CLAIMS

1. A traction control simulation system for a rail vehicle, comprising: a control line set, two main control devices and at least one execution device, wherein:

the two main control devices and the execution device are connected to the control line set;

the two main control devices are configured to implement a traction control function and a traction monitoring function of a traction control device on the rail vehicle, and only one main control device of the two main control devices is in a control state at the same time;

a control line in the control line set is configured to implement a data transmission function of a train line on the rail vehicle;

the execution device is configured to implement an operation execution function of a traction execution equipment on the rail vehicle; and

the two main control devices are further configured to: transmit a vehicle control command to the execution device through the control line in the control line set, and to control the execution device to perform an operation corresponding to the vehicle control command.

2. The traction control simulation system according to claim 1, wherein the two main control devices each comprises: a display simulation unit, a processor simulation unit, a driver controller traction control simulation circuit, a running direction and traction brake control simulation circuit, a high-speed circuit breaker control simulation circuit, a traction safety loop simulation circuit, an automatic train protection, ATP, zero-speed delay control simulation circuit, and a traction converter control simulation circuit;

wherein the display simulation unit, the driver controller traction control simulation circuit, the running direction and traction brake control simulation circuit, and the traction converter control simulation circuit are connected to the processor simulation unit; the ATP zero-speed delay control simulation circuit is connected to the driver controller traction control simulation circuit; the traction safety loop simulation circuit, the high-speed circuit breaker control simulation circuit, the running direction and traction brake control simulation circuit, and the driver controller traction control simulation circuit are connected to the control line set; and the traction converter control simulation circuit and the processor simulation unit are both connected to the execution device;

wherein the display simulation unit is configured to display data to be displayed sent by the processor simulation unit;

wherein the driver controller traction control simulation circuit is configured to generate and output a driver controller traction command;

wherein the running direction and traction brake control simulation circuit is configured to generate and output a running direction control command and a traction brake command;

wherein the high-speed circuit breaker control simulation circuit is configured to generate and output a high-speed circuit breaker control command;

wherein the traction safety loop simulation circuit is configured to generate and output a traction safety loop control command;

wherein the ATP zero-speed delay control simulation circuit is configured to establish a traction safety loop;

wherein the traction converter control simulation circuit is configured to generate and output a traction converter control command; and

wherein the processor simulation unit is configured to: receive commands from the driver controller traction control simulation circuit, the running direction and traction brake control simulation circuit, and the traction converter control simulation circuit, and output the commands to the display simulation unit to display.

3. The traction control simulation system according to claim 1, wherein in the traction safety loop simulation circuit, a normally-open contact of a driver's cab activation relay in a control state, a normally-closed contact of a door selecting switch, a normally-open contact of an ATP cutting relay, a normally-open contact of a left door being closed relay, a normally-open contact of a right door being closed relay, a normally-open contact of a brake relief relay, a normally-open contact of an emergency brake relief relay, and a normally-open contact of a parking brake relief relay are connected in series and connected to a traction safety control line in the control line set;

wherein the traction safety control line is connected to a normally-closed contact of the driver's cab activation relay in a non-control state, to form a closed traction safety monitoring

loop;

wherein a normally-open contact of a door being closed bypass switch is connected in parallel with a circuit comprising the normally-open contact of the left door being closed relay and the normally-open contact of the right door being closed relay connected in series; and

wherein a normally-open contact of an ATP zero-speed relay is connected in parallel with a circuit comprising the normally-open contact of the brake relief relay and the normally-open contact of the emergency brake relief relay connected in series.

4. The traction control simulation system according to claim 2, wherein the number of the execution device is three, and each execution device comprises: a high-speed circuit breaker simulation unit, a traction converter simulation unit and a traction motor execution simulation unit;

wherein the high-speed circuit breaker simulation unit and the processor simulation unit are connected to the traction converter simulation unit, respectively;

wherein the traction converter control simulation circuit is connected to the traction converter simulation unit and the traction motor execution simulation unit, respectively;

wherein the high-speed circuit breaker simulation unit and the traction converter simulation unit are connected to the control line set, respectively; and

wherein the high-speed circuit breaker simulation unit obtains electrical energy from a pantograph connected to the high-speed circuit breaker simulation unit.

