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(54) TACS AND TBTC INTEGRATED SIGNALING SYSTEM AND SWITCHING METHOD THEREOF

(57) The present invention relates to a TACS and TBTC fused signal system and a switching method thereof, the system including a TACS system device, a TBTC system device, and a TACS and TBTC system interface, wherein the signal system integrates the TACS system device and the TBTC system device, and adds the TACS and TBTC system interface, so as to realize coexistence of signal systems of two standards; and under a normal condition, a train runs under the control of a TACS system; under a condition that the train is degraded, the system automatically identifies a device degraded state and switches a control mode to be under the control of a TBTC system; the TBTC system opens signaling for train route setting; and the train runs in a manual driving mode of a driver. Compared with the prior art, the present invention has the advantages of low reconstruction cost, good realization effect, etc.

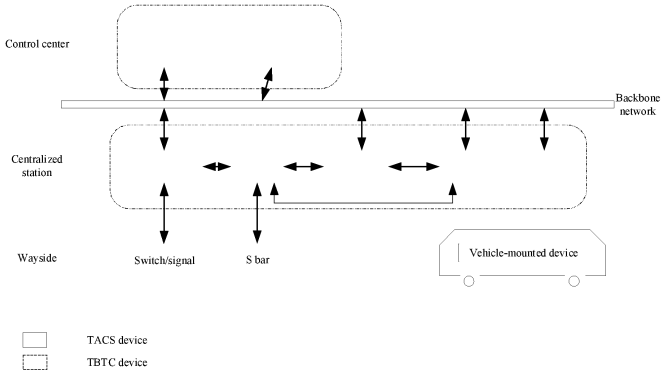

FIG. 1

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Description

FIELD OF TECHNOLOGY

[0001] The present invention relates to a rail transit signal system, in particular to a TACS and TBTC fused signal system and a switching method thereof.

BACKGROUND

[0002] In current rail transit signal systems, there are a quite number of subway lines using a TBTC (track circuit based train control) standard, that is, train control systems based on track circuits. The lines using this standard generally have a long operation life, basically more than 15 years of operation time, and are about to face overhaul and transformation.

[0003] Transformation solutions can be divided into: a first solution, upgrading a whole signal system and replacing an existing TBTC system; a second solution, retaining the existing system and superimposing a new system on the existing system. The advantage of using the second solution is that the new system is usually operated, and the old system can be used as a backup system in a case that the new system is degraded. The disadvantage of the first solution is that the existing TBTC system would be completely abandoned, and the disadvantage of the second solution is that two sets of vehicle-mounted signal systems need to coexist on a train, which increases a maintenance cost in a later stage.

[0004] After searching, disclosed in a Chinese patent application with a publication number CN113320574A is a TACS and CTCS fused signal system. The system comprises a centralized traffic control (CTC) or an automatic train supervision (ATS), a centralized maintenance system (CMSS), a computer interlocking (CI), a train control center (TCC), a track circuit, a temporary speed restriction server (TSRS), a radio block center (RBC), an objective controller (OC), a wayside resource controller (WSIC), a wayside train control (WSTC) and a vehicle-mounted device which are connected to each other through a network. However, the fusion system is not applicable to the TBTC system as the CTCS and TBTC are two completely different signal systems. Therefore, how to develop fusion of the TACS system and TBTC system to realize a TACS vehicle-mounted system that can operate in both a TACS mode and a TBTC mode becomes a technical problem to be solved.

SUMMARY

[0005] The purpose of the present invention is to provide a TACS and TBTC fused signal system and a switching method thereof with low reconstruction cost and good effect in order to overcome the defects existing in the prior art.

[0006] The purpose of the present invention can be realized by the following technical solutions:

[0007] According to a first aspect of the present invention, provided is a TACS and TBTC fused signal system, comprising a TACS system device, a TBTC system device, and a TACS and TBTC system interface, wherein the signal system integrates the TACS system device and the TBTC system device, and adds the TACS and TBTC system interface, so as to realize coexistence of signal systems of two standards; and

under a normal condition, a train runs under the control of a TACS system; under a condition that the train is degraded, the system automatically identifies a device degraded state and switches a control mode to be under the control of a TBTC system;
the TBTC system opens signaling for train route setting; and the train runs in a manual driving mode of a driver.

