



Automatic Train Control based on the Multi-Agent Control of Cooperative Systems

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Abstract

The growing traffic intensity and complexity of the railway systems as well as the demand for higher speed need to new Automatic Train Control (ATC) methods. The conventional ATC system has some problems and in recent years new ATC methods like the Decentralized ATC (D-ATC) and autonomous decentralized ATC are developed which have some advantages. In this paper, an Intelligent Decentralized ATC (ID-ATC) approach based on the Multi-Agent systems theory is developed which can provide high transportation capacity, high-safety and high-reliability. In this method we combine the Voronoi concept of cooperative systems theory with Multi-Agent control theory by using of fuzzy control logic. The control algorithms are presented and by using of simulation results the effectiveness of the method is demonstrated.

Keywords: Automatic Train Control, Multi-Agent Control Systems, Cooperative systems, Fuzzy control, Voronoi Algorithm.

1. Introduction

Automatic control systems and their affects to reduce the human error problems are more attractive in recent years to control the railway transport systems due to the growing traffic intensity and complexity of these systems. Automatic Train Control (ATC) system is an automatic control algorithm to protect the trains from collision. In addition to collision avoidance, by using of the ATC system the following items can be achieved:

- Improve the performance of control and signaling systems
- Increase the safety
- Reduce the costs
- Reduce the energy consumption

According to the ATC definition, an ATC system consists of Automatic Train Protection (ATP), Automatic Train Operation (ATO) and Automatic Train Supervision (ATS). In figure 1, the fundamental structure of a typical ATC system which contains the ATP, ATO and ATS is shown. There are many kinds of ATC systems but in all of them, the ATP helps to prevent collisions through a driver's failure to observe a signal or speed restriction. The ATO provides partial or complete automatic train piloting and driverless functions and the ATS which is the basis of the train protection

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