, the display of such train just after its departure is such that the train length increases with time. By this change, it is possible to represent the state just after the departure.

[0104]

Fig. 17 shows a display shape at time point T3 as the display shape of the train that is now in process of running. The term "running" refers to the train's state within a time period spanning from an instant corresponding to the elapse of more than Δt seconds since the train's departure time to an instant at which these are Δt seconds or more until its next arrival time. The display of such running train is such that the train length increases to its maximum and becomes fixed as shown by 3103. The train head position in this state becomes 3004; its tail position becomes 3005. By this change, it is possible to represent the running state.

[0105]

Fig. 18 shows a display shape at time point T5 as the display shape of the train that is just before its arrival. The term "just before its arrival" refers to the train's running state within a time span which has a remaining time of Δt or less until the train arrives at the next station. As shown by 3104, the display of such train right before its arrival is such that the train shape is gradually becoming shorter as it approaches the arrival time. The train head position in this state becomes 3006; its tail position becomes 3007. By this change, it is possible to represent the state right after the arrival. By this change, it is possible to represent the state right before the arrival.

[0106]

Fig. 19 shows a display shape at time point T6 right after the arrival as the display shape of the train that is stopping. From just after the arrival, the display shape becomes almost the same as that of the stopping train just before its departure shown in Fig. 15.

[0107]

With that, the detailed explanation as to the train's display shapes is over.

[0108]

By the train position display method and train operation assessment device of this embodiment, it is possible to visually check, from train positions and shapes, four kinds of train states, i.e., stopping, just after the arrival, running and right before arrival. Simultaneously, since train delay times and occupancy rates are visualized by means of the train's draw color C and width W, it is possible to grasp a wide-area distribution of train delay times at a glance, thereby enabling recognition of which one of trains is delayed by what degree. It is also possible to catch a wide-area distribution of train occupancy rates at a glance, thereby enabling comprehension of which train is congested to what degree. This makes it possible to implement effective preparation of a train operation plan or alteration of the operation plan.

EMBODIMENT 2

[0109]

A method for displaying trains and moving bodies and an operation assessment device in accordance with another embodiment of this invention will be described.

[0110]

A configuration of this embodiment and data used therein are similar to those of the embodiment 1; so, explanations thereof are eliminated herein.

[0111]

A processing flow in this embodiment will be explained using Fig. 20. Fig. 20 is a flowchart of train display processing of train position display unit 10. The train display processing of the embodiment 2 shown in Fig. 20 corresponds to that of the embodiment 1 of Fig. 11, and many parts are the same ones. Different processing steps are steps S114 to S117, which are shown by double-line blocks.

[0112]

Firstly in a loop 1 of step S101, a target track section is given by S, and target steps are repeatedly applied to all track sections, which steps consist of the following steps S102-S107 and steps S114-S117.

[0113]

In step S102, track section information of the track section S is read in.

[0114]

A loop 2 of step S103 is for repeating, while setting a train n as the object of interest, target steps, i.e., the following steps S104-S107 and S114-S117, for all trains in the track section S.

[0115]

At step S104, the train n's diagram information is read from diagram information database DB1.

[0116]

At step S105, upon input of a display time t and train n, train-running interstation calculation processing is performed in such a way that the train-running interstation calculation unit calculates, as output data, time points Tα and Tβ and stations α and β which represent an interstation zone in which the train n is running at time t or a train-stop station(s).

[0117]

The station α is the train n's nearest departure or arrival station before the time point t; Tα is the train n's nearest departure or arrival time point before the time t. The station β is the train n's nearest departure or arrival station after the time t; Tβ is the train n's nearest departure or arrival time after the time t.

[0118]

When the station α≠β, it shows that the train of interest is running, wherein an interstation zone of from the station α to station β represents the train-running interstation. When the station α=β, it shows that the train is stopping at the station, wherein the stations α and β represent stop stations. When the station α=indefinite or the station β=indefinite, it shows that the display time t is before the train's first departure time or after its last arrival time and that the train n is out of operation. Regarding the train-running interstation processing, this will be described later.

[0119]

At step S106, when the train is in operation, i.e., when the station β≠indefinite and station β≠indefinite, the procedure goes to step S107. On the other hand, when the train is not in operation, i.e., when the station α=indefinite or station β=indefinite, go to step S112, followed by termination of the processing for the train n.

[0120]

At step S107, the train n's head position p1 at the time point t is represented by p1, and its tail position p2 is by p2; then, a respective one of the head position p1 and tail position p2 is calculated by the train position/shape calculation unit. To reflect a movement change of a time width Δt on the train shape, the head position p1 and tail position p2 are arranged to have a time difference Δt therebetween. The processing at the train position/shape calculation unit will be described later.

[0121]

The above-stated processing of the embodiment 2 shown in Fig. 20 is similar to that of embodiment 1 of Fig. 11 and is different therefrom in processing contents which follow.

[0122]

First, at step S114, it acquires from the train information acquisition unit 13 train occupancy changes v1, v2 and train delay time u of the train n at stations α, β representing an interstation or stop station. The train delay time u is obtained from the train delay time information database DB3; the train occupancy v1, v2 is from train occupancy information database DB4.

[0123]

Additionally, since the train delay time information database DB3 is arranged to store therein train delay times on a per-station basis as shown in Fig. 9, what is done here is to acquire a train delay time u corresponding to the station α. As the train occupancy information database DB4 has its record on a per-interstation basis as shown in Fig. 10, what is done here is to get a train occupancy corresponding to the interstation α, β.

[0124]

For example, when the station α is a station B, a value of "five seconds" is acquired as the train delay time u from the train delay time information database DB3; "120%" and "190%" are obtained as the train occupancy rates v1, v2 from the train occupancy information database DB4. Note that when α=β, a train occupancy rate with the departure station (left) of interstation 602 being identical to the station β is obtained.

[0125]

At step S115, the train n's display color c1, c2 is calculated from the train delay time u or train occupancy change v1, v2. A calculation method of the display color c1, c2 will be described later.

[0126]

At step S116, the train n's display size w1, w2 is calculated from the train delay time u or train occupancy change v1, v2. A calculation method of the display size w1, w2 will be described later.

[0127]

At step S117, the display size w1, w2, display color c1, c2, head position p1 and train position p2 are used to display the train n on the screen. At this time, on-screen image display is performed by alternately switching a pictorial image of the train based on a combination of the display size w1 and display color c1 and an image of the train based on a combination of the display size w2 and display color c2 in accordance with a predetermined constant period.

[0128]

Accordingly, for example, when acquiring "200%" and "190%" as the train occupancy rates v1, v2 from the train occupancy information database DB4 as in the previous case, the train is displayed at a timing by means of the combination of display size w1 and display color c1 in the case of 200%. After the elapse of a time corresponding to the constant period, the train is displayed using the combination of display size w2 and display color c2 in the case of 190%. With this scheme, a state change of the train occupancy at this station is visually displayed.

[0129]

At step S112, the processing for the train n is completed; then, the procedure returns to step S103, followed by repeated execution of the processing until completion of processing operations for all of the trains of the track section S.

[0130]

At step S113, the processing for the track section S is completed; then, return to step S101, for repeated execution of the processing until completion of processing for all track sections.

[0131]

The explanation as to the train display processing is over.

[0132]

By the train display method of this embodiment, it is possible to blink the train's display color and size, thereby enabling ascertainment of changes of train occupancy and train delay time.

[0133]

Next, the train display color and shape will be described in detail. Fig. 6 shows a color model for determination of a train shape and train display color.

[0134]

In Fig. 6, numeral 1020 denotes a train display shape in the case of the train's head position p1 being not the same as its tail position p2. 1021 indicates the head position p1. 1022 is the tail position p2.

[0135]

1026 designates a train display shape when the train's head position p1 is the same as its tail position p2. 1025 indicates the head position p1 and tail position p2.

[0136]

1024 represents display size w1, w2. The display size w1, w2 is calculated per train. In the case of the display size w1, w2 being calculated by the train delay time u, the display size w1 is equal in value to the display size w2 so that it is proportional to the train delay time u. In the case of calculating the display size w1, w2 by train occupancy change v1, v2, the display size w1 is calculated from train occupancy v1, and the display size w2 is calculated from train occupancy v2, resulting in each display size having a value proportional to the train occupancy.

[0137]

1023 and 1027 denote regions to be painted by display color c1, c2. The display color c1, c2 is determined from either the color model 1031 of train delay time or the color model 1034 of train occupancy. The color models 1031 and 1034 are for determining the display color c1, c2 by setting the chromaticity and brightness with 100% based on a well-known HSB color space model and causing the hue to vary from 66% to 0% in accordance with the train delay time or the train occupancy.

[0138]

In the case of determining the display color c1, c2 by the train delay time u, set the display color c1, c2 as the same color. When the train delay time is 0 minute as shown by 1032, the color c1, c2 is set to blue with its hue of 66%. The hue value is made larger with an increase in train delay time u. It is set to red with its hue of 0% when the train delay time u is

60 minutes or more as shown by 1033.

[0139]

In the case of determining the display color c1, c2 by train occupancy v1, v2, the display color c1 is determined by train occupancy v1, and the display color c2 is by train occupancy v2. When the train occupancy is 0% as shown by 1035, the color is set to blue. With an increase in train occupancy v, the hue is made larger value. When the train occupancy is 300% or more as shown by 1036, the color is set to red with its hue of 0%.

[0140]

The detailed explanation as to the train display shape is over.

[0141]

In the train display method of this invention, the train's display shape and color are forced to periodically vary or change depending on its running state. With this scheme, even where a number of trains are displayed simultaneously on the screen, it is possible to ascertain the running state from the train's display shape. Even when displaying all trains in a track section simultaneously, their display shapes are arranged to vary depending on respective running states. Thus, it is possible to check running states of a plurality of trains at a time.

[0142]

As for the train-running interstation calculation unit and the train-running interstation calculation processing and also the train position/shape calculation processing to be performed by the train position/shape calculation unit, these are similar to the embodiment 1; so, explanations thereof will be omitted.

EMBODIMENT 3

[0143]

One embodiment of the train/moving-body operation control device of this invention will be explained using some of the accompanying drawings.

[0144]

Fig. 2 shows a configuration of train operation control system 2 embodying this invention. The operation control system 2 includes a plurality of operation control devices 3 which are provided in units of track sections, and further includes an integrated operation assessment device 4 provided in a shared manner.

[0145]

In other words, the operation control system 2 is the train operation assessment device 1 for managing a plurality of track sections, which can be said to be the one that deconcentrates functionalities of the train operation assessment device 1 of Fig. 1 among the plurality of operation control devices 3 and the common integrated operation assessment device 4.

[0146]

The principle of such function deconcentration lies in putting the information storage units of Fig. 1 in places near information sources to have an in-situ layout (aggregation of track information per track section), commonly having the arithmetic operation functions (10, 11, 12, 13) of Fig. 1 as the integrated operation assessment device 4, and connecting them by communication links. In this regard, however, the track information database DB1 is preferably built in the integrated operation assessment device 4 by taking account of its nature.

[0147]

More specifically, in the drawing, reference character 3A designates an operation control device 3 of track section 1, and 3B denotes an operation control device of track section 2, each of which has, per track section, a train delay time information database DB3, train occupancy information database DB4 and diagram information database DB2, and operates to store and manage corresponding data.

[0148]

The integrated operation assessment device 4 has the arithmetic functions (10, 11, 12, 13) of the train operation assessment device 1 shown in the embodiment 1 and includes route information database DB1. The integrated operation assessment device 4 is connected to the operation control devices of track sections 1 and 2.

[0149]

To the operation control system 2 arranged in this way, various types of terminals TM are connected. TM1 is an operation adjustment input terminal, TM2 is a train-existing track display terminal, and TM3 is an operation situation display terminal. These are coupled to the operation control device 3A of track section 1.

[0150]

On-screen display images of the operation adjustment input terminal TM1 and train-existing track display terminal TM2 are outputted from the operation control device 3A. An on-screen image of the operation situation display terminal TM3 is outputted from the integrated operation assessment device 4.

[0151]

TM 6 is an operation adjustment input terminal, TM5 is a train-existing track display terminal, and TM4 is an operation situation display terminal, which are connected to the operation control devices 3 of track section 2.

[0152]

On-screen display images of the operation adjustment input terminal TM6 and train-existing track display terminal TM5 are outputted from the operation control device 3B. An onscreen display image of the operation situation display terminal TM4 is from the integrated operation assessment device 4.

[0153]

OP1, OP2, OP3, OP4 represents a commanding staff member or dispatcher responsible for managing train operations. In each track section, train operations are managed by a plurality of dispatchers. Especially, OP1 and OP2 are train dispatchers who manage the track section 1; OP3 and OP4 are dispatchers who manage the track section 2.

[0154]

The integrated operation assessment device 4 acquires, as the information of track section 1, train diagram information (DB2A), train delay information (DB3A) and train occupancy information (DB4A). Similarly, as the information of track section 2, the device obtains diagram information (DB2B), train delay information (DB3B) and train occupancy information (DB4B).