5. The traction control simulation system according to claim 4, wherein the traction converter simulation unit comprises: a traction converter unit internal circuit and a traction converter unit external interface circuit;

wherein the traction converter unit internal circuit comprises: a logic controller, a frequency converter, a forward command input relay, a backward command input relay, a brake command input relay, a traction command input relay, a traction safety command input relay, a reset command input relay, a standby mode command input relay, a contact net position command input relay, a first working power input relay, a second working power input relay, a

high-speed circuit breaker sub-command input relay, a brake status loop command input relay, a high-speed circuit breaker status feedback command input relay, an output relay for outputting a K-line contactor, KIC, high voltage output command, an output relay for outputting a command to allow a high-speed circuit breaker to close, an output relay for outputting a high-speed circuit breaker closing command, an output relay for outputting a high-speed circuit breaker keep-on command, an output relay for outputting a brake status command, an output relay for outputting a standby brake status command, an output relay for outputting a traction status command, and a traction main circuit power supply contactor;

wherein the logic controller comprises a CPU module and an I/O module, the I/O module is connected to the frequency converter, the CPU module is configured to generate a frequency converter control signal, and the I/O module is configured to transmit the frequency converter control signal to the frequency converter;

wherein the forward command input relay, the backward command input relay, the brake command input relay, the traction command input relay, the traction safety command input relay, the reset command input relay, the standby mode command input relay, the contact net position command input relay, the first working power input relay, the second working power input relay, the high-speed circuit breaker sub-command input relay, the brake status loop command input relay, and the high-speed circuit breaker status feedback command input relay are connected to an input port of the logic controller; and

wherein the output relay for outputting the KIC high voltage output command, the output relay for outputting the command to allow the high-speed circuit breaker to close, the output relay for outputting the high-speed circuit breaker closing command, the output relay for outputting the high-speed circuit breaker keep-on command, the output relay for outputting the brake status command, the output relay for outputting the standby brake status command, the output relay for outputting the traction status command, and the traction main circuit power supply contactor are connected to an output port of the logic controller.

6. The traction control simulation system according to claim 4, wherein the high-speed circuit breaker simulation unit comprises: a closed high-speed circuit breaker signal input relay, a K-line contactor, KIC, high-voltage signal input relay, a closing permission signal input relay, a holding signal input relay, a high-speed circuit breaker closing contactor, and a high-speed

circuit breaker closing enabling relay, and a protection delay relay;

wherein the closed high-speed circuit breaker signal input relay is connected to an external interface of a closed high-speed circuit breaker, and is configured to receive a signal to close the high-speed circuit breaker;

wherein the KIC high-voltage signal input relay is connected to a KIC high-voltage external interface, and is configured to receive a KIC high-voltage effective signal;

wherein the closing permission signal input relay is connected to a closing permission external interface, and is configured to receive a closing permission signal of the high-speed circuit breaker;

wherein the holding signal input relay is connected to a holding signal external interface, and is configured to receive a holding signal of the high-speed circuit breaker;

wherein the high-speed circuit breaker closing enabling relay is connected to a normally-open contact of the closing permission signal input relay, and the normally-open contact of the closing permission signal input relay is connected in series with a normally-open contact of the closed high-speed circuit breaker signal input relay, so as to control an action of the high-speed circuit breaker closing enabling relay through two sets of contacts connected in series;

wherein the protection delay relay is connected to a normally-closed contact of the KIC high-voltage signal input relay, and the normally-closed contact of the KIC high-voltage signal input relay is connected in series with a normally-open contact of the high-speed circuit breaker closing contactor, so as to control an action of the protection delay relay through two sets of contacts connected in series; and

wherein the high-speed circuit breaker closing contactor is connected to a normally-closed contact of the protection delay relay, the normally-closed contact of the protection delay relay is connected to the normally-open contact of the closing permission signal input relay, a normally-open contact of a signal input relay is connected in parallel with the normally-open contact of the high-speed circuit breaker closing enabling relay, and is connected with the normally-open contact of the closing permission signal input relay, so as to control an action of the high-speed circuit breaker closing contactor through four sets of contacts connected in series and parallel.

7. The traction control simulation system according to claim 1, wherein the train line comprises: a traction safety control line, a traction control line, a traction and brake control line, a running direction and high-speed circuit breaker control line; and

wherein the traction safety control line is connected to the traction safety loop simulation circuit, the traction control line is connected to the driver controller traction control simulation circuit, the traction and brake control line is connected to the running direction and traction and brake control simulation circuit, and the running direction and high-speed circuit breaker control line is connected to the running direction and traction and brake control simulation circuit and the high-speed circuit breaker control simulation circuit, respectively.

8. A traction control method, applied to the main control device of the two main control devices in the control state in the traction control simulation system according to claim 1, wherein the traction control method comprises:

receiving a plurality of control commands input by an user sequentially in chronological order and outputting each of the plurality of control commands received to each execution device through a corresponding control line in the control line set;

determining, by each execution device, whether each of the plurality of control commands is a valid control command in turn; and

executing an operation corresponding to the valid control command in case of determining that a control command is the valid control command.

9. The traction control method according to claim 8, wherein the receiving the plurality of control commands input by the user sequentially in chronological order and outputting each of the plurality of control commands to each execution device through the corresponding control line in the control line set comprises:

receiving a current control command input by the user;

outputting the current control command to each execution device through a control line corresponding to the current control command;

receiving a next control command input by the user in a case that the current control

command is executed by a target execution device controlled by the current control command successfully; and

updating the next control command to the current control command, executing again the step of outputting the current control command to each execution device through a control line corresponding to the current control command in sequence, until all control commands input by the user are received.