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Implementation Algorithm of One Vehicle Electronic Control System

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Abstract

The vehicle electronic real-time control system is designed in combination with model design and code generation. The algorithm development and system modeling are mainly realized by using Simulink, and the embedded code is automatically generated by using RTW. The design method was applied in the development process of engine control system, and the simulation results in Simulink are compared to verify the feasibility of this method.

Keywords

electronic control system; Simulink.

1. Introduction

The design and development of vehicle electronic control system mostly adopts the serial mode development process, which requires a long design cycle and high cost, with the increase of design content and fuzzy design parameters, the workload of programmers is greatly increased to meet the design requirements of large-scale system. The model-based design method can improve the development efficiency, RTW is relatively mature in the automatic code generation technology, and the embedded code generated by RTW automatically eliminates the manual programming operation procedures. This paper combines the RTW code generation technology to realize the development of vehicle electronic real-time control system.

2. Overall Design of Vehicle Electronic Control System

Through the application of model-based design method, developers can make the test and simulation of the system be realized in the early stage of design through the application of practical models, and ensure the independence of each design department in time, and significantly improve the efficiency of design through the design mode of division and cooperation. Code generation technology greatly simplifies the software development process, significantly reduces the programming workload, and enables the programmer to invest more time and energy in the design and optimization of control algorithm. In order to ensure the consistency and reliability in the whole process from system requirements to design and implementation, this paper adopts the design method based on Simulink / RTW in the design of vehicle electronic control system. The specific design process is: on the basis of making full use of the powerful graphic modeling technology of Simulink, the system model is created, so that the model has the characteristics of visualization and graphics, the validity of the model is verified by simulation test. Under the condition that the simulation result is accurate and applicable, the RTW is used to automatically generate the target language code when developing the vehicle electronic control system. The specific system development process is shown in Fig.1.

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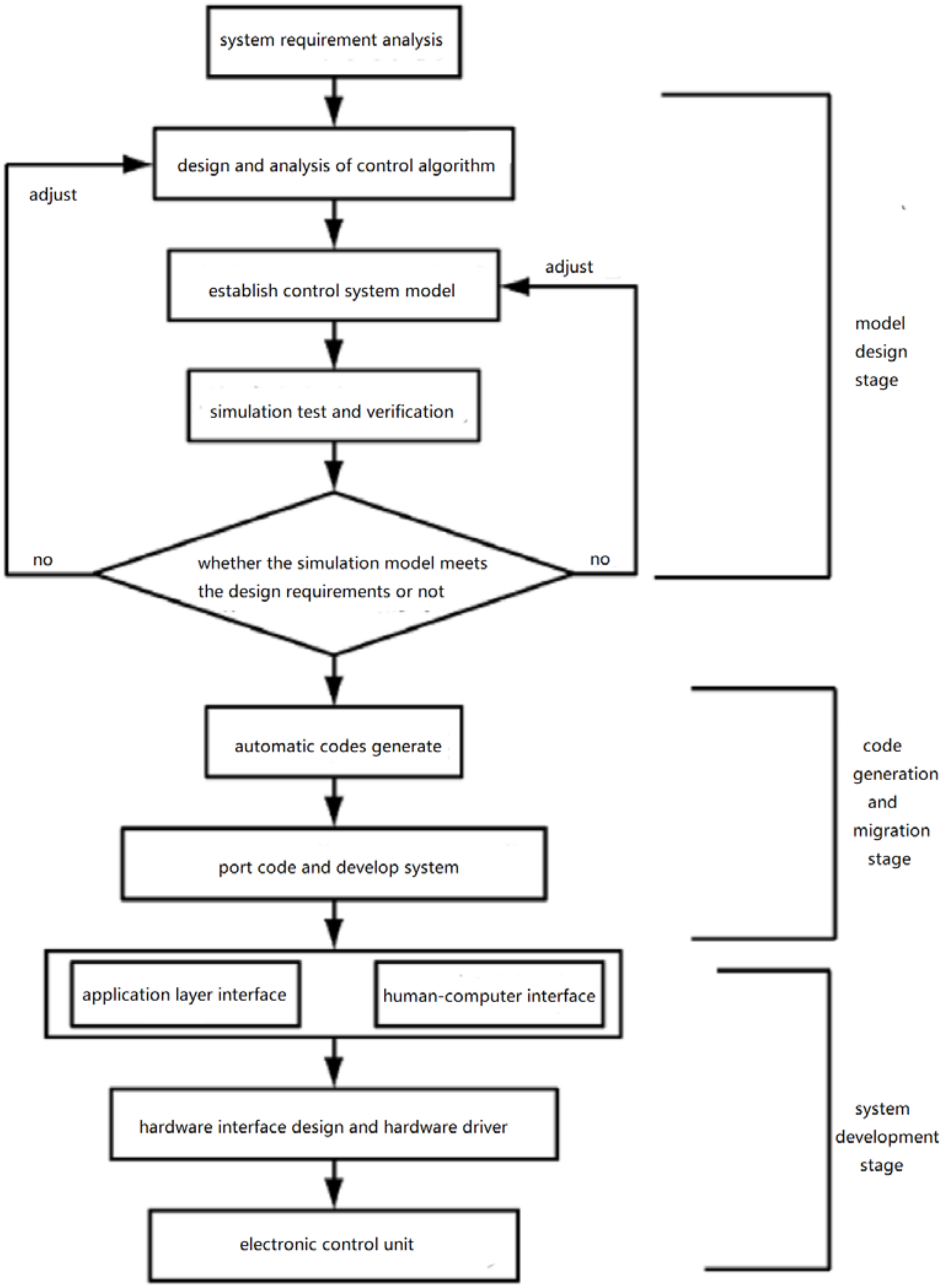