[0155]

The operation situation display terminal TM3, TM4 comprises a means for allowing the dispatcher OP, i.e., an user of this terminal, to input a display time point. The integrated operation assessment device 4 creates an on-screen image plane adapted for the input display time and then outputs it to each operation situation display terminal TM3, TM4.

[0156]

The dispatcher OP1, OP2 of track section 1 manages mainly train operations of track section 1. This person acquires train operation situations of a plurality of track sections from the operation situation display terminal TM3, acquires detailed positions of train operations of track section 1 from the train-existing track display terminal TM2, and inputs train operation changes of track section 1 to the operation adjustment input terminal TM1.

[0157]

The dispatcher OP3, OP4 of track section 2 manages mainly train operations in track section 2. The person acquires detailed train operation positions of track section 2 from the train-existing track display terminal TM5, acquires train operation situations of a plurality of track sections from the operation situation display terminal TM6, and inputs train operation changes of track section 2 to the operation adjustment input terminal TM4.

[0158]

The integrated operation assessment device 4 is linked via a communication line 2012 with the operation control device 3A, 3B of each track section and is able to acquire several information items including the train diagram information (DB2A, DB2B), train delay time information (DB3A, DB3B), train occupancy information (DB4A, DB4B) and railway route information (DB1).

[0159]

Data and processing in the integrated operation assessment device 4 are similar to those of the embodiment 1; so, explanations thereof are eliminated herein.

[0160]

Next, a flow of traffic control tasks in the operation control system having the integrated operation assessment device will be described with reference to Figs. 21 to 23 below.

[0161]

Fig. 21 depicts one example of on-screen image plane to be displayed at the operation situation display terminal. Here, an operation situation will be explained.

[0162]

In this drawing, Tr2, Tr3, Tr5, Tr6, Tr7 and Tr9 designate up-trains of a track section 1; Tr1, Tr4 and Tr8 denote down-trains of the track section 1. Part 711 indicates an exemplary set of delay time-dependent train display colors; 712 indicates exemplary train display sizes depending on occupancy rates. In this display example, it can be seen at this time that down-trains are high in vehicle occupancy while up-trains are relatively low in occupancy and also seen that down-trains are less in number than up-trains, suggesting that train operations are delayed.

[0163]

In this case, one or some of the up-trains are forced to turn back for operating as down-trains, thereby making it possible to establish equalization of the numbers of up-trains and down-trains and, simultaneously, enabling equalization of train occupancy. The way of coordinating train operations in this way will be referred to as the operation adjustment.

[0164]

The explanation of the operation situation is now over.

[0165]

Next, a flow of the operation adjustment to be performed by a train dispatcher(s) for turn-back of trains in the operation situation shown in Fig. 21 will be described with reference to a sequence diagram shown in Fig. 22.

[0166]

In step S701, a train operation situation is ascertained from an image plane being displayed on the screen of the operation situation display terminal TM3.

[0167]

At step S702, the dispatcher OP decides from the train operation situation displayed on the screen that a need is felt to implement operation adjustment for causing an up-train(s) to turn back.

[0168]

At step S703, the dispatcher OP inputs operation adjustment to the operation situation display terminal TM3. A method of inputting the operation adjustment is as follows: the dispatcher OP puts a mouse pointer 715 at a train icon Tr and clicks on it, resulting in appearance of a pop-up menu 712 at the lower right corner of Fig. 21. Further, s/he selects an operation adjustment 721 and turn-back 722 from the popup menu 712, causing a turn-back operation adjustment dialogue 714 to be displayed. This turn-back dialogue at least has input fields of a turn-back operation-applied train(s) 723, turn-back station(s) and turn-back time 725. By filling these input fields and depressing a button 726, the input of turn-back operation adjustment is completed.

[0169]

At step S704 of Fig. 22, the content of such operation adjustment inputted to the operation situation display terminal TM3 is automatically inputted to the operation adjustment input terminal TM1 from operation situation display terminal TM3.

[0170]

At step S705, the content of the operation adjustment inputted to operation adjustment input terminal TM1 is automatically inputted to the operation control device 3A from operation adjustment input terminal TM1.

[0171]

At step S706, train diagram alteration is implemented based on the operation adjustment inputted to the operation control device 3A.

[0172]

At steps S707-S708, the diagram alteration content changed by operation control device 3A is transmitted to the operation adjustment input terminal TM1 and operation situation display terminal TM3, thereby updating each on-screen display image to an image plane reflecting the alteration content.

[0173]

The explanation on the flow of operation adjustment tasks is over.

[0174]

With the operation assessment system of this invention, an on-screen image that enables ascertainment of a congestion situation along with delay times of trains is displayed at the operation situation display terminal, thereby making it possible for the dispatcher who manages train operations to adequately grasp a present train operation situation, and also possible to quickly input and implement operation adjustment in conformity with the train operation situation.

EMBODIMENT 4

[0175]

An explanation will now be given of a train/moving-body display method and operation assessment device in accordance with another embodiment of this invention.

[0176]

Fig. 23 shows a configuration of train operation assessment device 3 having the train display method of this embodiment. The configuration of the train operation assessment device will be described using Fig. 23.

[0177]

The train operation assessment device 3 has an arithmetic computing unit including a train position display unit 10b and train information acquisition unit 13b. It also has, as the database storing input information and processed information used for these computing operations, storage units of railway route information database DB1 and train run information database DB5. The arithmetic unit and storage units are interconnected together.

[0178]

Among them, the train position display unit 10b acquires from the route information database DB1 a sequence of stations and station positions in each track section and displays a route diagram. For example, assuming that the railway route configuration of Fig. 3 is displayed on the monitor screen, the route information database DB1 is arranged to have route information data like that shown in Fig. 7. The route information database DB1 is similar to that of the embodiment 1; so, its explanation is omitted. Additionally, the train information acquisition unit 13b acquires train positions, train operation delay times and train occupancy rates from the train run information database DB5 and displays train running states. The train run information database DB5 has train run information data shown in Fig. 25.

[0179]

Fig. 25 depicts the data being stored in train run information database DB5. TB7 is a route information table of train n, and TB8 is a route information table of train m. Stored in these tables on a per-train basis are X- and Y-coordinates of a train in the track section at respective time points along with train delay times and train occupancy rates.

[0180]

A flow of processing in this embodiment will be explained using Fig. 24. Fig. 24 is a flowchart of train display processing of the train position display unit 10b. Fig. 24 of the embodiment 4 shows train display processing corresponding to Fig. 11 of the embodiment 1, wherein partial processing is the same. Processing of steps S118 and S119 is different from those of Fig. 11 as indicated by double-line blocks added thereto.

[0181]

In step S118, it reads from the train run information database DB5 train run information involving a train position at display time t which is represented by its head position p1, a train delay time u, a train occupancy v, and a train position of time t-Δt given by tail position p2. When there is no information of a corresponding time point, set the head position p1, tail position p2, train delay time u and train occupancy v as indefinite. Note however that when only p2 is indefinite, set p2=p1.

[0182]

At step S119, a decision is made as to whether the train n is running. Depending on this decision, the procedure will be branched. If the train n is running, go to step S119; otherwise, go to step S112 which performs processing for the next train. Whether the train n is running or not may be judged by determining whether the train position p2 that was read in step S118 is indefinite or not.

[0183]

The explanation on train display processing is over.

[0184]

In the train display method of this invention, the train's display shape and color are caused to vary depending on its running state. In particular, it is possible to visually check the train's acceleration and deceleration conditions. This makes it possible even when a number of trains are displayed simultaneously to ascertain respective train running states from display shapes thereof. Even where the trains in an entire area of track section are displayed simultaneously, their display shapes are forced to change depending on the running states of respective trains. Thus, it is possible to check the running states of a plurality of trains simultaneously.

REFERENCE SIGNS LIST

[0185]

1: Operation Assessment Device

2: Operation Control System

3A: Operation Control Device of Track Section 1

3B: Operation Control Device of Track Section 2

4: Integrated Operation Assessment Device

10: Train Position Display Unit

11: Train Position/Shape Calculation Unit

12: Train-Running Interstation Calculation Unit

13: Train Information Acquisition Unit

DB1: Route Information Database

DB2: Diagram Information Database

DB3: Train Delay Time Information Database

DB4: Train Occupancy Information Database

M: Interstation Route

L1: Locus of Train Tail Position

L2: Locus of Train Head Position

L3: Locus of Representative Position

ST: Station

Tr: Symbol of Train

TB1, TB2: Route Information Table

TB3, TB4: Diagram Information Table

TB5: Train Delay Time Table

TB6: Train Occupancy Table

CLAIMS

[Claim 1] A method for displaying trains and moving bodies, wherein said method changes display positions and shapes of symbols indicating a train and a moving body in accordance with running states of the train and the moving body.

[Claim 2] The method for displaying trains and moving bodies according to claim 1, wherein the method modifies as said running states the shapes of the symbols indicating the train and the moving body in accordance with stopping and running conditions.

[Claim 3] The method for displaying trains and moving bodies according to claim 2, wherein shape change of the symbols indicating the train and moving body as said running states is alternation in length along time course.

[Claim 4] The method for displaying trains and moving bodies according to any one of the preceding claims 1 to 3, wherein alternation of shapes of said symbols indicating the train and moving body is displayed along movement directions of the train and moving body.

[Claim 5] The method for displaying trains and moving bodies according to any one of the preceding claims 1 to 4, wherein said symbols indicating the train and moving body are arranged to reflect delay situations or vehicle occupancy rates of the train and the moving body.

[Claim 6] The method for displaying trains and moving bodies according to any one of the preceding claims 1 to 5, wherein alteration of the display positions and shapes of the train and moving body includes calculating, for each of the train and moving body, positions at two different time points with an on-screen display time being as a reference and determining positions and shapes of the train and moving body to be displayed depending on the calculated positions of the train and moving body.

[Claim 7] The method for displaying trains and moving bodies according to any one of the preceding claims 1 to 5,

wherein the position of said train is calculated from an actually achieved diagram with a record of actual arrival and departure times at train-stop stations on a per-train basis.

[Claim 8] The method for displaying trains and moving bodies according to any one of the preceding claims 1 to 5,

wherein the position of said train is calculated from a predictive diagram with a record of predictive per-train arrival and departure times at train-stop stations, the arrival and departure times being forecasted at a given prediction time point.

[Claim 9] The method for displaying trains and moving bodies according to any one of the preceding claims 1 to 5,

wherein the position of said train is calculated from actual results of per-train running positions in regard to already operated trains.

[Claim 10] The method for displaying trains and moving bodies according to any one of the preceding claims 1 to 5,

wherein the symbol shape is a line segment having a width connecting together said two train positions.

[Claim 11] The method for displaying trains and moving bodies according to any one of the preceding claims 1 to 5,

wherein the symbol shape is a line segment having a width coupling together said two train positions and is caused to vary in shape so as to make a one end distinguishable from an other end.

[Claim 12] The method for displaying trains and moving bodies according to any one of the preceding claims 1 to 5,

wherein alternation of the symbol shape causes an end on the movement direction side to have an acute angle.

[Claim 13] The method for displaying trains and moving bodies according to any one of the preceding claims 1 to 5, wherein display colors of the train and moving body are determined by delay times of the train and moving body.

[Claim 14] The method for displaying trains and moving bodies according to any one of the preceding claims 1 to 5, wherein a display color of the train is determined by a vehicle occupancy rate of the train.

[Claim 15] The method for displaying trains and moving bodies according to any one of the preceding claims 1 to 5, wherein display sizes of the train and moving body are determined by delay times of the train and moving body.

[Claim 16] The method for displaying trains and moving bodies according to any one of the preceding claims 1 to 5, wherein a display size of the train is determined by a vehicle occupancy rate of the train.

[Claim 17] An operation assessment device having a display device for displaying positions of a train and a moving body, comprising:

a train-running interstation calculation unit for inputting diagram information storing per-train departure and arrival times at each train-stop station, railway route information storing positions of stations constituting a railway route in accordance with route sequence and a display time for visual display of said diagram information on a screen of said display device and for calculating train-running interstation zones or train-stop stations,

a train position/shape calculation unit for calculating train positions and shapes from either said interstation zones or train-stop stations and also from said route information and said display time, and

a train position display unit for calculating train positions at two different time points with the on-screen display time as a reference by means of said train position/shape calculation unit and for determining display positions and shapes of symbols indicating each train and a moving body from the two train positions calculated.

[Claim 18] The operation assessment device according to claim 17,

wherein said diagram information is an actually achieved train diagram with a record of actual arrival and departure times at each train-stop station on a per-train basis.

[Claim 19] The operation assessment device according to claim 17,

wherein said diagram information is a predictive diagram with a record of predictive per-train arrival and departure times at train-stop stations, the arrival and departure times being forecasted at a given prediction time point.

[Claim 20] The operation assessment device according to claim 17,

wherein determination of a display position and shape by said train position display unit is for setting the display position and shape as a line segment having a width coupling together said two train positions.

