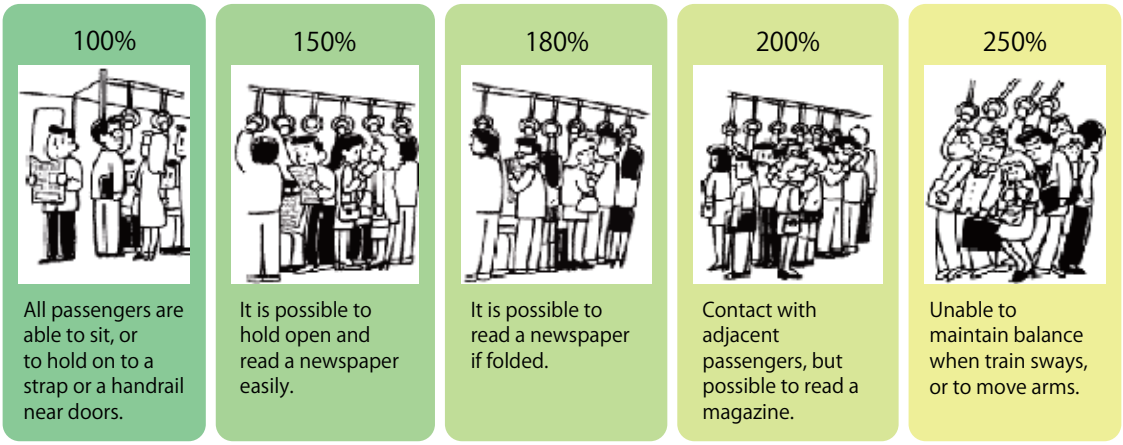
Mitigation of Overcrowding Train



PCL (%) = (Number of passengers) / (Passenger capacity) × 100

Passenger congestion levels (PCLs)

Overview

Overcrowding on trains is a source of discomfort for passengers. Overcrowding on trains on metropolitan railway lines in Japan during morning and evening rush hours is recognized as a social problem. Overcrowding also causes train delays so that various efforts are made by railway operators to reduce it.

The use of ICT has recently made it possible to acquire data on daily train delays as well as passenger congestion levels (hereinafter referred to as PCLs). The large amount of past data has allowed RTRI to formulate a method of analyzing and forecasting daily train delays and PCLs At present, we are studying a traffic control system that may be capable of reducing train overcrowding and improving passenger comfort in the future.

Passenger congestion levels of urban railways in Japan and reduction measures

In metropolitan areas in Japan, overcrowding on trains during morning and evening rush hours is recognized as a problem. Whereas the Japanese Ministry of Land, Infrastructure, Transport and Tourism has set a goal of attaining a PCL of 150% or less, many of the train lines in the Tokyo

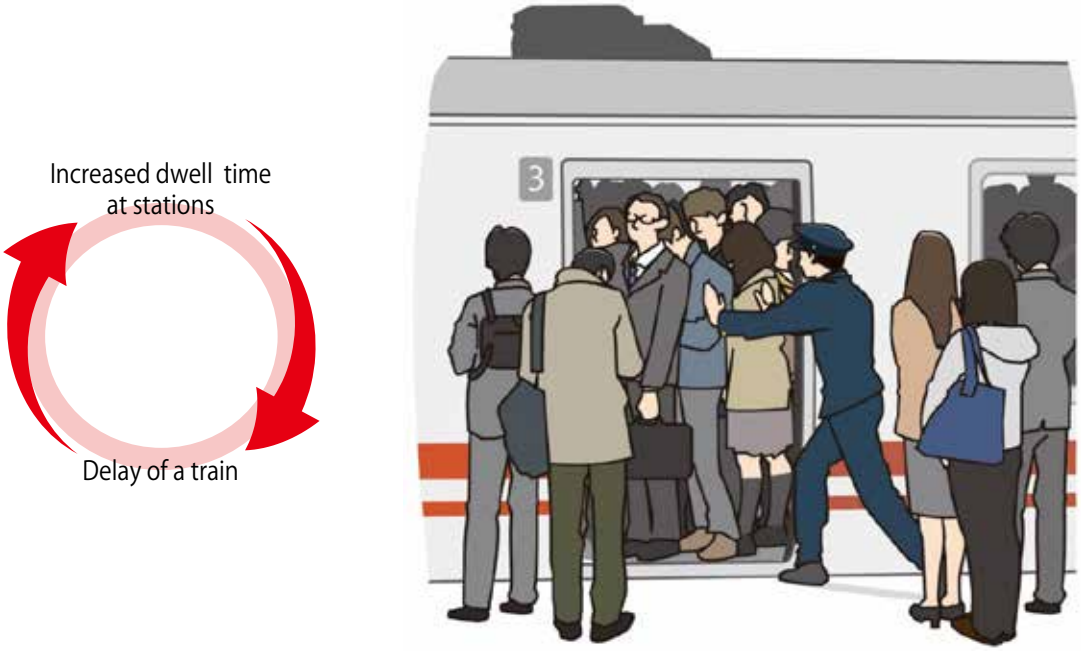
Dr. Taketoshi Kunimatsu
Assistant Senior Researcher
Transport Operation Systems