[0008] As a preferred technical solution, the TACS system device comprises:

a central ATS, for assigning, in the TACS system, a train operation task to the train;

a wayside resource controller, for managing a wayside resource, receiving resource occupation and release requests transmitted by the train, and feeding back a resource locked state to the train;

an objective controller, for receiving wayside resource locking and releasing commands transmitted by the wayside resource controller and performing output control; and

a vehicle-mounted device, for applying, in a TACS mode, a resource from the wayside resource controller.

[0009] As a preferred technical solution, the central ATS is shared by the TACS system and the TBTC system; and when degraded to the TBTC system, the central ATS is used to transmit a route setting command to wayside.

[0010] As a preferred technical solution, the vehicle-mounted device is shared by the TACS system and the TBTC system; and when degraded to the TBTC system, the vehicle-mounted device is used to run the train according to a command of a wayside ATP.

[0011] As a preferred technical solution, the TBTC system device comprises:

a track circuit, for detecting train occupancy and transmitting variable information to the train;

a wayside ATP for receiving a track state transmitted by an interlocking system and transmitting the track state to the train; and

an interlocking system, for setting a route and transmitting a route state to the wayside ATP.

[0012] As a preferred technical solution, the variable information comprises information pertaining to a switch signal state, a speed level, a section length and a gradient.

[0013] As a preferred technical solution, the track state comprises state information of a switch, a signal and the track circuit.

[0014] As a preferred technical solution, the TACS and TBTC system interface comprises:

a wayside resource controller and interlocking system interface, for determining a control right of the wayside resource;

an objective controller and interlocking system interface, for controlling the wayside resource;

an objective controller and track circuit interface, for transmitting occupancy or clearance information of a track section; and

a vehicle-mounted device and track circuit interface, for applying the wayside resource and switching a mode.

[0015] As a preferred technical solution, a specific operation of the wayside resource controller and interlocking system interface is as follows:
in a normal case, the wayside resource controller WRC controls the wayside resource; and under a condition that the wayside resource controller WRC is fault, an interlocking system takes over the control right of the wayside resource.

[0016] As a preferred technical solution, the control right can be set manually.

[0017] As a preferred technical solution, a specific operation of the objective controller and interlocking system interface is as follows:

[0018] in a TACS mode, the wayside resource is controlled by a wayside resource controller and an objective controller; and in a TBTC mode, the wayside resource is controlled by an interlocking system and the objective controller.

[0019] As a preferred technical solution, a specific operation of the objective controller and track circuit interface is as follows:
the objective controller adopts the occupation or clearance information of the track section transmitted by a track circuit and transmits the occupation or clearance information to an interlocking system.

[0020] As a preferred technical solution, a specific operation of the vehicle-mounted device and track circuit interface is as follows:

[0021] in a TACS mode, the wayside resource is actively applied; and when a wayside resource controller is fault, the train is degraded to a TBTC mode.

[0022] According to a second aspect of the present invention, provided is a switching method for the TACS and TBTC fused signal system, wherein the method comprises the following steps:

step S1: under a normal condition, running a train in a TACS mode;

step S2: monitoring, by the system, an operating state of a wayside resource controller in real time to determine a control right of the wayside resource;

step S3: after the wayside resource controller is fault, obtaining, by an interlocking system, the control right of the wayside resource and setting a route for the train by means of a central ATS;

step S4: assigning the control right of the wayside resource to the interlocking system in a TBTC system by means of manual authorization;

step S5: deciding, by a vehicle-mounted device, to run the train in the TACS mode or in a TBTC mode according to a communication state with the wayside resource controller; after the communication with the wayside resource controller is lost or the control right of the wayside resource is manually and forcibly assigned to the interlocking system, switching to the TBTC mode; and

step S6: after the train mode is switched, running the train in the TBTC mode.

[0023] According to a third aspect of the present invention, provided is an electronic device, comprising a processor and a memory in which a computer program is stored, wherein the processor, when executing the program, implements the above-mentioned methods.

[0024] According to a fourth aspect of the present invention, provided is a computer readable storage medium in which a computer program is stored, wherein the program, when being executed by a processor, implements the above-mentioned methods.