[Claim 21] The operation assessment device according to claim 17,

wherein determination of a display position and shape by said train position display unit is for setting the display position and shape as a line segment having a width coupling together said two train positions and for causing the shape to vary so as to make a one end distinguishable from an other end.

[Claim 22] The operation assessment device according to claim 17,

wherein determination of a display position and shape by said train position display unit is for setting the display position and shape as a line segment having a width coupling together said two train positions and for causing an end point on the movement direction side to have an acute angle.

[Claim 23] The operation assessment device according to claim 17, further comprising:

a train information acquisition unit for acquiring train delay time information storing a delay time in each train-running interstation zone on a per-train basis and for obtaining said train delay time from the train delay time information,

wherein the train position display unit determines a display size of each train based on the train delay time acquired from said train acquisition unit and displays each train.

[Claim 24] The operation assessment device according to claim 17, further comprising:

a train information acquisition unit for acquiring train occupancy information storing a train occupancy rate in each train-running interstation zone on a per-train basis and for obtaining said train occupancy rate from the train occupancy information,

wherein the train position display unit determines a display size of each train based on said train occupancy rate acquired from said train acquisition unit and displays each train.

[Claim 25] The operation assessment device according to claim 17, further comprising:

a train information acquisition unit for acquiring train delay time information storing a delay time in each train-running interstation zone on a per-train basis and for obtaining said train delay time from the train delay time information,

wherein the train position display unit determines a display color of each train based on the train delay time acquired from said train acquisition unit and displays each train.

[Claim 26] The operation assessment device according to claim 17, further comprising:

a train information acquisition unit for acquiring train occupancy information storing a train occupancy rate in each train-running interstation zone on a per-train basis and for obtaining said train occupancy rate from the train occupancy information,

wherein the train position display unit determines a display color of each train based on said train occupancy rate acquired from said train acquisition unit and displays each train.

[Claim 27] The operation assessment device according to claim 17, further comprising:

a train information acquisition unit for acquiring train occupancy information storing a train occupancy rate in each train-running interstation zone on a per-train basis and for obtaining said train occupancy rate from the train occupancy information,

wherein the train position display unit determines a display color of each train based on said train occupancy rate acquired from said train acquisition unit and displays each train.

[Claim 28] The operation assessment device according to claim 17, further comprising:

a train information acquisition unit for acquiring train occupancy information storing a train occupancy rate in each train-running interstation zone on a per-train basis and for obtaining said train occupancy rate from the train occupancy information,

wherein the train position display unit acquires from said train acquisition unit train occupancy rates at two different time points with the display time as a reference, and determines two display colors of each train said train occupancy rate based on said train occupancy rates at the two different time points, and displays each train while alternately changing said two display colors.

[Claim 29] The operation assessment device according to claim 17, further comprising:

a train information acquisition unit for acquiring train occupancy information storing a train occupancy rate in each train-running interstation zone on a per-train basis and for obtaining said train occupancy rate from the train occupancy information,

wherein the train position display unit acquires from said train acquisition unit train occupancy rates at two different time points with the display time as a reference, determines two display sizes of each train said train occupancy rate based on said train occupancy rates at the two different time points, and displays while alternately changing said two display sizes.

[Claim 30] An operation control system having an operation control device arranged in each track section, a commonly provided integrated operation assessment device, and a display device for displaying positions of trains and moving bodies,

wherein said display device is arranged to display a train operation situation using symbols indicating said trains and moving bodies by the display method defined in any one of the preceding claims 1 to 16.

[Claim 31] The operation control system according to claim 30,

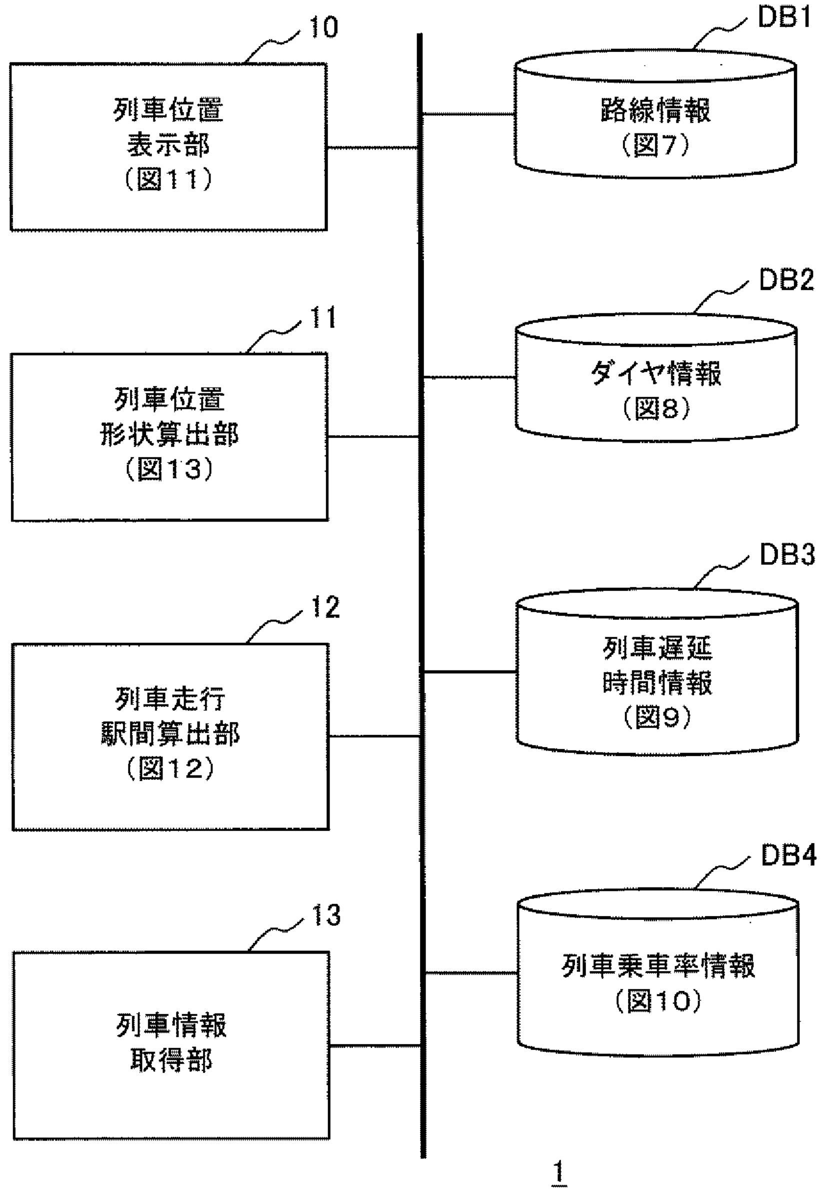
wherein said operation control system includes a display terminal for displaying operation situations of said trains and moving bodies and an operation adjustment input terminal for inputting conditions used by a commanding staff member to perform operation adjustment.

[Claim 32] An operation control system having an operation control device arranged per track section, a commonly provided integrated operation assessment device, and a display device for displaying positions of trains and moving bodies,

wherein said display device is arranged to display a train operation situation using symbols indicating said trains and moving bodies, which symbols are determined by the train position display unit of the operation assessment device defined in any one of the preceding claims 17 to 29.

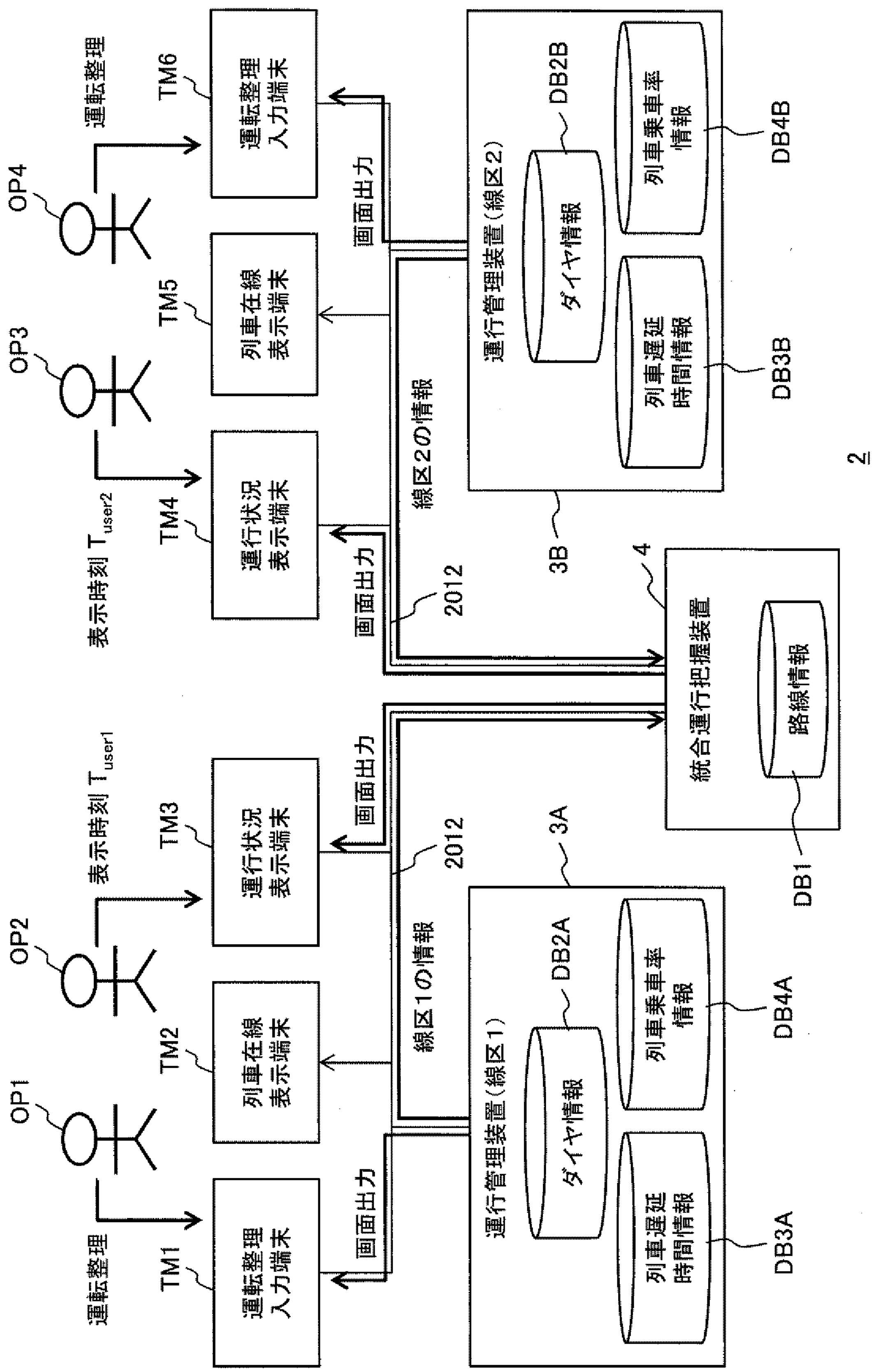
[図1]

図 1


10
列車位置
表示部
（図11）
11
列車位置
形状算出部
（図13）
12
列車走行
駅間算出部
（図12）
13
列車情報
取得部
DB1
路線情報
（図7）
DB2
ダイヤ情報
（図8）
DB3
列車遅延
時間情報
（図9）
DB4
列車乗車率情報
（図10）
1