Fig.1 system design flow based on Simulink

3. Design and Implementation of the System

3.1. Model Design

Through the model-based design method, the complex system can be designed graphically, and has good specification requirements. The integrated tool functions, including model design, simulation test and code generation, ensures the consistency of the program and requirements. The designed system model is easy to make corresponding modifications, and pass the performance in the early stage of design Evaluate and identify and improve design defects. The design of control algorithm can be realized by using existing modules or user-defined function modules of Simulink. Simulink has the advantages of supporting subsystems and multi-layer models. According to this, when the actual control system model is established, it starts with the modules and adopts the way of progressive layer by layer to establish the clear and concise simulation model. Then the established control model and control algorithm are tested and verified repeatedly. This process is also realized by the simulation debugging function provided by Simulink. According to the test results, the model is continuously optimized until the design requirements are met. The block diagram of the engine control system simulation model is shown in Fig.2; the top-level form of the encapsulated model is saved as engine, and the engine control system simulation model is shown in Fig.3

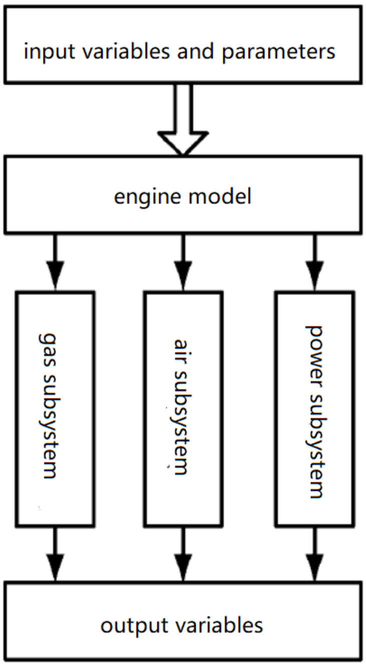

Fig.2 block diagram of engine model

3.2. Code Generation Stage

The automatic code generation tool RTW can automatically generate the codes of different objects that the model established by Simulink faces, moreover, RTW also provides an open interface to meet the user's expanding access requirements. When setting the RTW configuration, the corresponding object codes of different system object files are different, providing users with rich Because RTW only supports constant step integrators, it needs to set tabs to avoid errors in the code generation process. Specifically, it needs to set the type of fixed step in solver options. In this paper, the target file system is selected, and the corresponding compact code format is specially for generating products. The embedded code generated by RTW conforms to the code specification written by programmers, has good readability and consistency, and can meet the requirements of embedded system. The core function code generated by RTW automatically is as follows:

```
void engine step (int T id)
{
// rtb dbl tmp and rtb dbl tmp b are intermediate variables
real T rtb dbl tmp b;
//enging Y. Torquee1 calculation process
engine B. Add4 = engine B. Fcnpf2 + engine B. Fcn3;
rtb dbl tmp = engine B. Add4;
rtb dbl tmp b = engine B. s2;
engine B. Fcn4 = 9.550000000000007 *
```

