



# Project Summary

Texas Department of Transportation

## 0-5176: Conversion of Volunteer-Collected GPS Diary Data to Travel Time Performance Measures

### *Background*

Household travel surveys have been used for nearly 50 years as part of long-range transportation planning efforts to document travel behavior. The survey data is used for general planning and policy analysis, as well as to serve as the foundation for regional travel demand models. Technology advancements have led to changes in survey data collection procedures, the most recent being the introduction of Global Positioning Systems (GPS) to record travel patterns. GPS technology shows promise in minimizing costs while maximizing the volume of travel data collected. However, the data recorded by GPS devices does not directly yield travel information; rather, the outputs from these devices are in the form of navigational streams that must be processed to derive travel information. The success of this new technology as a travel survey instrument depends, therefore, on the ability of the analyst to derive meaningful trip information from the navigational data streams of GPS devices.

Texas is one of the leaders in the nation in the use of GPS technology for travel-data collection. In an effort to fully realize the strengths of this new approach and to efficiently generate the required data for travel modeling, the objectives of this project were to develop a prototype software that (1) automates the process of converting data collected by in-vehicle GPS devices into an electronic travel diary (i.e., a sequence of vehicle trips, with each trip characterized in terms of attributes such as trip-end location, trip purpose, time of day, duration, distance, and speed), and (2) aggregates the derived trip diaries to produce inter-zonal vehicle trip tables and network performance measures.

### *What the Researchers Did*

A travel diary extraction algorithm comprised of three major components was developed. In the first component, potential trip ends or stops are detected in the GPS streams by identifying time gaps between GPS recordings as well as non-movement for extended periods of time. In the next component, the attributes of the potential trips identified are determined. These attributes include trip timing, trip-end locations, distance, speed, and activity at trip-end. In the final component of the travel-diary extraction algorithm, the trips are examined for reasonableness in terms of their attributes, such as trip duration.

A software package called the “GPS-Based Travel Diary Generator” (GPS-TDG) implements the travel-diary extraction algorithm. The software has been designed to operate either in a basic analysis mode or in an enhanced analysis mode.

### *Research Performed by:*

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The basic mode converts the GPS data into a simple trip file that distinguishes among home-based work, home-based other, and non-home-based trips. The enhanced mode utilizes additional land-use data and pre-selected default parameters to generate a refined trip purpose classification.

GPS-TDG can be calibrated for any specific study region. It is also capable of aggregating the derived trip diaries to produce inter-zonal vehicle trip tables, network performance measures (average trip speed, distance, and travel time), and other summary measures (such as average trip lengths, distance, and speeds by trip-end activity purpose). These aggregate measures can be generated in a complete set for specific trip purposes, or for specific times of the day.

## *What They Found*

This project demonstrates the feasibility of developing and automating procedures for systematically identifying travel patterns from GPS streams. Almost all the attributes reported in computerized assisted telephone interviewing (CATI) surveys can be derived purely from the GPS streams. Further, it is possible to compute travel attributes, such as trip distances and speeds, that are not collected in conventional travel surveys. The GPS streams, however, do not provide information on activity purpose and vehicle occupancy.

Researchers found that it is possible to augment the trip diary derived from GPS streams using commonly available supplemental information. Specifically, this research highlights the utility of land-use data for disaggregate trip purpose determination. Further, the use of detailed roadway network data can be exploited to improve trip detection (i.e., to better distinguish between signal delays and short-duration stops).

## *What This Means*

Researchers recommend applying GPS-TDG for processing data generated by GPS-based travel surveys once it has been optimized for performance in terms of memory and speed. This approach requires that self-reported travel surveys be collected for at least a fraction of the households. The self-reported and passively recorded data from these households can then be used to calibrate the software (i.e., determine the best algorithm parameters) before application to the entire study. A second possible application of the software is to develop correction factors for under-reporting through the combined analysis of recorded and reported trip rates. The research team recommends extensive validation to help determine better default parameters, as well as to enhance the travel-diary extraction algorithm.

The validation process will require further data collection. Specifically, well-designed test runs should be performed aimed at (1) fine-tuning procedures for handling signal-loss situations during travel through urban canyons, (2) identifying GPS stream patterns that may help distinguish between short-duration stops and signal delay, (3) developing algorithms for determining trip timing more accurately (accounting for signal acquisition times), and (4) evaluating trip distance and trip speed computation procedures using odometer readings and self-recorded times.

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