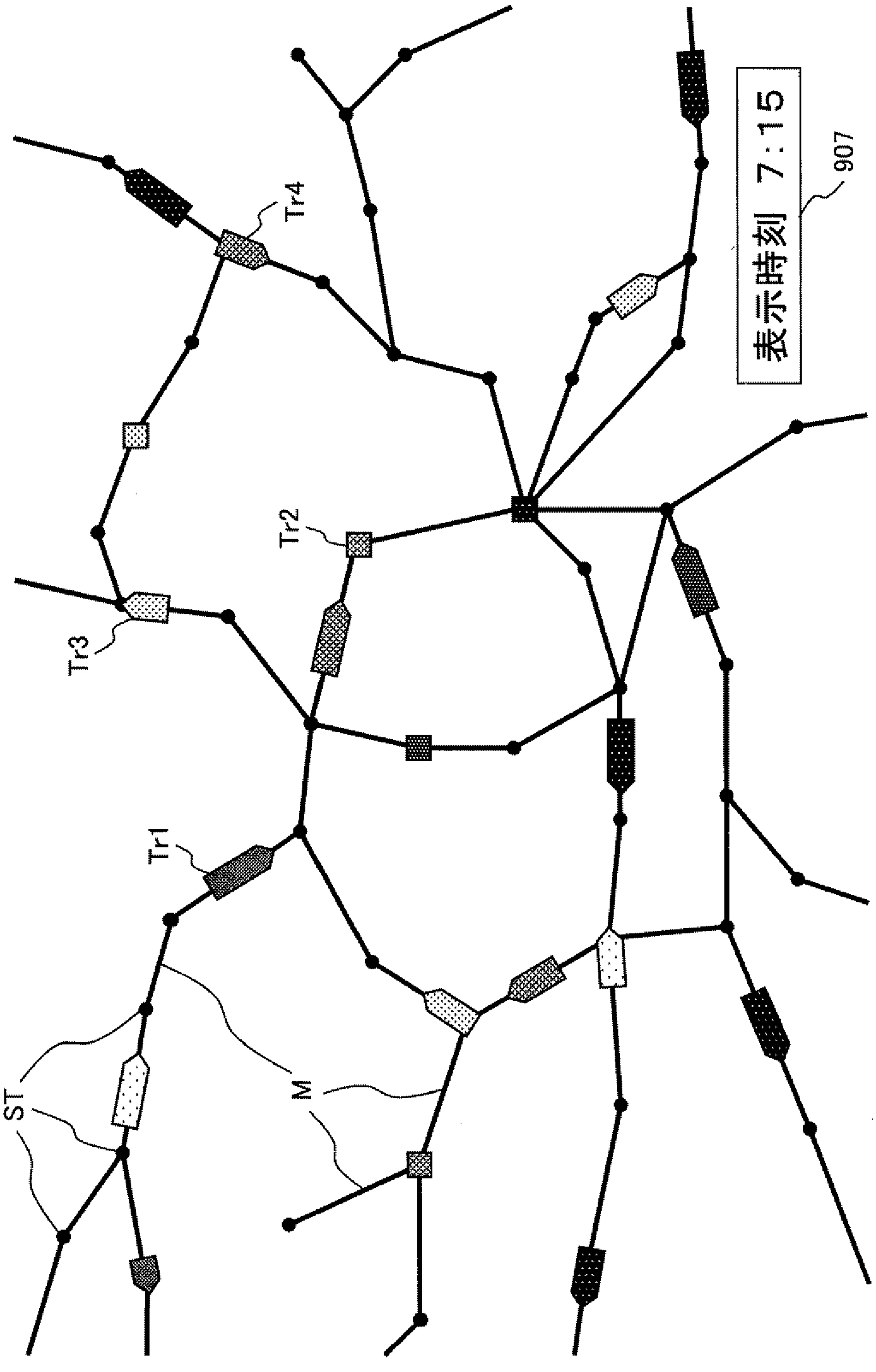
[図2]

図 2


OP1
OP2
OP3
OP4
運転整理
表示時刻 T_{user1}
表示時刻 T_{user2}
運転整理
TM1
運転整理
入力端末
TM2
列車在線
表示端末
TM3
運行状況
表示端末
TM4
運行状況
表示端末
TM5
列車在線
表示端末
TM6
運転整理
入力端末
画面出力
画面出力
画面出力
画面出力
線区1の情報
線区2の情報
2012
2012
運行管理装置（線区1）
DB2A
ダイヤ情報
列車遅延
時間情報
列車乗車率
情報
DB3A
DB4A
3A
運行管理装置（線区2）
DB2B
ダイヤ情報
列車遅延
時間情報
列車乗車率
情報
DB3B
DB4B
3B
4
統合運行把握装置
路線情報
DB1
2

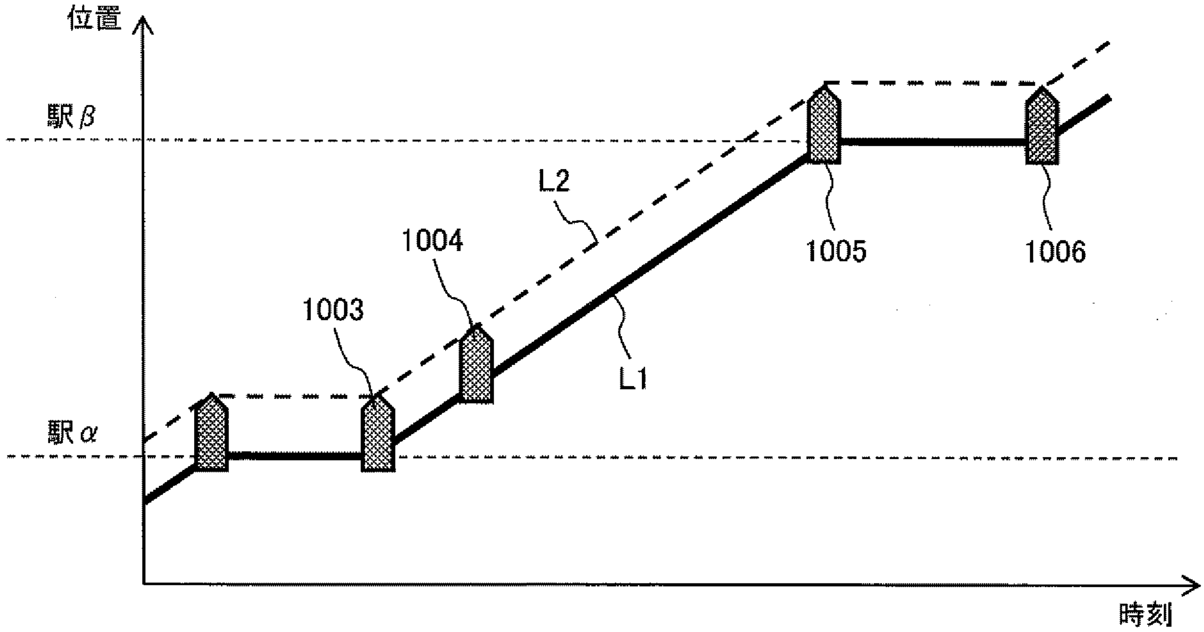
[図3]

図 3



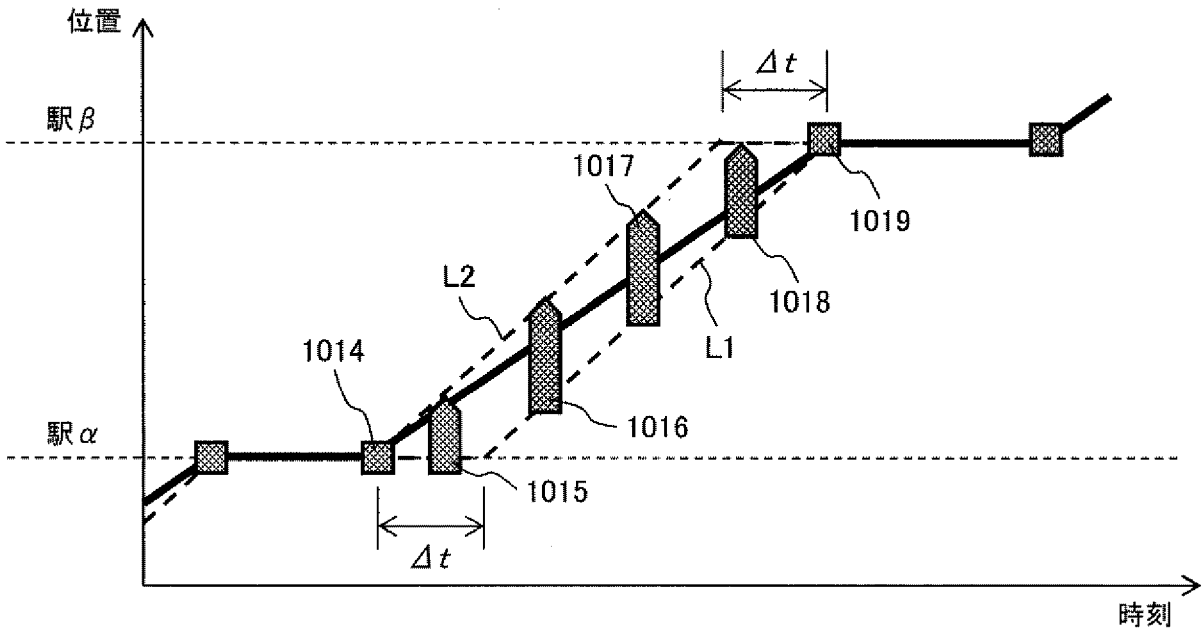
[図4]

図 4


位置
駅β
駅α
L2
L1
1003
1004
1005
1006
時刻

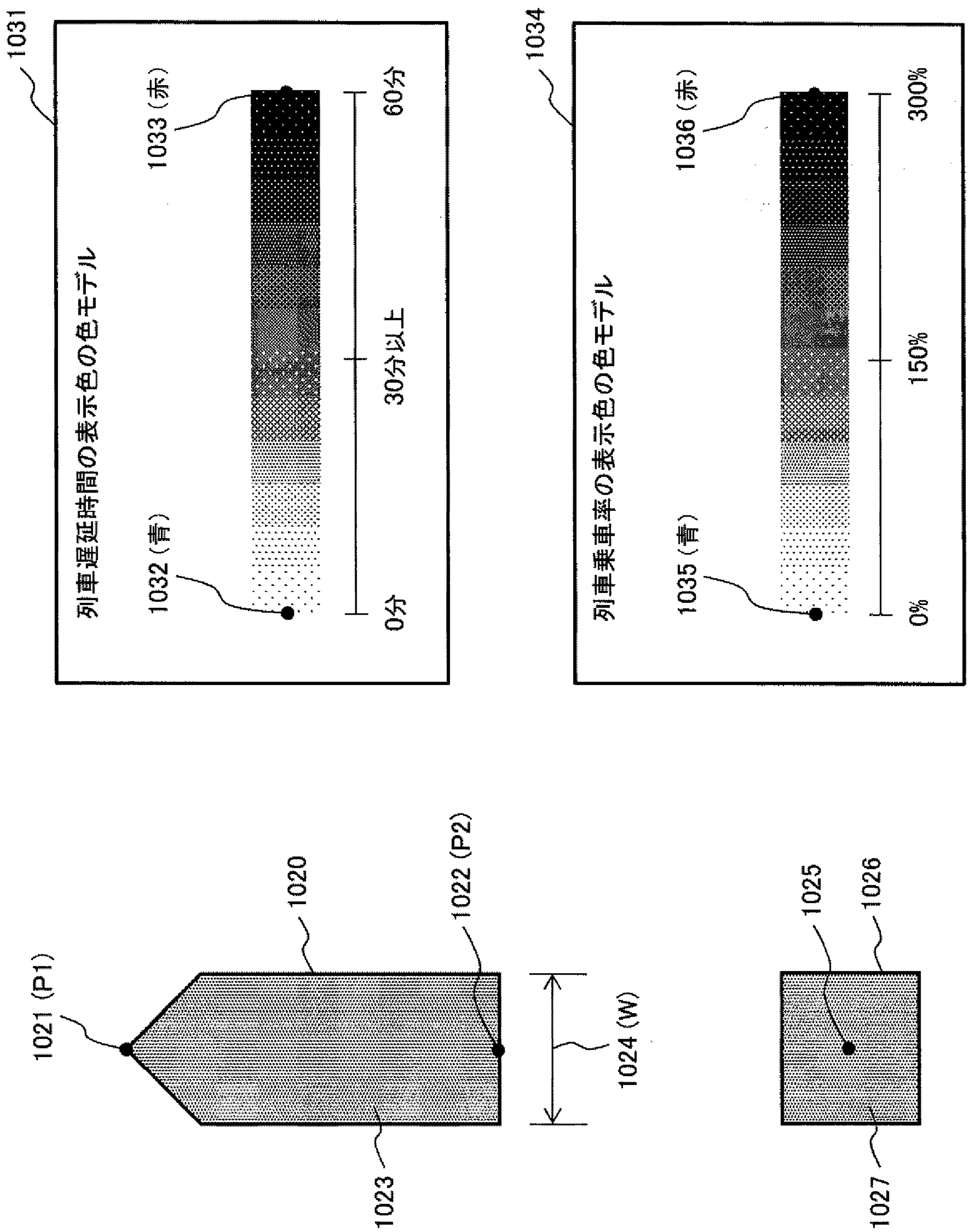
[図5]

図 5


位置
駅β
駅α
Δt
1017
L2
1014
1015
1016
1018
1019
L1
Δt
時刻

[図6]

図 6


1031
列車遅延時間の表示色の色モデル
1032（青）
1033（赤）
0分
30分以上
60分
1034
列車乗車率の表示色の色モデル
1035（青）
1036（赤）
0%
150%
300%
1021 (P1)
1020
1022 (P2)
1023
1024 (W)
1025
1026
1027

[図7]

図 7

線区1 TB1

駅名	位置
A駅	(x_1, y_1)
B駅	(x_2, y_2)
C駅	(x_3, y_3)
D駅	(x_4, y_4)
E駅	(x_5, y_5)
F駅	(x_6, y_6)
:	:

ST 512

線区2 TB2

駅名	位置
G駅	(x_7, y_7)
H駅	(x_8, y_8)
C駅	(x_3, y_3)
I駅	(x_9, y_9)
J駅	(x_{10}, y_{10})
K駅	(x_{11}, y_{11})
:	:

ST

[図8]

図 8

316

No.	駅	区分	A701
1	A駅	到着	07:10:00
2	A駅	出発	07:10:32
3	B駅	到着	07:15:25
4	B駅	出発	07:16:42
5	C駅	到着	07:21:11
6	C駅	出発	07:22:22
7	D駅	到着	07:25:15
8	D駅	出発	07:27:47
:	:	:	:

TB3

320 311 312 313

316

No.	駅	区分	A702
1	B駅	到着	07:15:00
2	B駅	出発	07:15:30
3	C駅	到着	–
4	C駅	出発	–
5	D駅	到着	07:28:16
6	D駅	出発	07:30:51
:	:	:	:

319 TB4

320 311 312 313

.....