[0025] Compared with the prior art, the present invention has the following advantages:

1. The present invention deeply integrates the TACS mode and the TBTC mode, realizes the coexistence of the two signal standards in the same line, and can realize the switching;

2. The present invention realizes that the wayside resource can be controlled by two sets of systems respectively through the control right conversion;

3. The present invention realizes that the train can operate in the signal system with two standards

through the vehicle-mounted fusion track circuit interface; and

4. The present invention provides a new solution for the reconstruction of old lines, and can superimpose the TACS system on the basis of retaining the existing TBTC signal system.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026]

FIG. 1 is a structure diagram of fusion of a TACS and a TBTC of the present invention;

FIG. 2 is a schematic diagram of TACS and TBTC fusion system interfaces of the present invention;

FIG. 3 is a flow chart of a switching process of TACS and TBTC systems of the present invention.

DESCRIPTION OF THE EMBODIMENTS

[0027] The following is a clear and complete description of the technical solutions in the embodiments of the present invention in combination with accompanying drawings attached to the embodiments of the present invention. Obviously, the embodiments described are a part of the embodiments of the present invention, but not the whole embodiments. Based on the embodiments of the present invention, all other embodiments obtained by a person skilled in the art without creative labor shall fall within the protection scope of the present invention.

[0028] As shown in FIG. 1, a TACS and TBTC fused signal system, comprising a TACS system device, a TBTC system device, and a TACS and TBTC system interface, wherein the signal system integrates the TACS system device and the TBTC system device, and adds the TACS and TBTC system interface, so as to realize coexistence of signal systems of two standards; and under a normal condition, a train runs under the control of a TACS system; under a condition that the train is degraded, the system automatically identifies a device degraded state and switches a control mode to be under the control of a TBTC system; the TBTC system opens signaling for train route setting; and the train runs in a manual driving mode of a driver.

[0029] The TACS system device comprises:

a central ATS (shared with the TBTC), which is used to assign a train operation task to the train in the TACS system; when degraded to the TBTC system, it is used to transmit route an arrangement command to the wayside;

a wayside resource controller, which is used to manage a wayside resource, receive resource occupation and release requests transmitted by the train, and feedback a resource locking state to the train.

an objective controller, which is used to receive wayside resource locking and releasing commands transmitted by the wayside resource controller and perform output control; and

a vehicle-mounted device (shared with the TBTC system), which is used to apply a resource from the wayside resource controller in a TACS mode; when degraded to the TBTC system, it is used to run the train according to a command of a wayside ATP.

[0030] The TBTC system device comprises:

a track circuit, for detecting train occupancy and transmitting variable information to the train (information pertaining to a switch signal state, a speed level, a section length and a gradient);

a wayside ATP, for receiving a track state (a switch, signal, track circuit) transmitted by an interlocking system and transmitting a track state to the train;

an interlocking system, for setting a route and transmitting a route state to the wayside ATP.

[0031] After the fusion of TACS system and TBTC system, an interface relationship between the two systems is shown in FIG. 2, wherein the following interfaces are added:

a wayside resource controller and interlocking system interface, for determining a control right of the wayside resource; in a normal case, the wayside resource controller WRC controls the wayside resource; and under a condition that the wayside resource controller WRC is fault, an interlocking system takes over the control right of the wayside resource; and the control right can also be set manually;

an objective controller and interlocking system interface, wherein the interlocking does not interface directly with the wayside resource, but interfaces with the wayside resource through the objective controller; in a TACS mode, the wayside resource is controlled by a resource control and an objective controller; and in a TBTC mode, the wayside resource is controlled by an interlocking and the objective controller;

an objective controller and track circuit interface, wherein the objective controller adopts the occupation or clearance information of the track section transmitted by a track circuit and transmits the occupation or clearance information to the interlocking;

a vehicle-mounted device and track circuit interface, wherein in a TACS mode, the wayside resource is actively applied; and when a wayside resource controller is fault, the system may degrade to a TBTC mode.

