

Driving Characteristics of Heavy-Duty Urban Transit Vehicles in Seoul: Insights from Real-Time Data and Annual Statistics

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Abstract

This study examined Seoul City bus-driving behavior using an extensive dataset with real-time driving data and detailed annual statistics to determine distinct patterns in bus operation. The study focused on four distinct scenarios near bus stations, offering insight into the complex interaction between diverse traffic conditions and station locations. Moreover, the study explored standard speed profiles around ten strategically selected stations derived from cases of buses approaching and departing without external disturbances, providing a baseline for understanding typical bus movement dynamics. Furthermore, the analysis was extended to the speed profiles of 12 consecutive units, revealing insights into traffic conditions and route quality. Furthermore, k-means clustering was applied, and three unique driving categories were distinguished. By integrating these findings with broader traffic flow theories and urban mobility, this study provides valuable insights for improving bus operations and traffic management in metropolitan areas, offering practical recommendations for enhancing public transportation systems and urban mobility in Seoul and other cities with similar challenges.

Keywords Seoul bus · Driving characteristics · Bus driving data · k-means clustering · Traffic conditions

Abbreviations

CNG Compressed natural gas
WHVC World harmonized vehicle cycle
GPS Global positioning system

1 Introduction

Buses serve as vital arteries in urban transportation systems and facilitate the daily movement of millions of commuters. The efficiency and safety of bus operations significantly affect the overall functionality of a city's transportation network. Thus, understanding the driving characteristics of city buses is crucial for optimizing routes, enhancing passenger experience, and promoting sustainable urban mobility.

Seoul, the capital city of South Korea, is a metropolitan area where bus transportation is crucial for daily commuting. With a population of 9,655,918 inhabitants (The Seoul

Institute, 2023) and a sprawling urban landscape of 605 km² (KOSIS, 2023), Seoul's bus network represents the backbone of its public transit system. However, amidst congested streets, the driving behaviors of bus operators can vary widely, influencing the operational efficiency, emissions, and safety of the transportation system (Jiao et al., 2024).

This study statistically investigates the driving characteristics of Seoul city buses to identify underlying patterns, factors, and implications associated with bus operations in this vibrant urban environment. By employing advanced data analytics techniques, this study aims to understand the effect of various factors, such as traffic conditions, driver behavior, route design, and passenger demand (Yu et al., 2016), on the dynamics of bus operations in Seoul.

Moreover, this research sheds light on the broader implications of vehicle speed prediction modeling, extending beyond immediate operational considerations. By elucidating the driving behavior of Seoul City buses, this study aims to provide data-based interventions and strategies for developing a robust vehicle driving simulation model for public transportation.

The systematic examination of driving behaviors and statistics provides valuable insights into prediction modeling, energy, and emission estimation (Achour & Olabi, 2016), regulatory driving cycle development (Tong & Ng, 2021),

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