rtb dbl tmp / rtb dbl tmp b;
// get engine. Torquee1 operation result
}

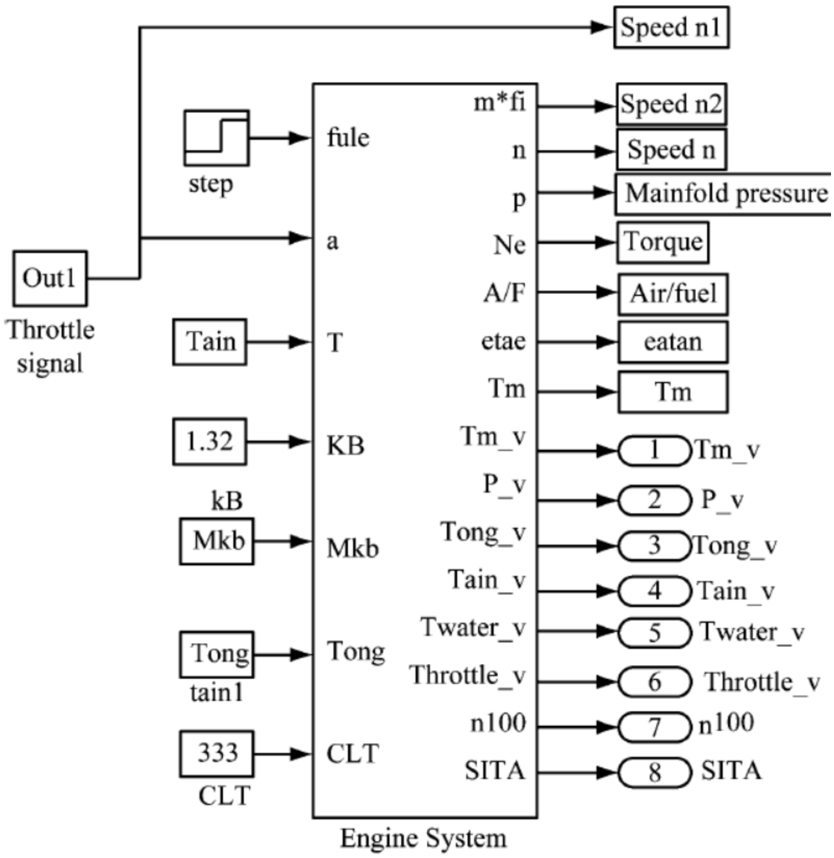

Fig.3 simulation model of engine control system

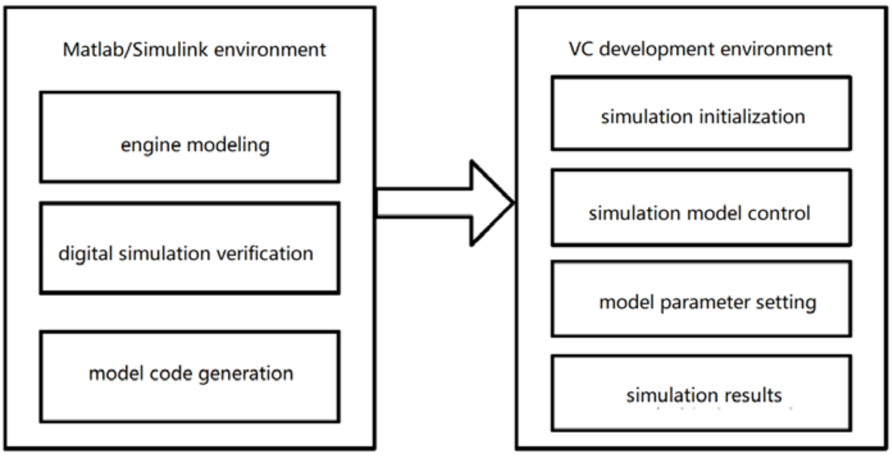

Fig.4 software structure of host computer

3.3. System Development Stage

In the process of controlling the operation of the entire system, the host computer acts as a driving hub and is the main control machine of the simulation system. Through this man-machine interaction interface, the operator can effectively manage and control the entire simulation process and observe the simulation results and various data processing tasks involved can be implemented by calling other application software, which is easy to maintain and expand. The operation of the underlying hardware is realized through the entire software

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program, which has good portability. The modeling of the model is completed through Simulink powerful modeling and simulation functions. In order to complete the development process of the entire control system quickly and continuously, make full use of the powerful interface functions of VC and its customizability, the specific structure of the host computer software platform is shown in Fig.4.

The simulation initialization is responsible for setting the simulation time and step size. The simulation model has been built and verified in Simulink, so it is not necessary to modify the model in VC, only to open the Simulink model; the simulation model control mainly includes running, pause, stop, etc.; the modification of the corresponding model parameter value is through the model parameter setting dialog box. The form can be realized by associating the parameter variable with the edit control in the dialog box, so as to realize the adjustment of the model parameters through the modification of the value of the edit control; the function of the simulation result display is that in the specific simulation process, the calculation result of the model in each step time is completed through the call of the engine step() function, Finally, the control signal of ECU and the output signal of simulation model are displayed in the form of virtual instrument.

4. Conclusion

The complexity of vehicle electronic control system is gradually increasing, and it is difficult to meet the actual system development needs by the way of manual code writing, by integrating model design and code generation technology, the vehicle electronic real-time control system is designed, Simulink is used to achieve algorithm development, and RTW is used to automatically generate embedded code, the development of software simulation platform is realized by using the powerful function of VC, this design method is applied in the development process of engine control system, compared with the simulation results in Simulink, the feasibility of the method is verified, it can significantly shorten the development cycle of control system, effectively reduce the development risk, eliminates the potential hidden dangers in the system, improves product reliability and stability, and has high practical value in the development of embedded control system.

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