Specific embodiments

[0032] In order to retain the existing TBTC signal system as a backup, a TBTC superimposed TACS system is adopted for the reconstruction of a quasi-mobile blocked urban rail transit line. A train operation manner after the reconstruction is as follows:

(1) under a normal condition, running a train in a TACS mode;

(2) when a wayside resource controller fails, obtaining, by an interlocking, a control right of a wayside resource by force; and setting, by a central dispatcher and for a train, a train operation route in a route fault zone through an ATS;

(3) after communication between a vehicle-mounted device and the wayside resource controller is lost, automatically changing the train to a TBTC mode as a resource application command cannot be issued; and

(4) after the train mode is switched, running the train in an ATP driving mode in the TBTC mode, so as to ensure uninterrupted operation.

[0033] The above is an introduction of system embodiments, and the solution of the present invention is further explained by method embodiments.

[0034] As shown in FIG. 3, a switching method for the TACS and TBTC fused signal system, wherein the method comprises the following steps:

step S1: under a normal condition, running a train in a TACS mode;

step S2: monitoring, by the system, an operating state of a wayside resource controller in real time to determine a control right of wayside resource; or assigning the control right of the wayside resource manually, as in step S4;

step S3: after the wayside resource controller is fault, obtaining, by an interlocking system, the control right of the wayside resource and setting a route for the train by means of a central ATS;

step S4: assigning the control right of the wayside resource to the interlocking system in a TBTC system by means of manual authorization, wherein this situation can be implemented when there is non-passing train in a line;

step S5: deciding, by a vehicle-mounted device, to run the train in the TACS mode or in a TBTC mode according to a communication state with the wayside resource controller; after the communication with the wayside resource controller is lost or the control right of the wayside resource is manually and forcibly assigned to the interlocking system, switching to the TBTC mode; and

step S6: after the train mode is switched, running the train in the TBTC mode.

[0035] A person skilled in the art can clearly understand that for the convenience and simplicity of description, the specific working process of each described module can refer to the corresponding process in the above-mentioned method embodiments, and it is not be repeated herein.

[0036] The electronic device of the present invention comprises a central processing unit (CPU) that can perform various appropriate actions and processes according to computer program instructions stored in a read-only memory (ROM) or loaded from a storage unit into a random access memory (RAM). In the RAM, various programs and data required for operations of the device can also be stored. The CPU, ROM, and RAM are connected to each other via a bus. An input/output (I/O) interface is also connected to the bus.

[0037] A plurality of components in the device are connected to the I/O interface, wherein the plurality of components comprise: an input unit, such as a keyboard, a mouse, etc.; an output unit, such as various types of displays, a speaker, etc.; a storage unit, such as a disk, an optical disc, etc.; and a communication unit, such as a network card, a modem, a wireless communication transceiver, etc. The communication unit allows the device to exchange information/data with other devices through a computer network such as the Internet and/or various telecommunications networks.

[0038] The processing unit performs each step of the method and each process described above, such as the steps S1 to S6. For example, in some embodiments, the steps S1 to S6 may be realized as a computer software program that is physically contained in a machine readable medium, such as a storage unit. In some embodiments, parts or all of the computer program may be loaded and/or installed on the device via the ROM and/or communication unit. When the computer program is loaded into the RAM and executed by the CPU, one or more steps of S1 to S6 of the method described above can be performed. Alternatively, in other embodiments, the CPU may be configured to execute the steps S1 to S6 of the method by any other appropriate means (e.g., by means of a firmware).

[0039] The functions described above herein can be performed, at least in part, by one or more hardware log-

ical components. For example, without limitation, demonstration types of hardware logic components that can be used include: a Field Programmable Gate Array (FPGA), an Application-Specific Integrated Circuits (ASIC), an Application-Specific Standard Product (ASSP), a System-On-Chip (SOC), a Complex Programmable Logic Device (CPLD), etc.

[0040] Program codes for implementing the method of the present invention may be written in any combination of one or more programming languages. These program codes may be provided to a processor or controller of a general-purpose computer, a special-purpose computer or another programmable data processing apparatus so that the program codes, when being executed by the processor or controller, implements the functions/operations specified in the flow chart and/or block diagram. The program codes can be executed entirely on a machine, partially on a machine, partially on a remote machine as a stand-alone software package, or completely on a remote machine or server.

