Interlocking Train Control Integrated System Modeling Design Based on AADL

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Abstract: In view of the characteristics of high-speed railway signal system due to its huge structure and complex fault phenomenon, the structure and function of the interlocking train control integrated system was designed by analyzing the important components of the computer interlocking and train control center. The computer interlocking, train control center and interlocking train control integrated system are designed and modeled by architecture analysis and design language (AADL). According to the specific requirements of high-speed railway signal system, reasonable AADL components are adopted in the modeling.

1. Introduction
With the rapid development of China’s high-speed railway, the train speed is constantly improved, and the requirements for transportation safety are also constantly improved. Through the use of digital signal processing, network communication and other advanced mature technology, the signal system structure is optimized. The design of interlocking train control system reduces the number of equipment, simplifies the peripheral relay circuit, improves the reliability and security of the system, and provides a feasible direction for the development of high-speed railway signal control system.

The architecture analysis and design language (AADL), which was developed in 1999, is a MetaH imitated study prototype for analyzing and generating embedded real-time systems languages and toolsets, developed by the Honeywell technology center and successfully used in various pilot projects in the 1990s. Originally issued in 2001, AADL has been used in a number of industrial and research initiatives, and its standard was approved as an industrial standard in November 2004, number AS5506[1].

AADL standard consists of text and graphics language, XML, the extensible markup language of UML2.0 contour and error model accessories, including AADL is the core of AADL standard language, its elements and the relationship is shown in figure 1[2]. AADL declared by the type of component, and the implementation of the system hardware, software and hardware and software interaction modeling. Components of the objective world of the embedded system components in the abstract, the component type of component implementation of abstraction and generalization. A component type needs to be described from the following items: identifier, features, flows, and properties. Components of a component type are classified into three categories: software classes including data, subprogram, thread, thread group, and process. The execution platform classes include memory, device, processor, and bus. The system class includes system[3].
2. Modeling of CBI and TCC

Computer interlocking system (CBI) and Train control center system (TCC) can be realized by using device components in AADL language, and bus components are used to connect devices. Both cores are used to compute and process data, so they are represented by a dedicated processor component, and both have a two-for-two security redundancy structure at the core.

2.1. CBI model

CBI is a real-time signal system which realizes the station interlocking by computer. Its structure is mainly divided into human-computer interface layer, interlocking master control layer, executive layer and outdoor equipment. The human-computer interface layer displays the status of the station, receives operating orders and alarms for operators. The interlocking master control layer is the core layer of logic control and logic function. The executive layer is controlled by the main control layer and drives the outdoor equipment. Outdoor equipment mainly includes track circuit, signal machine and switch machine, whose structure is shown in figure 2 [4]. Its component and instance diagrams are shown in figure 3.
2.2. model of TCC

TCC controls the safe operation of trains in the interval through computer control technology. The system is mainly composed of six parts: safety host unit, communication interface unit, drive collect unit, power unit, assist maintenance unit and safety data network. Security host unit as the core equipment, responsible for logic processing and system management; The communication interface unit communicates with the trackside electronic unit (LEU) and other systems; The drive collect unit is responsible for driving and collecting interval signal equipment [5], whose structure is shown in figure 4. Its component and instance diagrams are shown in figure 5.
3. Design and modeling of interlocking train control integrated system

3.1. analysis of integrated system structure
CBI and TCC cooperate with each other through interactive information to realize high-speed and safe train operation. Structure has similar system structure requirements; The interface is basically the same in connection mode, transmission medium and secure communication protocol, so it is feasible to integrate the two systems to realize integration [6].

The functions and design of the integrated system should follow the following principles:

- The system has all the functions of CBI and TCC, and meets the relevant technical requirements;
- The hardware design of the system should conform to the fault-safety principle and adopt redundant structure;
- The jurisdiction between the two adjacent systems should be distributed, to avoid the occurrence of "blank" and command "overlap";
- The system should be the station and the interval signal unified control.

3.2. structure and model of the integrated system
The interlocking train control integrated system is located in the computer room of the signal building. Its composition can refer to the structure of CBI and TCC system. The integrated system structure is mainly divided into human-computer interface layer, master control layer, executive layer, interface layer and outdoor equipment. human-computer interface layer for state display, operation command and alarm information; The master control layer is still the core layer of system logic operation. The executive layer drives and controls outdoor equipment and collects state information. The port layer is divided into two types because the transponder needs a special line to transmit information and a track circuit of the same standard. Outdoor equipment mainly includes track circuit, signal machine, switch machine and transponder, and its structure is shown in figure 6. Its component and instance diagrams are shown in figure 7.
4. Conclusion
In this paper, by analyzing the CBI and TCC system structures, we propose the design scheme of interlocking train control integrated system structure, and make a reasonable model with AADL language. The following research will further improve the integrated system model based on AADL and the use of AADL modeling language to explore the reliability of the system.

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