

Transit Train Activity Data for Use in Energy Consumption Estimation

Weichang Yuan¹, **H. Christopher Frey**^{*1}, Yanshuo Sun²

¹Department of Civil, Construction and Environmental Engineering, North Carolina State University, Raleigh, NC

²Department of Civil and Environmental Engineering, University of Maryland, College Park, MD

**Corresponding Author:*

H. Christopher Frey

Professor of Environmental Engineering

Department of Civil, Construction and Environmental Engineering, North Carolina State University

Mann Hall Room 308

2501 Stinson Dr., Raleigh, NC, 27607

Telephone: 919-515-1155

Email: frey@ncsu.edu

Energy consumption is related to emissions of criteria pollutants, hazardous air pollutants, and greenhouse gases (GHG). In 2015, transportation accounted for 28% of the energy used in the U.S. Substitution of personal transport with public transit can reduce energy consumption and emissions. Here, a procedure is demonstrated for quantifying transit train activity data to estimate the energy consumption using the General Transit Feed Specification (GTFS) data and transit tracking. The objective is to quantify the daily number of trips, travel time of each trip, stop-by-stop travel distance of each route, dwell time at each stop, and speed profiles for each train service. The method is illustrated based on a case study for the Washington Metropolitan Area Transit Authority (WMATA) Metrorail system. The GTFS, an open source data format, consists of GTFS-Static and GTFS-Realtime. From GTFS-Static data, information regarding stops, routes, trips, train schedules, and cumulative distance from start to the end of each route were extracted. The stop data include stop names, stop sequence, and geographic coordinate for each stop. Trip travel time was estimated using train schedules. From the GTFS-Realtime data, the cumulative amount of time that a given train spends at a given stop was estimated as an approximation of the actual dwell time. To validate the GTFS-Realtime derived dwell times and to obtain 1 Hz speed profiles, 1 Hz position data were collected for above ground portions of selected routes using Global Positioning System (GPS) receivers. An average of 20 seconds overestimation of the GTFS-Realtime derived dwell times were confirmed by comparing to actual dwell times. A Matlab-based program was developed to filter GPS data and to obtain typical speed profiles. The transit activity data can be used to estimate the energy consumption for the WMATA Metrorail system.