[0041] In the context of the present invention, the machine readable medium may be a tangible medium that may contain or store a program for use by or in conjunction with an instruction executing system, apparatus or device. The machine readable medium may be a machine readable signal medium or a machine readable storage medium. The machine readable medium may include, but are not limited to, an electronic, magnetic, optical, electromagnetic, infrared, or semiconductor system, apparatus, or device, or any suitable combination of the above. More specific examples of the machine readable storage medium would include an electrical connection based on one or more wires, a portable computer disk, a hard disk, a random access memory (RAM), a read-only memory (ROM), an erasable programmable ROM (EPROM or flash memory), optical fibers, a convenient compact disk ROM (CD-ROM), an optical storage device, a magnetic storage device, or any suitable combination of the above.

[0042] The above are only specific embodiments of the present invention, but the protection scope of the present invention is not limited to this, and any technical person familiar with the technical field can easily think of various equivalent modifications or replacements within the technical scope disclosed by the present invention, and these modifications or replacements shall be covered by the protection scope of the present invention. Therefore, the protection scope of the present invention shall be subject to the protection scope of the claims.

Claims

1. A TACS and TBTC fused signal system, comprising a TACS system device, a TBTC system device, and a TACS and TBTC system interface, wherein the signal system integrates the TACS system device and the TBTC system device, and adds the TACS and TBTC system interface, so as to realize coexistence of signal systems of two standards; and under a normal condition, a train runs under the control of a TACS system; under a condition that the train is degraded, the system automatically identifies a device degraded state and switches a control mode to be under the control of a TBTC system; the TBTC system opens signaling for train route setting; and the train runs in a manual driving mode of a driver.

2. The TACS and TBTC fused signal system according to claim 1, wherein the TACS system device comprises:

   a central ATS, for assigning, in the TACS system, a train operation task to the train;
   a wayside resource controller, for managing a wayside resource, receiving resource occupation and release requests transmitted by the train, and feeding back a resource locked state to the train;
   an objective controller, for receiving wayside resource locking and releasing commands transmitted by the wayside resource controller and performing output control; and
   a vehicle-mounted device, for applying, in a TACS mode, a resource from the wayside resource controller.

3. The TACS and TBTC fused signal system according to claim 2, wherein the central ATS is shared by the TACS system and the TBTC system; and when degraded to the TBTC system, the central ATS is used to transmit a route setting command to wayside.

4. The TACS and TBTC fused signal system according to claim 2, wherein the vehicle-mounted device is shared by the TACS system and the TBTC system; and when degraded to the TBTC system, the vehicle-mounted device is used to run the train according to a command of a wayside ATP.

5. The TACS and TBTC fused signal system according to claim 1, wherein the TBTC system device comprises:

   a track circuit, for detecting train occupancy and transmitting variable information to the train;
   a wayside ATP for receiving a track state transmitted by an interlocking system and transmitting the track state to the train; and
   an interlocking system, for setting a route and transmitting a route state to the wayside ATP.

6. The TACS and TBTC fused signal system according to claim 5, wherein the variable information comprises information pertaining to a switch signal state, a speed level, a section length and a gradient.

7. The TACS and TBTC fused signal system according to claim 5, wherein the track state comprises state information of a switch, a signal and the track circuit.

8. The TACS and TBTC fused signal system according to claim 1, wherein the TACS and TBTC system interface comprises:

a wayside resource controller and interlocking system interface, for determining a control right of the wayside resource;
an objective controller and interlocking system interface, for controlling the wayside resource;
an objective controller and track circuit interface, for transmitting occupancy or clearance information of a track section; and
a vehicle-mounted device and track circuit interface, for applying the wayside resource and switching a mode.

9. The TACS and TBTC fused signal system according to claim 8, wherein a specific operation of the wayside resource controller and interlocking system interface is as follows:
under a normal condition, the wayside resource controller WRC controls the wayside resource; and under a condition that the wayside resource controller WRC is fault, an interlocking system takes over the control right of the wayside resource.

10. The TACS and TBTC fused signal system according to claim 9, the control right can be set manually.

11. The TACS and TBTC fused signal system according to claim 8, wherein a specific operation of the objective controller and interlocking system interface is as follows:
in a TACS mode, the wayside resource is controlled by a wayside resource controller and an objective controller; and in a TBTC mode, the wayside resource is controlled by an interlocking system and the objective controller.

