Chapter 6
System Dynamics for Modelling Subway Passenger Flow in the Transportation Sector

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ABSTRACT

Thank to developed SD model, decision makers can create appropriate policy. The importance of passenger numbers in compartments increased due to COVID-19, and managers didn't want to increase passengers in compartments too much. In this study, a model will be developed in Vensim package program. The model will be developed for analyzing passenger flows. Different scenarios can be tested thanks to developed system dynamics model. Subway passenger flow was analyzed via system dynamics. The SD model was developed in Vensim PLE package program. Passenger flow was defined as rate, and stations are defined as stock. Managers would change timing according to time, and effects of these changes can be observed via the model.

INTRODUCTION

As a key part in accelerating the process of urban modernization, the construction and management of urban rail transit system has the advantages of large traffic volume, high speed and less land occupation, and is therefore regarded as an important measure to eliminate urban traffic shackle and build a three-dimensional urban transportation system (Liu et.al., 2020).

The system dynamics model in the macro model can relatively accurately analyze the internal structure and causality of a complex transfer station system in the above model, and grasp the macro characteristics

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of a station. Reasonable analysis of the station, reasonable simplification and modeling of the station, so that its macro characteristics are basically in line with the actual situation (Xue et.al., 2020).

Xue et.al.(2020), summarized the research status on passenger flow simulation technologies from macroscopic and microscopic aspects. The macro-model mainly contains the system dynamics model and the hydrodynamic model. And the macro-model mainly introduces the magnetic model, the queuing theory model, the cellular automaton model and the social force model. Through comparative analyzing the simulation models mentioned. The advantages and disadvantages of system dynamics are as below (Xue et.al., 2020):

The advantages: Simple and convenient, low requirement for computer performance, convenient debugging, low simulation cost and fast simulation speed; The station state can be predicted quickly in the near future according to the real-time situation; The internal mechanism of the system is clearer and clearer; It can reflect the key macro passenger flow information such as speed, density and flow.

The disadvantages: The interaction between individuals and individual habits are neglected. It is not suitable for describing specific and complex pedestrian movement characteristics. There is no visual effect of micro-model simulation.

A SHORT LITERATURE REVIEW

Zhong et.al.(2020), created a CPS-enhanced subway operations safety framework using the concept of CPS and short-term prediction techniques of subway passenger flow; our framework is characterized by a "flexible and controllable, real-time operation" composed of six components: system, adjust, facilities, early warning, time control, and yielding. In the framework, the forecasting methods of subway passenger flow are the core, and cyber-physical systems are used to couple other components into a safety management information platform in which the CPS is responsible for sensing, control, and feedback in the entire operating process.

Zhang et.al.(2020), proposed a deep learning architecture combining the residual network, graph convolutional network and long short-term memory to forecast short-term passenger flow in urban rail transit on a network scale. This study provides subway operators with insight into short-term passenger flow forecasting by leveraging deep learning models.

Li et.al.(2020), proposed a multi-sites prediction method (MSP) of passenger flow in subway station. Real time passenger flow data collected from multi-sites in a subway station is used as inputs, and delay parameter is introduced to identify the correlation between measurements at multiple sites in this paper. In order to achieve a stable predictive effect, wavelet decomposition and reconstruction are used to process the data.

Sun et.al. (2020), proposed under the condition of network operation, considering the correlation of passenger flow congestion between multiple stations on the metro network, and the lagging effect of measures controlling passenger flow at stations, a simulation-based network coordinated passenger inflow control method. The influence of stranded passengers on the implementation effect of passenger control scheme is considered leading to the proposal of a network coordinated passenger inflow control model and time-division optimization method based on the simulation.

Jia et.al.(2020), studied on this topic and proposes a passenger-oriented network capacity calculation method. They studied on the case study Beijing subway network to calculate and analyze network