Chapter 47
Application of Artificial Neural Networks in Predicting the Degradation of Tram Tracks Using Maintenance Data

Sara Moridpour
RMIT University, Australia

Ehsan Mazloumi
RMIT University, Australia

Reyhaneh Hesami
Yarra Trams, Australia

ABSTRACT

The increase in number of passengers and tramcars will wear down existing rail structures faster. This is forcing the rail infrastructure asset owners to incorporate asset management strategies to reduce total operating cost of maintenance whilst improving safety and performance. Analysing track geometry defects is critical to plan a proactive maintenance strategy in short and long term. Repairing and maintaining the correctly selected tram tracks can effectively reduce the cost of maintenance operations. The main contribution of this chapter is to explore the factors influencing the degradation of tram tracks (light rail tracks) using existing geometric data, inspection data, load data and repair data. This chapter also presents an Artificial Neural Networks (ANN) model to predict the degradation of tram tracks. Predicting the degradation of tram tracks will assist in understanding the maintenance needs of tram system and reduce the operating costs of the system.

1. INTRODUCTION

1.1. Background

Transport organisations have traditionally focused on construction and expansion of transport infrastructure. After completing the expansion of transport networks, the emphasis has shifted from developing new infrastructure to intelligently maintaining the existing ones (Hensher, 2000; El-sibaie & Zhang, 2004; Andrade & Teixeira, 2013). In recent years, economical constraints have influenced budget allocation to transport sectors (Alfelor, Carr, & Fateh, 2001; Jovanovic, 2004; Larsson, 2004; Andrade & Teixeira, 2011). This resulted in highlighting the development of maintenance management systems in transport sectors particularly in transport infrastructure. Maintenance management systems assist organisations in deciding when and how to maintain transport infrastructure facilities to minimise the maintenance cost/time and diminish replacement activities (Jovanovic, 2004; Larsson, 2004; Zhao, Chan, Stirling, & Madelin, 2006; Ahmad & Kamaruddin, 2012; Yaghini, Khoshraftar, & Seyedabadi, 2013).

1.2. Statement of Problem

Melbourne tram network is the largest urban tram network in the world which consists of 250 kilometres of track that runs 31,500 scheduled tram services every week (Yarra Trams 2015). Many parameters involve ensuring that Melbourne tram system is operating to its safe and best practice standards. Track infrastructure is one of the fundamental elements of the tram system. The condition of the track infrastructure can influence the system operation either directly or indirectly. To keep the track infrastructure in a reasonable condition and to obtain the most benefit out of its life cycle, an optimised maintenance and renewal regime is required. Providing a maintenance plan to recover the serviceability of tram tracks from damages and preventing further wear-out is essential for such a large network. Currently, tram track maintenance activities are achieved by manual inspections across the network. Yarra Trams has a fixed number of maintenance teams who are responsible to manually inspect the status of the tram tracks and identify whether tracks need maintenance. They approximately estimate a time frame for the scheduled maintenance. Since, the inspections are done manually, the human error is unavoidable. Mistakes in inspection and detection of track faults as well as inaccurate prediction of maintenance time frame are the challenges in current maintenance system. In addition, prioritising the maintenance projects is often a significant challenge. Poorly planned maintenance schedules results in high maintenance and operation costs. This is due to repairing or replacing tram tracks at very early or late stage. Unnecessary maintenance and replacement of tram tracks or maintenance at the very late stages of the damage is very costly.

1.3. Research Objectives

To solve this problem, a model is required to predict the degradation of tram tracks. In this chapter, this will be done by analysing and trending the tram track attributes/variables over a period of time. Afterwards, the correlation between those variables and track deterioration will be identified and a model will be developed to predict the track deterioration/degradation based on tram track variables. The results of this chapter can be used to identify the maintenance and replacement activities and prepare a priority list

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