12. The TACS and TBTC fused signal system according to claim 8, wherein a specific operation of the objective controller and track circuit interface is as follows:
the objective controller adopts the occupation or clearance information of the track section transmitted by a track circuit and transmits the occupation or clearance information to an interlocking system.

13. The TACS and TBTC fused signal system according to claim 8, wherein a specific operation of the vehicle-mounted device and track circuit interface is as follows:
in a TACS mode, the wayside resource is actively applied; and when a wayside resource controller is fault, the train is degraded to a TBTC mode.

14. A switching method for the TACS and TBTC fused signal system according to claim 1, wherein the method comprises the following steps:

step S1: under a normal condition, running a train in a TACS mode;
step S2: monitoring, by the system, an operating state of a wayside resource controller in real time to determine a control right of the wayside resource;
step S3: after the wayside resource controller is fault, obtaining, by an interlocking system, the control right of the wayside resource and setting a route for the train by means of a central ATS;
step S4: assigning the control right of the wayside resource to the interlocking system in a TBTC system by means of manual authorization;
step S5: deciding, by a vehicle-mounted device, to run the train in the TACS mode or in a TBTC mode according to a communication state with the wayside resource controller; after the communication with the wayside resource controller is lost or the control right of the wayside resource is manually and forcibly assigned to the interlocking system, switching to the TBTC mode; and
step S6: after the train mode is switched, running the train in the TBTC mode.

15. An electronic device, comprising a processor and a memory in which a computer program is stored, wherein the processor, when executing the program, implements the method according to claim 14.

16. A computer-readable storage medium in which a computer program is stored, wherein the program, when being executed by a processor, implements the method according to claim 14.

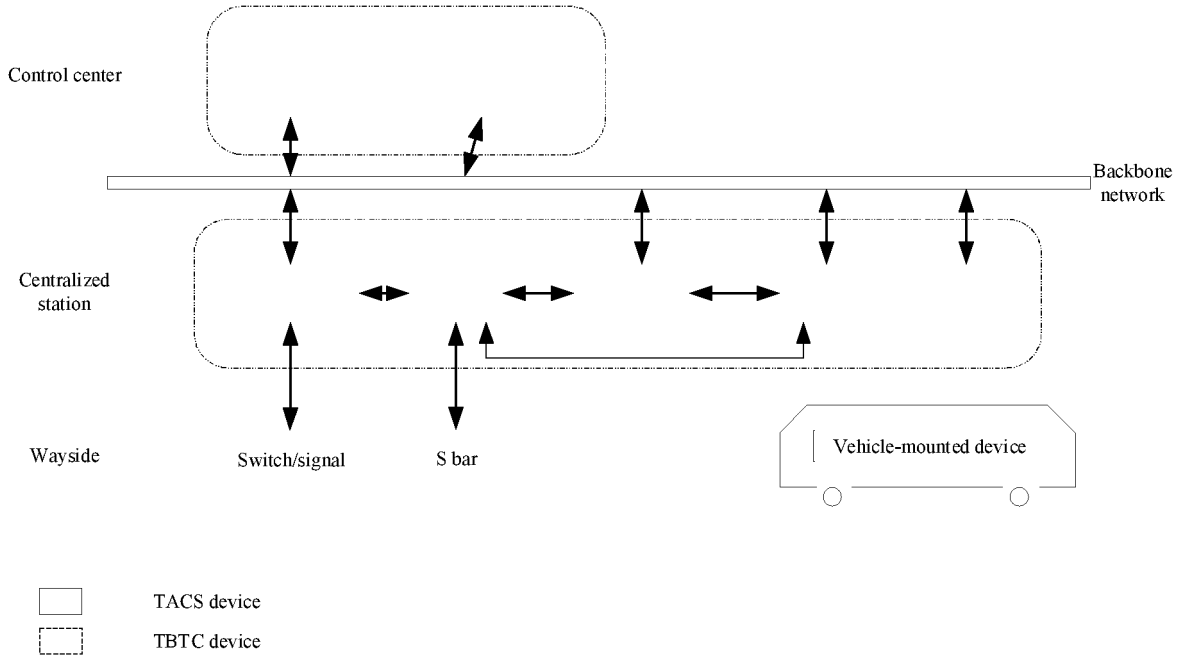
Control center
Backbone network
Centralized station
Wayside
Switch/signal
S bar
Vehicle-mounted device
TACS device
TBTC device

FIG. 1

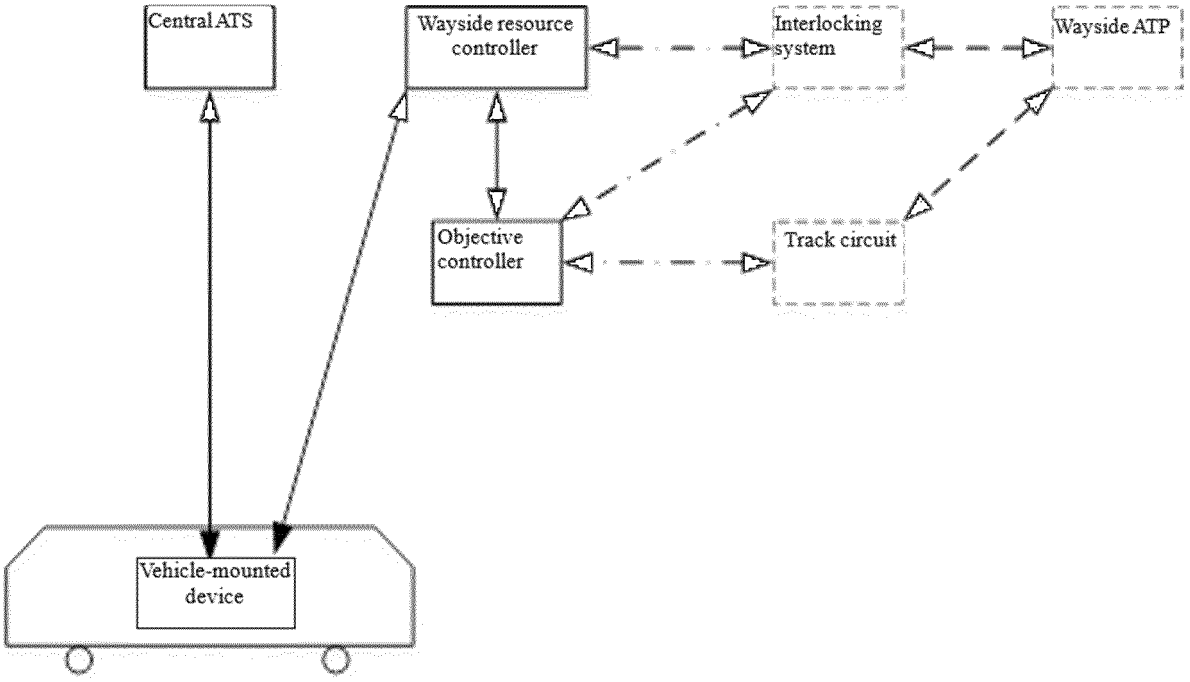
Central ATS
Wayside resource controller
Interlocking system
Wayside ATP
Objective controller
Track circuit
Vehicle-mounted device

FIG. 2

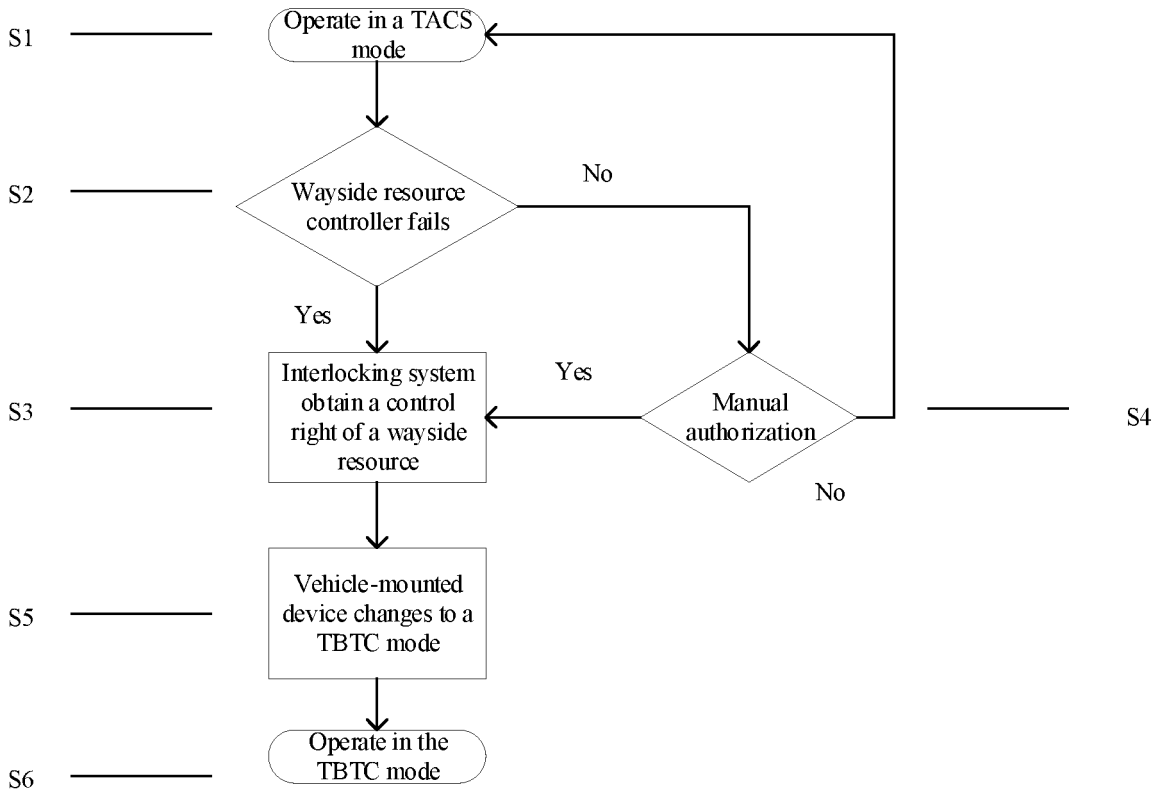
S1
Operate in a TACS mode
S2
Wayside resource controller fails
No
Yes
S3
Interlocking system obtain a control right of a wayside resource
Yes
Manual authorization
S4
No
S5
Vehicle-mounted device changes to a TBTC mode
S6
Operate in the TBTC mode

FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2022/134981

A. CLASSIFICATION OF SUBJECT MATTER

B61L27/30(2022.01)i;B61L27/04(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B61L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNABS, CNTXT, CNKI, VEN, DWPI, USTXT, WOTXT, EPTXT: 融合, 兼容, 冗余, 互备, 轨道资源管理器, 联锁, TACS, TBTC, ATS, ATP, WRC, standby, redundancy, compatible

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 114194260 A (CASCO SIGNAL LTD.) 18 March 2022 (2022-03-18) claims 1-16	1-16
X	CN 112550363 A (CASCO SIGNAL LTD.) 26 March 2021 (2021-03-26) description, paragraphs [0033]-[0044], and figures 1-4	1-16
A	CN 112550360 A (CASCO SIGNAL LTD.) 26 March 2021 (2021-03-26) entire document	1-16
A	CN 112550379 A (CASCO SIGNAL LTD.) 26 March 2021 (2021-03-26) entire document	1-16
A	CN 112660206 A (CASCO SIGNAL LTD.) 16 April 2021 (2021-04-16) entire document	1-16

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
14 February 2023	**22 February 2023**
Name and mailing address of the ISA/CN **China National Intellectual Property Administration (ISA/CN)** **China No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088** Facsimile No. **(86-10)62019451**	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
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Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 114194260 A	18 March 2022	None	
CN 112550363 A	26 March 2021	CN 112550363 B	26 August 2022
CN 112550360 A	26 March 2021	CN 112550360 B	26 August 2022
CN 112550379 A	26 March 2021	CN 112550379 B	26 August 2022
CN 112660206 A	16 April 2021	CN 112660206 B	26 August 2022

Form PCT/ISA/210 (patent family annex) (July 2022)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 113320574 A **[0004]**