[図9]

図 9

線区1 406 407 408 TB5

駅	A701	A702	A703	A704
A駅	0秒	0秒	0秒	60秒
B駅	5秒	−	120秒	−
C駅	10秒	20秒	180秒	300秒
D駅	15秒	30秒	300秒	600秒
:	:	:	:	:

409

402

[図10]

図 10

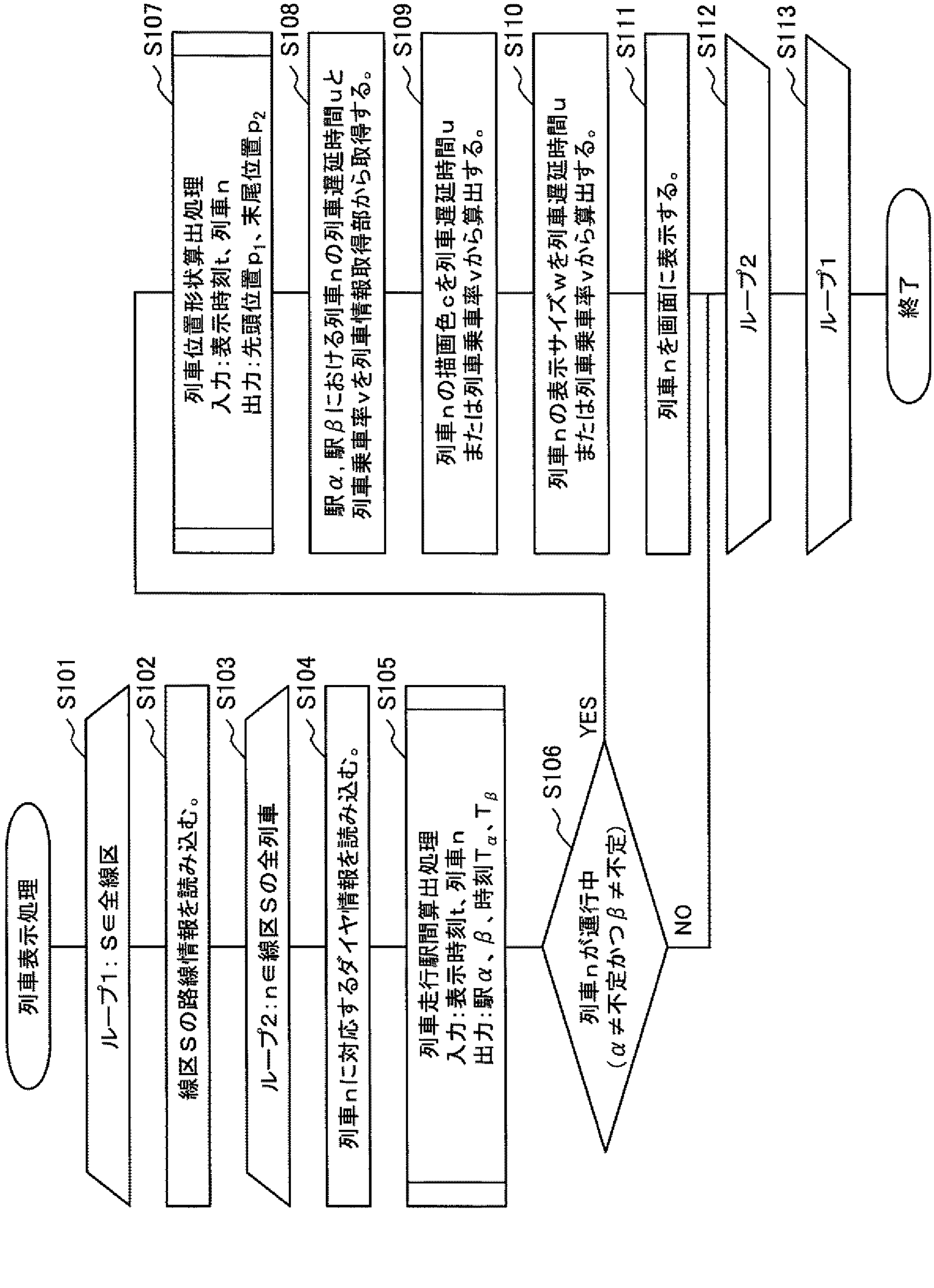
線区1 602 606 607 608 TB6

駅間		A701	A702	A703	A704
A駅	B駅	200%	150%	100%	150%
B駅	C駅	190%	−	90%	−
C駅	D駅	180%	120%	80%	80%
D駅	E駅	175%	110%	70%	80%
:	:	:	:	:	:

609

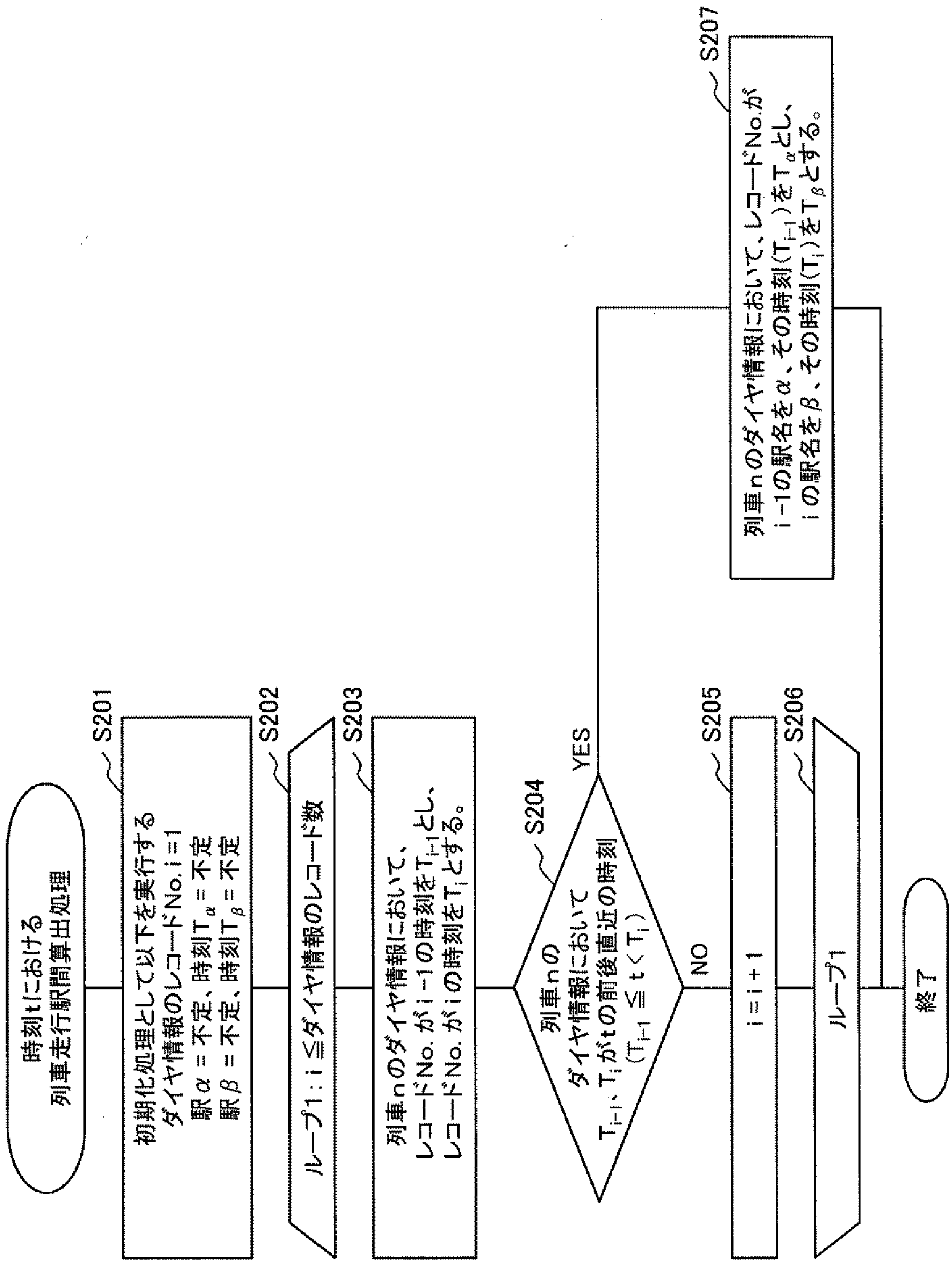
[図11]

図 11


列車表示処理
S101
ループ1：S∈全線区
S102
線区Sの路線情報を読み込む。
S103
ループ2：n∈線区Sの全列車
S104
列車nに対応するダイヤ情報を読み込む。
S105
列車走行駅間算出処理
入力：表示時刻t、列車n
出力：駅α、β、時刻Tα、Tβ
S106
列車nが運行中
（α≠不定かつβ≠不定）
YES
NO
S107
列車位置形状算出処理
入力：表示時刻t、列車n
出力：先頭位置p1、末尾位置p2
S108
駅α，駅βにおける列車nの列車遅延時間uと
列車乗車率vを列車情報取得部から取得する。
S109
列車nの描画色cを列車遅延時間u
または列車乗車率vから算出する。
S110
列車nの表示サイズwを列車遅延時間u
または列車乗車率vから算出する。
S111
列車nを画面に表示する。
S112
ループ2
S113
ループ1
終了

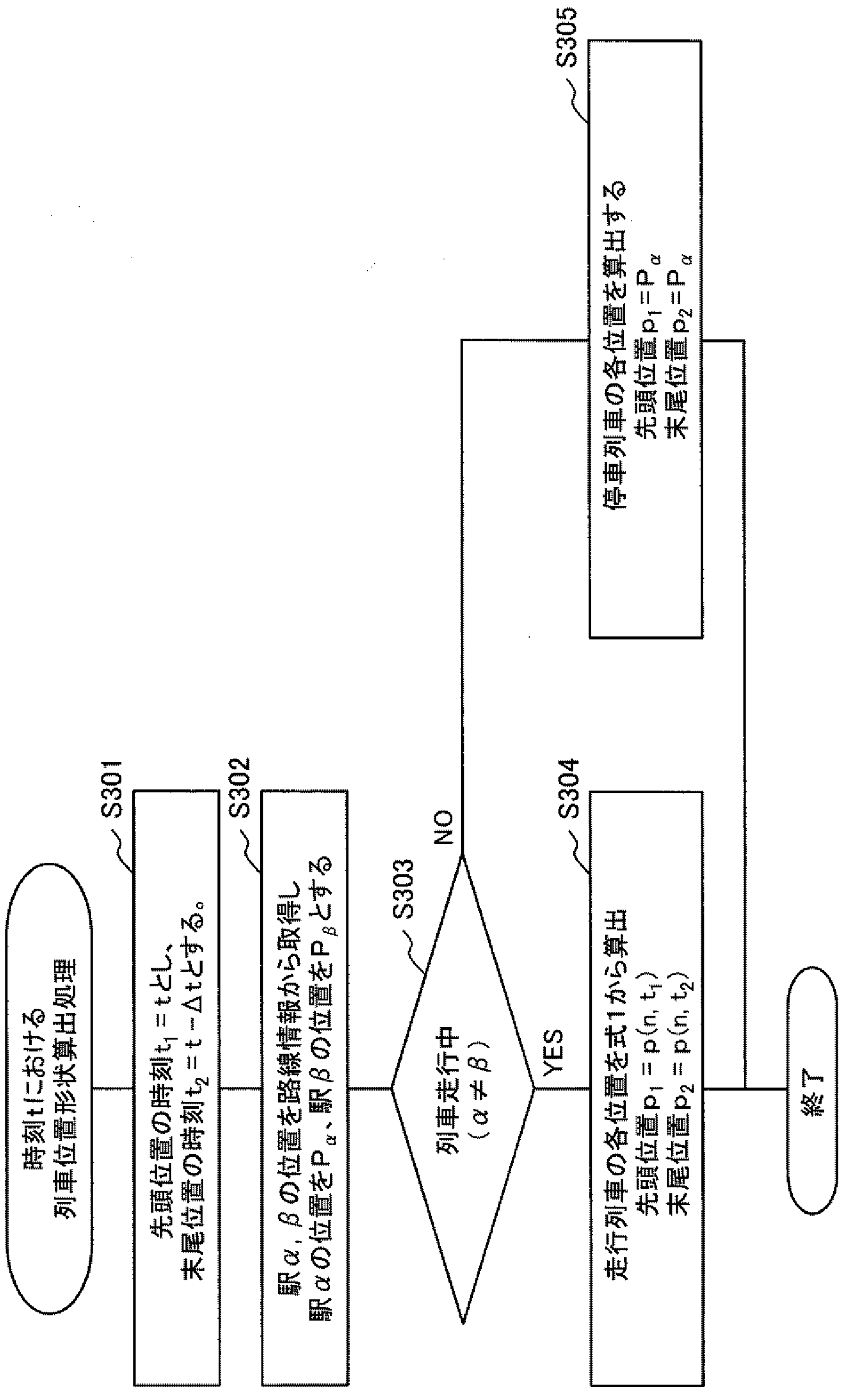
[図12]