Mr. Daisuke Tatsui
Assistant Senior Researcher
Transport Operation Systems

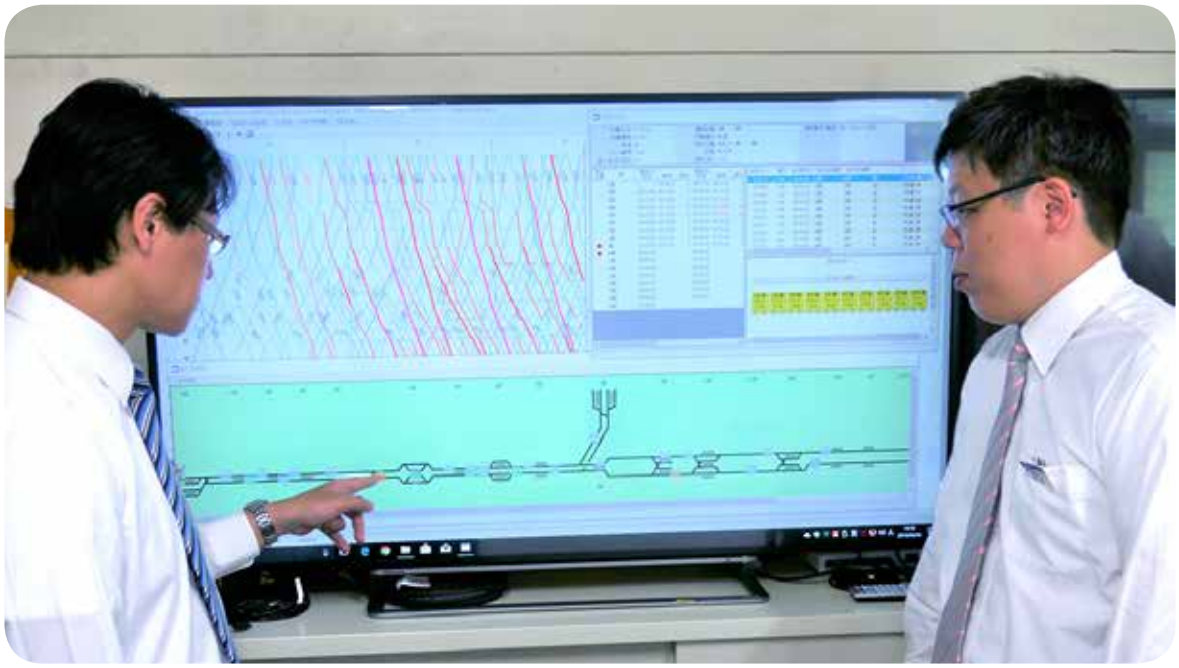
metropolitan area have a PCL of 180% or more. The reduction of such high PCLs is required.

Overcrowding on trains also causes train delays. The more crowded a train, the longer it takes for passengers to get on and off at stations. This means the train stands for a longer time at the stations, causing it to get behind schedule. Delaying a train expands the interval between it and the preceding train causing a higher concentration of passengers at a station at which it is going to stop. As a result, the standing time at subsequent stations increases further and the delay expands further.

Railway operators are taking measures to reduce train overcrowding. Even though an increase in the number of trains is difficult due to limitation by track capacity, operators are attempting to level out PCLs between trains by adjusting train intervals using revised train schedules and traffic control. Recently, they are also beginning to introduce or upgrade a "reserved-seat service with additional fare" for some trains in appropriate time slots in order to ensure passengers can have a seat during transportation.



Congestion results in the vicious circle of train delays and increase dwell times



Use of digital data for measures against overcrowding

Recently, progress in ICT has enabled the acquisition of data on PCLs on trains in each track section and train delays at each station in daily operation. A massive amount of this data has been accumulated. Furthermore, passenger flow data has been acquired from automatic ticket gates using information on passengers' tickets. This has enabled RTRI to formulate a method of analyzing and forecasting daily train delays and PCLs. Such analysis and forecasting are realized using neural networks and deep learning, which are techniques of machine learning. We expect that, if train delays and PCLs at some future time can be forecast, it is possible to devise appropriate train schedules and adjust train intervals to level out PCLs on trains and thus reduce the discomfort felt by passengers on trains.

Future prospects

In the future, we are going to study a system that enables real-time adjustment of train schedules and control of trains utilizing the results of forecasting train delays and PCLs to further reduce the discomfort of overcrowding felt by passengers.