

Modeling and safety analysis of CTCS-3 train control system for high-speed railway

Haifeng Wang

1 National Engineering Research Centre of Rail Transportation Operation and Control Systems,
Beijing Jiaotong University, Beijing 100044, China

Abstract:

CTCS-3 train control system is a signaling solution for high speed railway in China. Compared to traditional signaling systems, CTCS-3 is becoming very powerful and extremely complex. Thanks to the development of ever more influential and reliable computer technology, more and more train control functions are implemented by means of computer based control systems with complex software logic. In recent years, with the increasing requirements placed on railway service quality, the scale and scope of CTCS-3 system software have become ever greater, and it has become difficult to handle the complexity of this software. Conventional software development methods do not cope well with this challenge. As a result, system testing and verification have become very expensive.

Due to its safety-critical and hybrid natures, specialized technologies must be adopted to guarantee the quality of the system. Firstly, the fundamental principle of CTCS-3 train control is discussed. On the basis of formal railway network description, a discrete computational model of route and movement authority control is introduced. In order to accurately describe the CTCS-3 system, the functional models of the track-side equipment are designed in SCADE and, trains' continuous behaviors are modeled in Simulink. Then the safety analysis is performed in SCADE environment by integrating the continuous Simulink model. The application of this methodology will contribute to achieving ever higher levels of integrity in the design and implementation of such systems.

Keywords: Train Control System; CTCS-3; Hybrid Modeling; SCADE; Simulink; Safety Analysis.