図 12


時刻tにおける
列車走行駅間算出処理
S201
初期化処理として以下を実行する
ダイヤ情報のレコードNo. i=1
駅α=不定、時刻Tα=不定
駅β=不定、時刻Tβ=不定
S202
ループ1: i≦ダイヤ情報のレコード数
S203
列車nのダイヤ情報において、
レコードNo. がi-1の時刻をT_{i-1}とし、
レコードNo. がiの時刻をT_iとする。
S204
列車nの
ダイヤ情報において
T_{i-1}、T_iがtの前後直近の時刻
(T_{i-1}≦t<T_i)
YES
NO
S205
i=i+1
S206
ループ1
終了
S207
列車nのダイヤ情報において、レコードNo.が
i-1の駅名をα、その時刻(T_{i-1})をTαとし、
iの駅名をβ、その時刻(T_i)をTβとする。

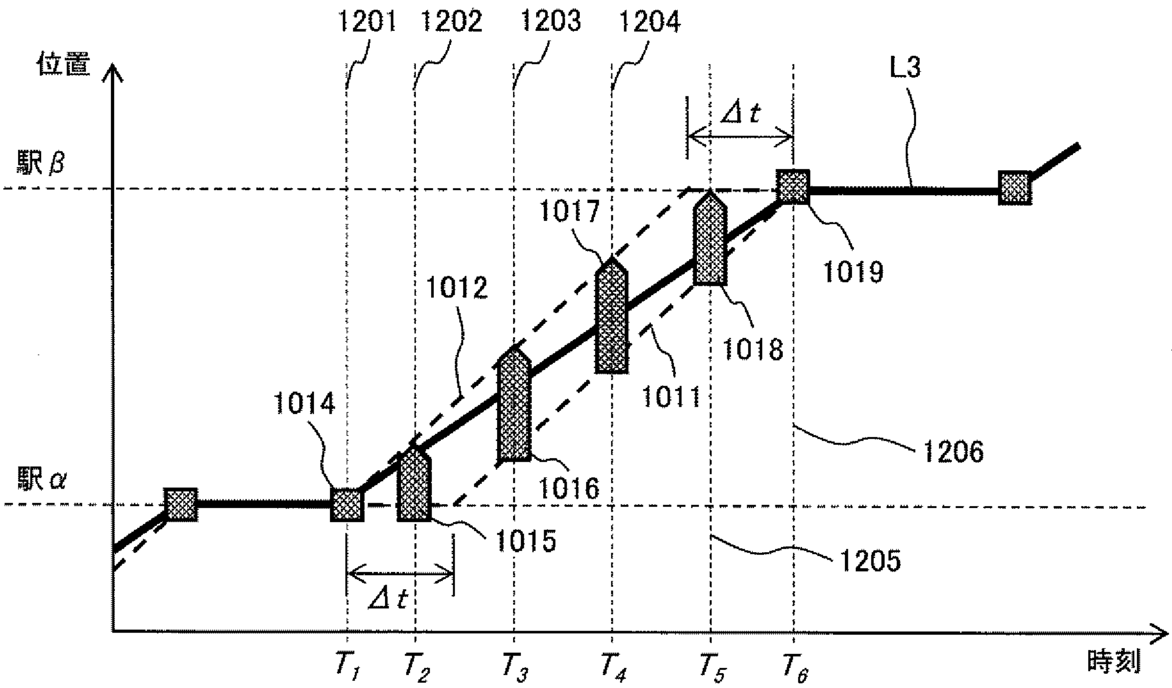
[図13]

図 13


時刻tにおける
列車位置形状算出処理
S301
先頭位置の時刻t_1＝tとし、
末尾位置の時刻t_2＝t－Δtとする。
S302
駅α，βの位置を路線情報から取得し
駅αの位置をP_α、駅βの位置をP_βとする
S303
列車走行中
（α≠β）
YES
NO
S304
走行列車の各位置を式1から算出
先頭位置p_1＝p(n, t_1)
末尾位置p_2＝p(n, t_2)
S305
停車列車の各位置を算出する
先頭位置p_1＝P_α
末尾位置p_2＝P_α
終了

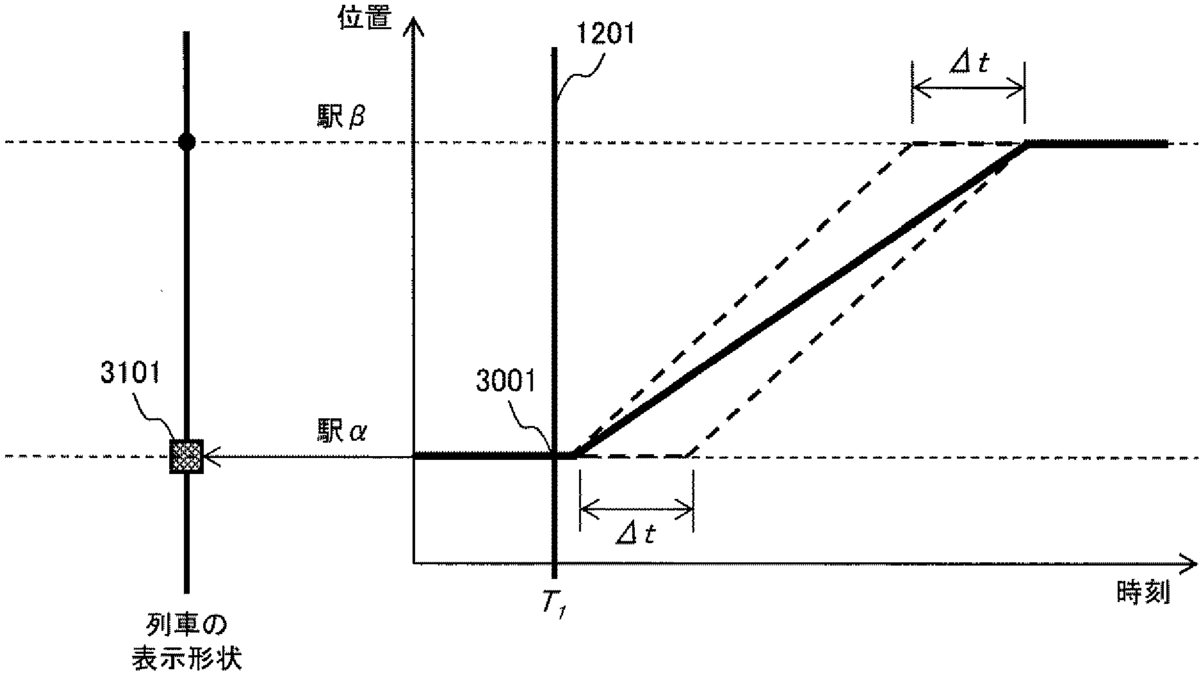
[図14]

図 14



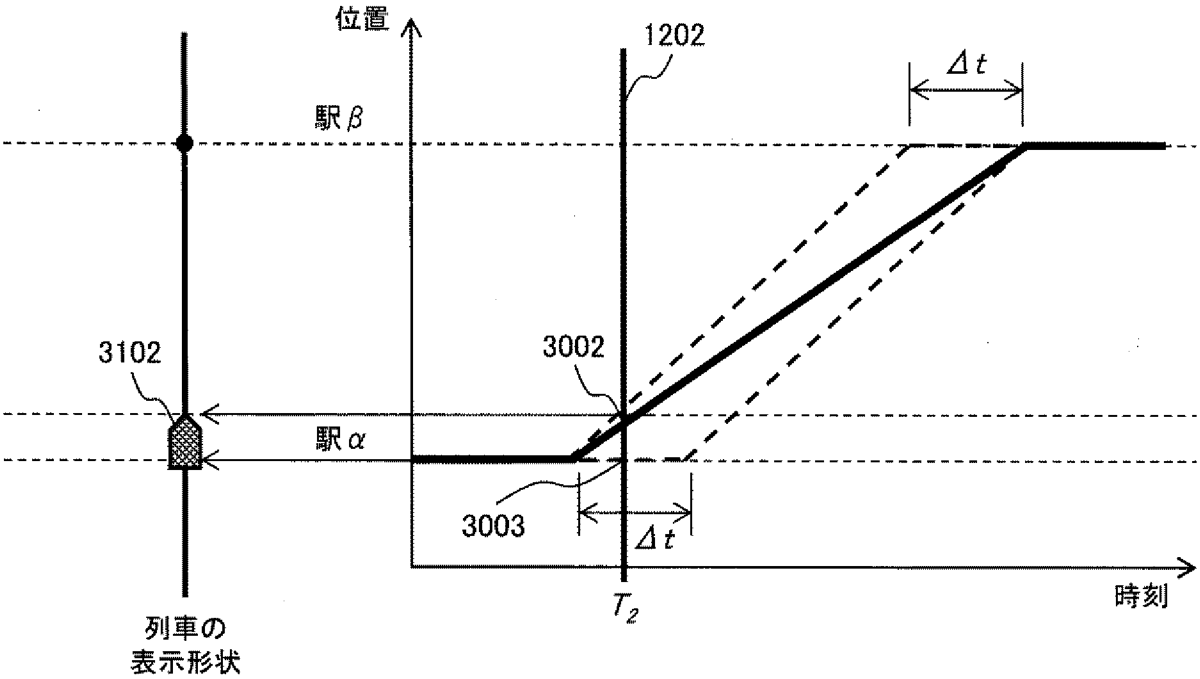
[図15]

図 15



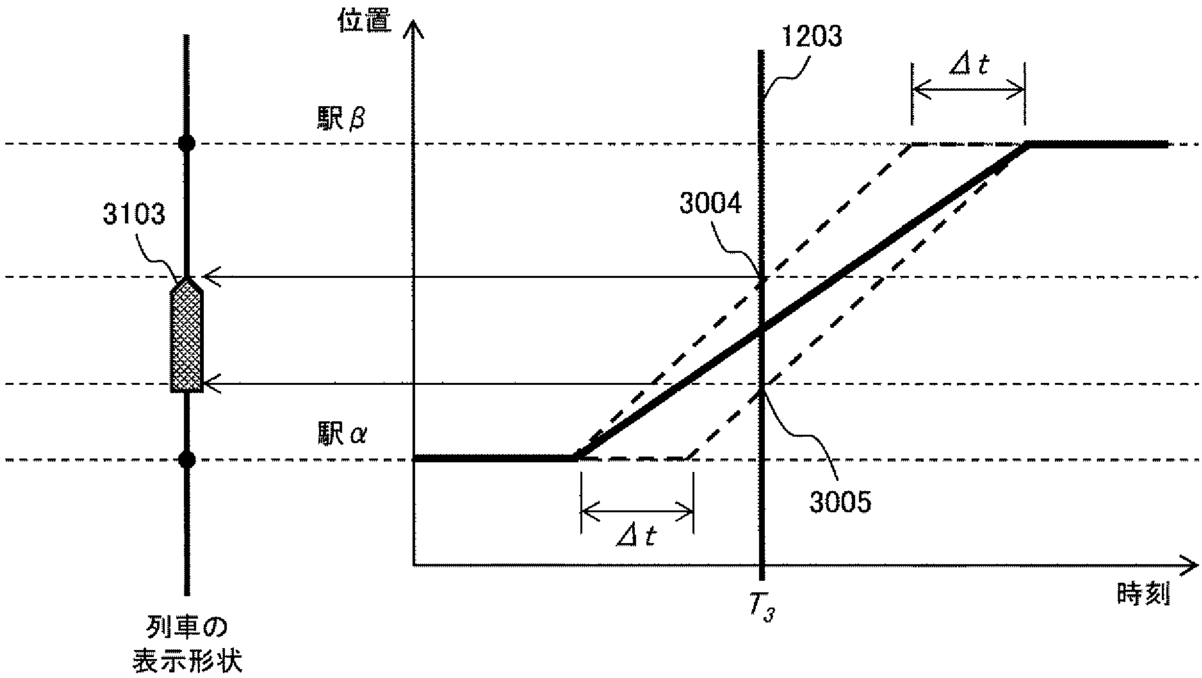
[図16]

図 16



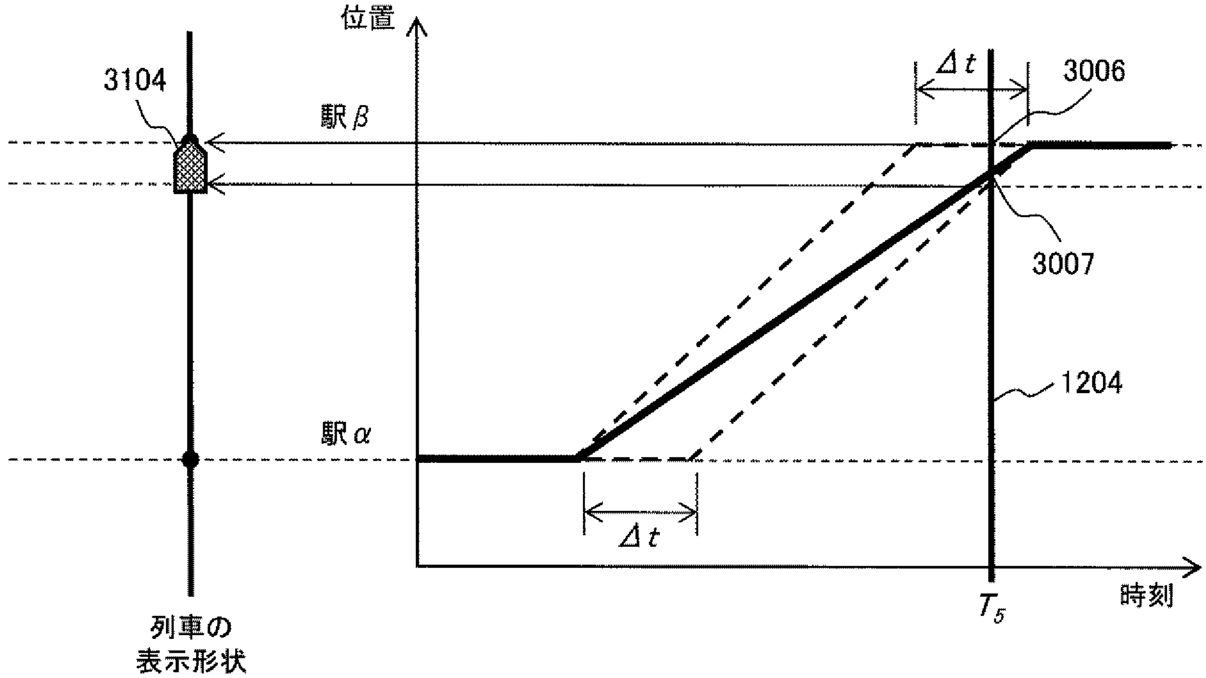
[図17]

図 17



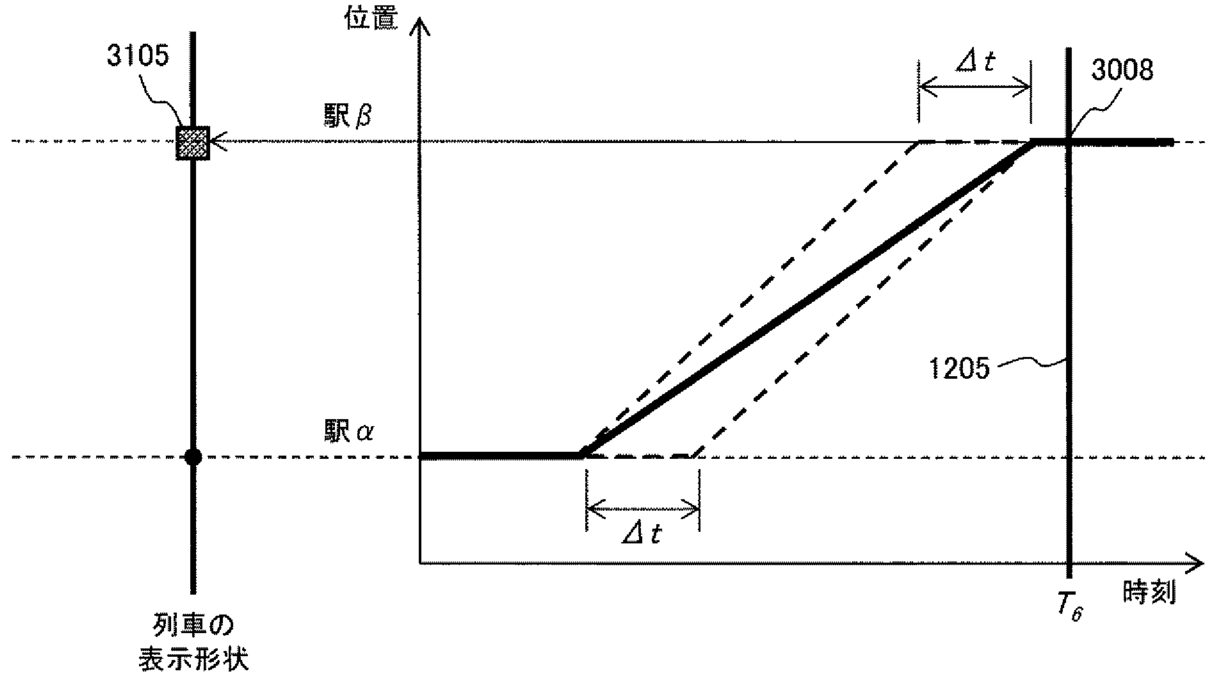
[図18]

図 18



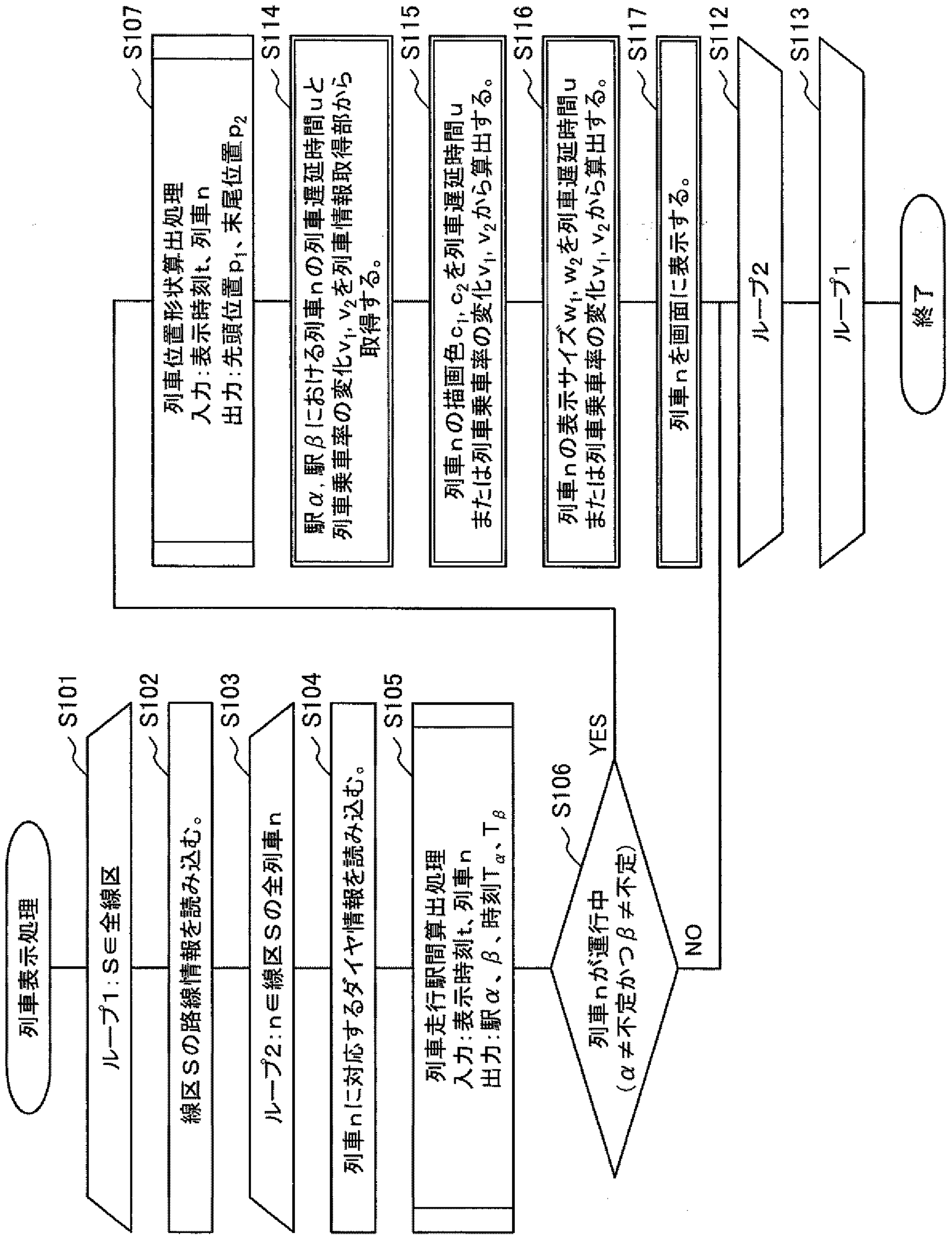
[図19]

図 19



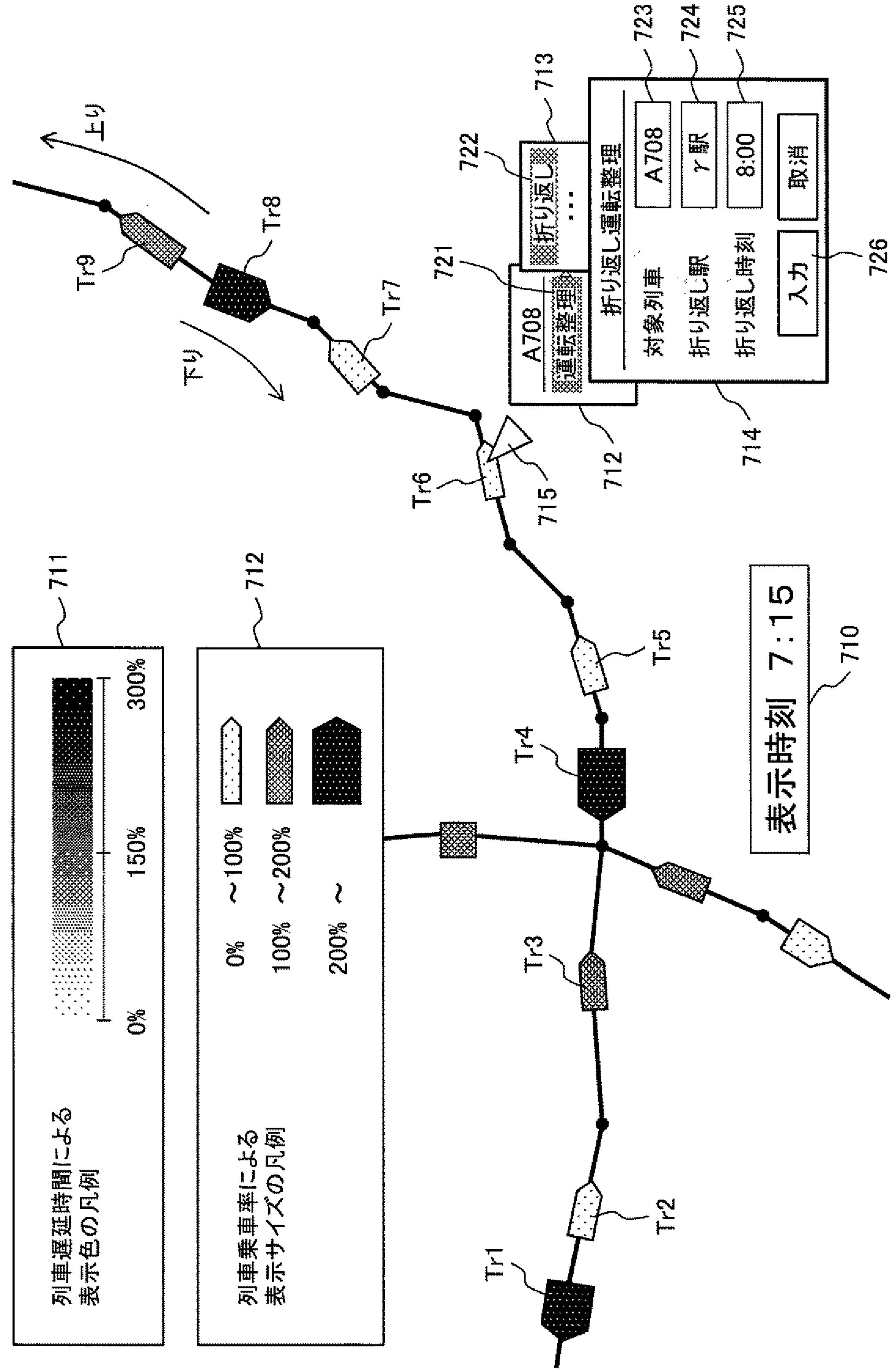
[図20]

図 20


列車表示処理
S101 ループ1：S∈全線区
S102 線区Sの路線情報を読み込む。
S103 ループ2：n∈線区Sの全列車n
S104 列車nに対応するダイヤ情報を読み込む。
S105 列車走行駅間算出処理
入力：表示時刻t、列車n
出力：駅α、β、時刻Tα、Tβ
S106 列車nが運行中
（α≠不定かつβ≠不定）
YES
NO
S107 列車位置形状算出処理
入力：表示時刻t、列車n
出力：先頭位置p1、末尾位置p2
S114 駅α，駅βにおける列車nの列車遅延時間uと列車乗車率の変化v1，v2を列車情報取得部から取得する。
S115 列車nの描画色c1，c2を列車遅延時間uまたは列車乗車率の変化v1，v2から算出する。
S116 列車nの表示サイズw1，w2を列車遅延時間uまたは列車乗車率の変化v1，v2から算出する。
S117 列車nを画面に表示する。
S112 ループ2
S113 ループ1
終了

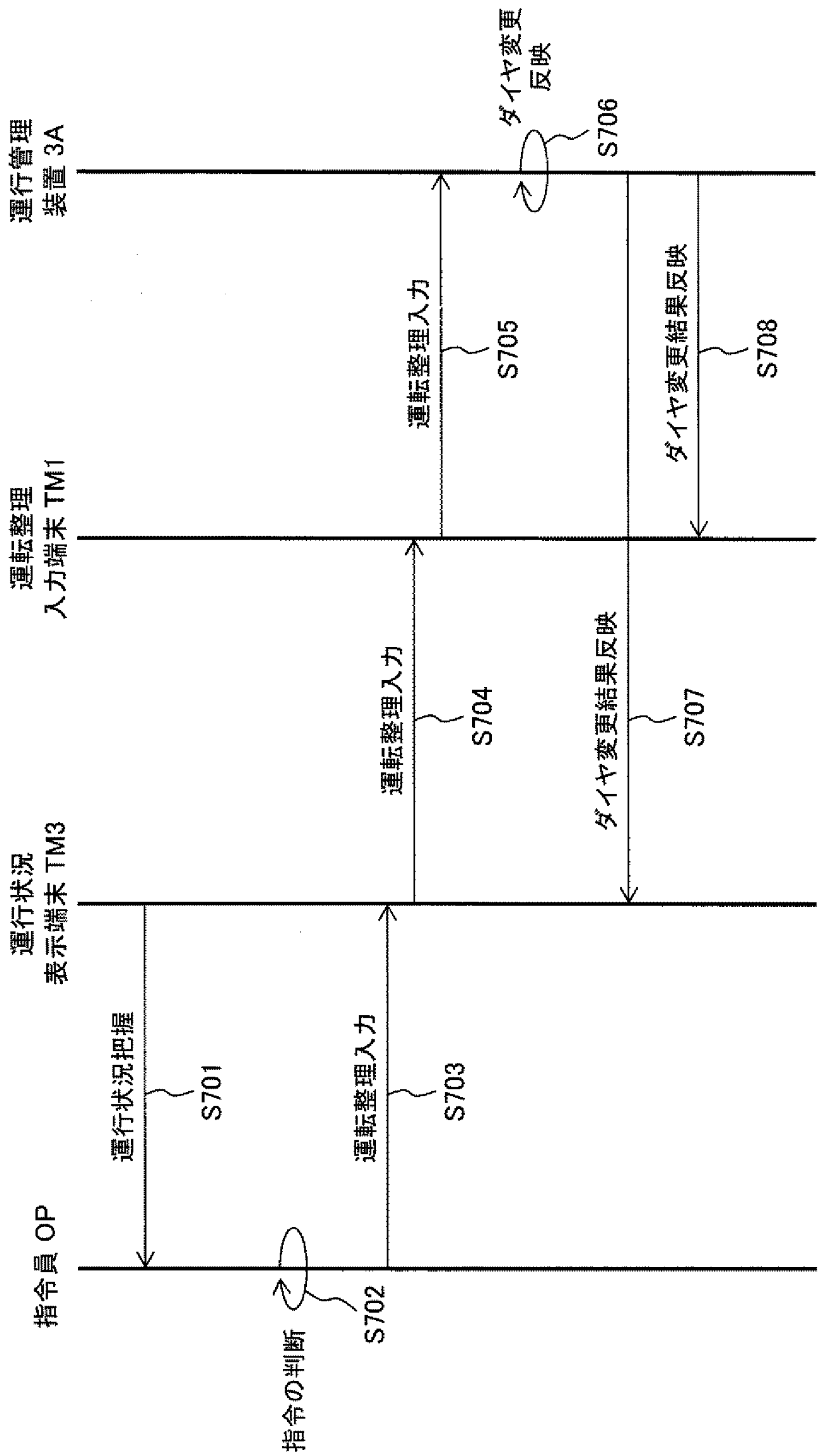
[図21]

図 21


上り
下り
Tr1
Tr2
Tr3
Tr4
Tr5
Tr6
Tr7
Tr8
Tr9
715
A708
運転整理
721
712
折り返し
...
722
713
折り返し運転整理
対象列車
A708
723
折り返し駅
γ駅
724
折り返し時刻
8:00
725
入力
取消
726
714
711
列車遅延時間による
表示色の凡例
0%
150%
300%
712
列車乗車率による
表示サイズの凡例
0% ～100%
100% ～200%
200% ～
表示時刻 7:15
710

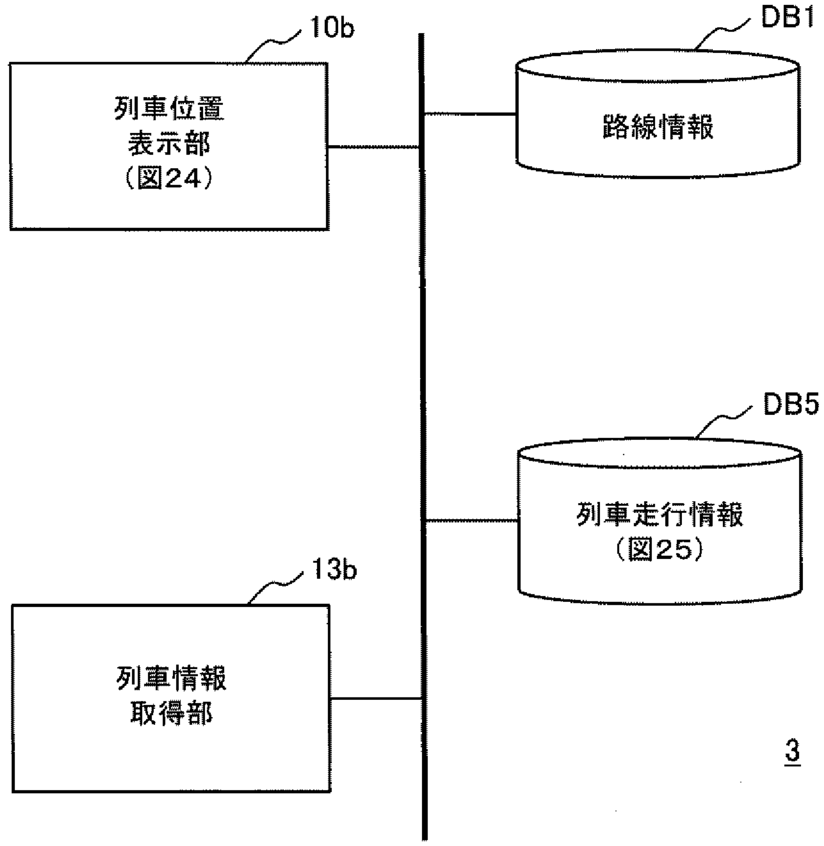
[図22]

図 22


運行管理装置 3A
運転整理入力端末 TM1
運行状況表示端末 TM3
指令員 OP
運行状況把握
S701
指令の判断
S702
運転整理入力
S703
運転整理入力
S704
運転整理入力
S705
ダイヤ変更反映
S706
ダイヤ変更結果反映
S707
ダイヤ変更結果反映
S708

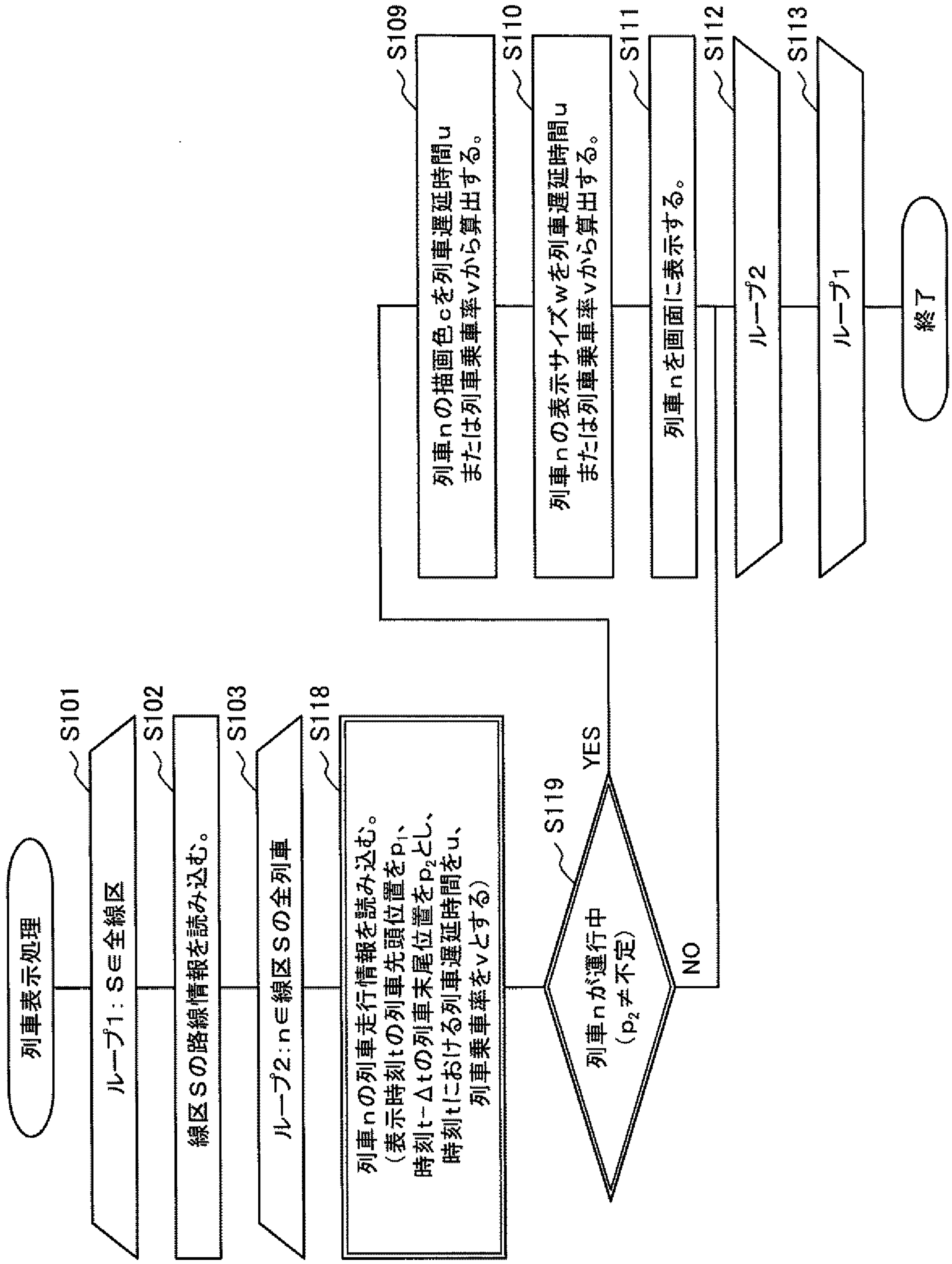
[図23]

図 23



[図24]

図 24



列車表示処理
S101
ループ1：S∈全線区
S102
線区Sの路線情報を読み込む。
S103
ループ2：n∈線区Sの全列車
S118
列車nの列車走行情報を読み込む。
（表示時刻tの列車先頭位置をp1、
時刻t−Δtの列車末尾位置をp2とし、
時刻tにおける列車遅延時間をu、
列車乗車率をvとする）
S119
列車nが運行中
（p2≠不定）
YES
NO
S109
列車nの描画色cを列車遅延時間u
または列車乗車率vから算出する。
S110
列車nの表示サイズwを列車遅延時間u
または列車乗車率vから算出する。
S111
列車nを画面に表示する。
S112
ループ2
S113
ループ1
終了

[図25]

図 25

TB7

列車n

時刻	X座標	Y座標	列車遅延時間	列車乗車率
07:10:10	x_1	y_1	0秒	51%
07:10:20	x_2	y_2	0秒	51%
07:10:30	x_3	y_3	5秒	50%
07:10:40	x_3	y_3	5秒	46%
:	:	:		:

701 702 703 704 705

TB8

列車m

時刻	X座標	Y座標	列車遅延時間	列車乗車率
07:10:10	x_1	y_1	0秒	51%
07:10:20	x_2	y_2	0秒	51%
07:10:30	x_3	y_3	5秒	50%
07:10:40	x_3	y_3	5秒	46%
:	:	:		: