

The GPS Odograph User's Guide

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Abstract

The GPS-based Odograph Prototype (GOP or GPS Odograph) was developed in an effort sponsored by The Federal Highway Administration (FHWA). The purpose of this effort was to develop a means of using inexpensive commercial off-the-shelf laptop (or notebook) computers and Global Positioning System (GPS) receivers to automate the collection of roadway speed and travel time data. This document, ***The GPS Odograph Users Guide***, was written to provide instructions on how to use the GPS Odograph.

KEYWORDS: GPS Odograph, Intelligent Transportation System

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Section 1

Introduction

The GPS-based Odograph Prototype (GOP or GPS Odograph) was developed in an effort sponsored by The Federal Highway Administration (FHWA). The purpose of this effort was to develop a means of using inexpensive commercial off-the-shelf laptop (or notebook) computers and Global Positioning System (GPS) receivers to automate the collection of roadway speed and travel time data. This document, ***The GPS Odograph Users Guide***, was written to provide instructions on how to use the GPS Odograph.

The GOP itself consists of a GPS receiver, a laptop PC, and GOP software. To complete the system there is a serial cable to connect the GPS receiver and the computer, an antenna for the GPS receiver that can be attached to the roof of a test vehicle (via a magnet), and a cable that plugs into the cigarette lighter to provide power to the GPS receiver and to the computer. The computer might also be operated under battery power.

For abbreviated instructions for operation of the GPS Odograph, please turn to Appendix A. Using those instructions which minimize advance preparation will minimize initial effort, but are not recommended for longer term use. More satisfactory results will be derived through use of roadway profiles for the routes to be run for data collection, see more detail in later sections, i.e., Section 2, step A.

1.1 What the GPS Odograph Does

The GOP is a portable traffic speed and travel time data collection device. The GOP automates the collection and processing of speed and travel time data through the use of GPS data. Using GPS to track a vehicle's speed, heading, and position eliminates any need to connect to or use information from the vehicle, such as odometer readings, or to take time readings from a stopwatch. All data, taken at one or two second intervals, is stored to an output file. Data processing is done automatically and represented graphically or in tabular form. If data from a specific speed run are saved, that run can be re-created and the displays can be reviewed to conduct further analysis.

The GOP operation mimics the manual process of taking a speed run. The GOP records speed, time, heading, and calculates traveled distance. Having speed and distance data every second or two, supports a very detailed picture of roadway segment operational characteristics. Some users have used the GOP to collect field data and have continued using spread sheets back in the office for processing the data. A manually conducted speed run only supplies information averaged over each delineated roadway segment. Similarly, every speed run has start, interim and end points, and it is no different with the GOP. The GOP is started at the designated start of the run. Interim points can also be indicated by the user to separate the collected data into segments. An input file, the roadway profile, can be included to customize the displays by identifying delineator points, such as cross streets, and to enhance the data collection and output displays. It may also be useful to identify intersections with traffic

signals in the profile so that the GOP software can associate delays with those signals. Predetermined roadway segment delineators can be entered into this file and will then be displayed. The exact location of each delineator is indicated by the user via depressing a key on the keyboard during the speed run. During the run the data are displayed, showing a graph of speed versus distance on the laptop's screen, as illustrated in Figure 1-1. When the end point of the run is reached, the user presses the escape key to terminate data collection. Using traditional methods, speed run data may be taken back to the office and entered into a spreadsheet to process the data and see the results. Although some user prefer this approach, this is not necessary with the GOP.

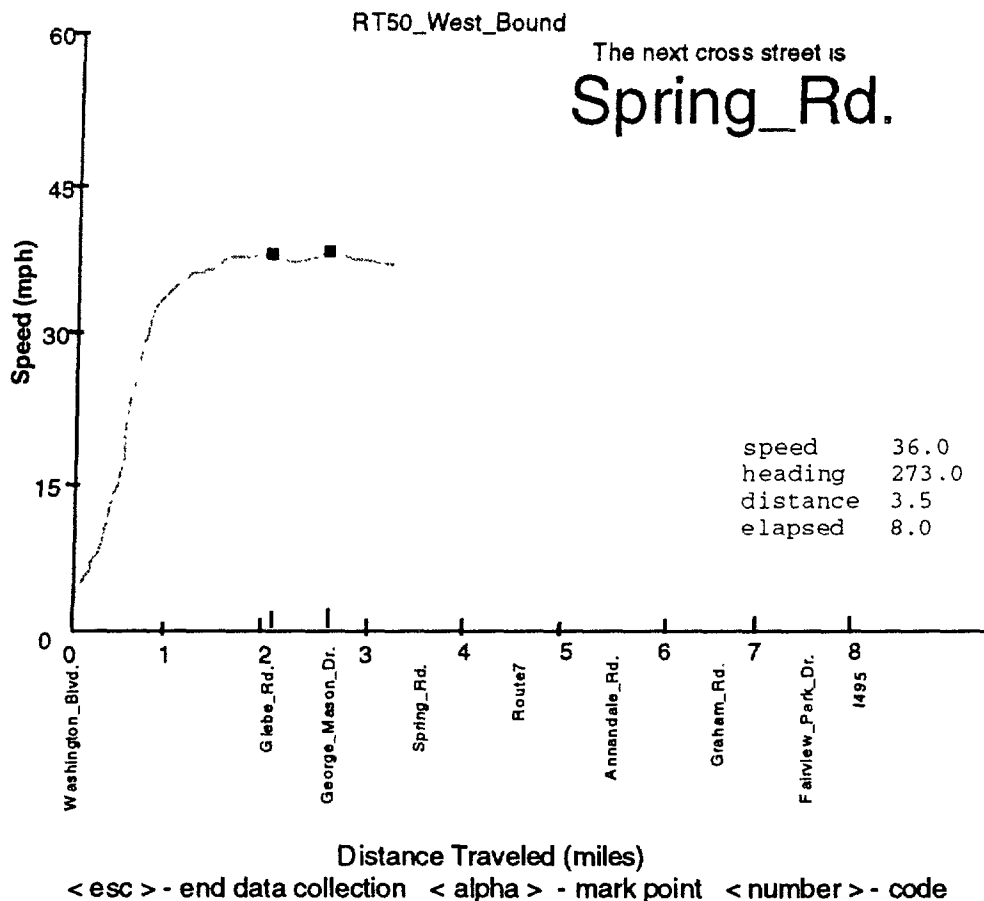


Figure 1-1. Dynamic Display Screen

After termination of the data collection the user can view a variety of screens that display the processed data. Moreover, the speed run can be viewed over and over again with the re-creation option. The re-creation option mimics the actual data collection by replaying the GPS parameters saved in a data file.

1.2 System Components

The GOP is very simple in concept. It consists of three major components which are: 1) GPS receiver, 2) laptop (or notebook) computer, and 3) GOP software. There are also three minor components: the GPS antenna, a serial cable for connecting the GPS receiver and the laptop computer, and the cable that supplies power to the GPS receiver.

Through use of the GPS satellites, the GPS receiver supplies the parameters that enable the determination of vehicle location, speed, and direction of travel. The message from the GPS receiver is sent to the laptop via the serial port. The type of GPS receiver that is used in the prototype utilizes an external antenna that is magnetically mounted to the outside center of the roof of the vehicle used. Also, the GPS receiver is powered by 12 volt DC through the cigarette lighter.

Testing has shown the performance of the GOP to be directly linked to the accuracy of the GPS receiver being used. Through informal testing of various GPS units, the best performer found to date has been the Trimble Navigation Place? GPS 400 receiver.

The laptop computer supports the GPS message input, input from the user, and is the platform by which the collected data is processed and output to the user. The laptop also houses the software, the user input file, and facilitates the recording of the collected data output file to disk. The program should be run in the DOS environment on a 386 or higher computer. The GOP program was written in C++. The GOP executable file is designated gopexe.exe.

Section 2

Operating the GPS Odograph

This section provides instructions for operating the GOP. The explanation of each step covers all the information the user must know to conduct a speed run with the GOP. **Abbreviated data collection user instructions are provided in Appendix A.** More complete and detailed preparation and operating instructions are explained in this section. File formats are explained in the Appendices B and C.

Initial Use – When the GPS Odograph software is initially received, working copies of the original disk should be made and the original should be safely put away. The working copy of the disk will have files written to it during operation. The user will also want to prepare roadway profiles and place them on working copies of the disk.

A. Create a Roadway Profile (highly recommended, but optional)

1. Initially the subject segments of the roadway on which the speed run is going to be conducted should be identified. Appropriate start, interim, and end delineator points should be chosen.
2. If the user wishes to customize the system to the particular run, the roadway profile parameters need to be developed according to the roadway profile format (format is presented in Appendix B). Parameter values for distances need not be exact, reasonably good estimates are sufficient and will not hamper data collection. As described in Appendix B, the distances may be determined using GPS data from the GOP.
3. Create an ASCII file and enter the roadway profile parameters.
4. Once the roadway profile is complete it should be saved as a DOS text file. The file designation uses not more than the first 6 characters to identify the route described in the file, followed by a direction indication of two characters, EB, WB, NB, or SB indicating the east, west, north or south bound direction. The extension for the roadway profile file has been designated as **.plf**. For example, the roadway profile **name** might be Rt50wb.plf as illustrated in Appendix B. This file should be placed on the disk with the GOP software.

B. Connecting the Hardware

1. First connect the serial cable to the serial port on the computer and serial port on the GPS receiver.
2. Connect the GPS receiver and the computer to the vehicle's power source or the computer may be battery powered.

3. Connect the antenna to the GPS receiver and place the antenna on the roof of the vehicle.
4. Turn on the computer.

C. Starting the GPS Odograph software

1. Insert the disk with the GOP software into the disk drive, usually the A: drive.
2. Switch the computer to the A: drive
3. Starting the executable can be done two ways, batch mode or command line.
 - Batch mode: Type the name of the batch command that contains the command line inputs and depress the return or enter key. The command with that batch command name would have been prepared in advance and placed on the disk containing the GOP software and the roadway profile file.
 - Command line: at the A:> prompt type gopexe followed by the command field inputs. (If you just enter gopexe the program will prompt you for the other command field information.) For example:

A:>gopexe f Rt50 EW

Note that the command fields are separated by spaces.

The first command field is the name of the executable file that runs the GOP (gopexe).

The second command field indicates the mode the GOP will operate, f - for field data collection run and r - for recreating a field run from a data file.

The third command field indicates the route or road identification, Rt50 (up to 6 characters). This indicates to the software what input files to use. This is the identification also used for the data files. If no indication is entered, the program will use a default profile. The operator will still be prompted to supply an output data file name.

The fourth and last command field input, EW, indicates the directions of the input file that will be used, Rt50eb.plf and Rt50wb.plf

The command line entry is completed by depressing the return or enter key.

4. After the software is started the main menu will appear. Route 50 is used as the example here.
 - 1. Collect data (road name and direction) Rt50_East_Bound
 - 2. Collect data (road name and opposite direction) Rt50_West_bound
 - 3. Obtain new profile
 - 4. Display time and speed versus distance

5. Display time versus speed
 6. Display path taken - plan view
 7. Display summary report
 8. Annotate current data file
 9. Exit
5. To initiate the data collection or view a re-creation of data, select options 1 or 2. If doing a field data collection, go on to do steps D., E. and F. However, if doing a re-creation go on to do step G.

D. Field collection mode

1. After selecting option one or two, a display graph will appear on the screen as illustrated by Figure 2-1 below. In this example, the profile file has identified roadway link delineators along Rt50 as shown in the figure.

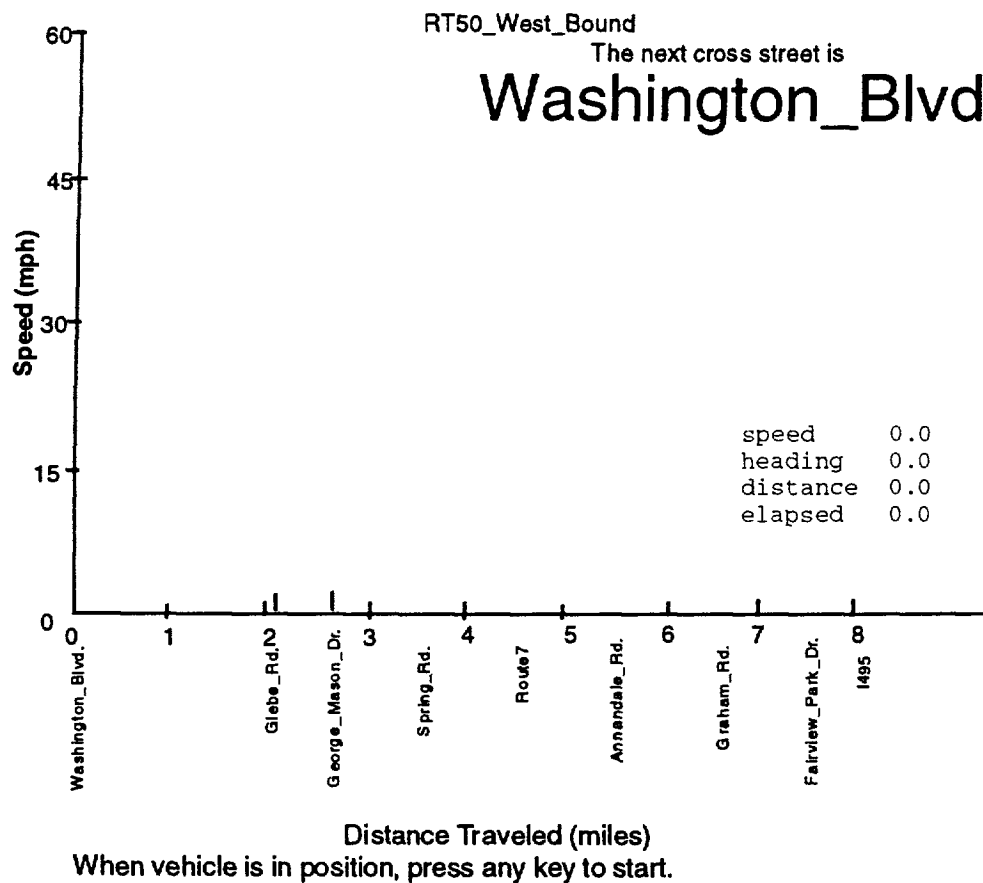


Figure 2-1. Initial Display Screen

2. The line on the bottom of the screen provides instructions to the operator concerning current command options. The instruction illustrated above "When vehicle is in position, press any key to start", is accompanied by an annoying sound. (Caution: do not hit the escape key since that will start the run and immediately terminate it.) This indicates to the operator that the unit is ready to begin recording data as soon as any key is hit. Any key (except esc) should be hit when the vehicle is at the starting point of the run and is starting the run. Once the key is hit, data will be recorded and the screen will begin to display the data as illustrated by the next figure, Figure 2-2.

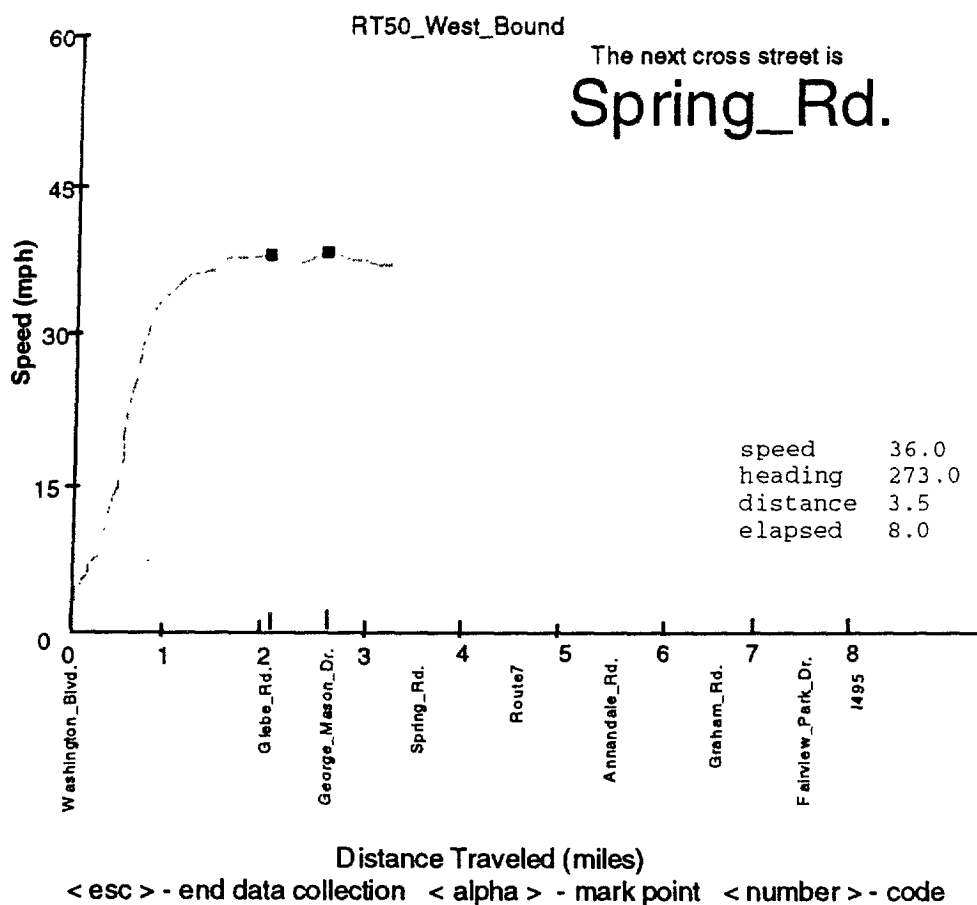


Figure 2-2. Dynamic Display Screen

E. Indication of a marked point or code data in field collection mode

1. The association of points (roadway link delineators) such as cross streets with GPS data points is accomplished by the operator pressing any letter key <alpha> when the vehicle reaches the point of interest. This is done during the collection of data. When an alpha key is pressed marking a delineator point, an indication of this is displayed on the screen by a highlighted box (n) as shown in Figure 2-2. (The data fields are further explained in Appendix C.) , Note that the next reference point identified in the roadway profile as a delineator is indicated at the top of the display.
2. To otherwise code a data point as a point of interest, select and enter a number key from 1 to 9, associated with the specific code. The number selected will be entered with the corresponding GPS data point into the output data file.

Note: a data point can not be both marked as a delineator and coded as a point of interest.

F. Termination of field data collection

1. To end the collection of data press the esc key. This is done at the end of the run. After the esc key is pressed, the instructions at the bottom of the screen will change to, Press any key. Pressing any key, except the esc key, will invoke the main menu.

G. Re-creation Mode

1. After selecting option 1 or 2 the instructions on the bottom of the screen, "Please enter input data file", will prompt for a data file name. Enter a data file name, e.g. Rt5000.out, and press return.
2. After pressing return, the graphical screen display will appear. Next, the data points that represent the speed vs. distance graph will be plotted. The points will be plotted faster than the points are plotted during an actual collection run. The displayed graph is a re-creation of the graph displayed during the collection of the data.
3. Upon completion of the graph, the instructions at the bottom of the screen will change to "Press any key". Pressing any key, except esc, will invoke the main menu. Since the data file has been entered into the program, the operator may now choose any of the other display options (see Section 4) which will then use the same data file.

H. Conducting other field runs or viewing other re-creations

To proceed with other field runs or recreations using a different profile file proceed as outlined below. To continue use of the prior profile file for data collection runs or re-creations return to the instructions at C-4.

1. Select the 3 option from the main menu and follow the instructions at the bottom of the screen.

2. First instruction: Enter the profile portion of the file name
Example: Rt50
and then press enter
3. Second instruction: Enter the first run direction
Type E, W, N, or S
4. Third instruction: Enter the second run direction
Type E, W, N, or S (opposite of the first)
5. "Press any key to continue", will appear at the bottom of the screen. Pressing any key, except esc, will reconfigure the main menu to the new roadway, From here continue with the steps under C-4 to start a new run or continue with G-1 to view a re-creation.

I, Other menu options

1. Option 8 - Annotate current data file

This option enables the operator to input comments concerning the field run or re-creation directly into the data file. After the field run is completed or the t-e-creation is done, select option 8. Follow the instruction at the bottom of the screen. To exit hit the return key twice.
2. Option 9 - Exit, exits program
3. Options 4,5,6, and 7 display collected data - These produce static displays discussed in detail in Section 4. Press the indicated key to invoke the desired display.

J. Data files

1. The data from a field run is saved automatically to a data file that is placed on the disk in the A: drive. The data file is identified by the profile route name, e.g. Rt50, a number designation, 00, and ended with .out. The files are numbered in succession from 00 to 99. After completing some runs the disk should have a series of .out files. Examples:
Rt5000.out
Rt5001.out
Rt5002.ot.u
Rt5003.out

If no profile file is used the program will ask for an output file name.

2. The name of the profile used appears at the top of each data file. Further information on the data file format is contained in Appendix C.

Section 3

Dynamic Display and Marking Delineator Locations

The dynamic display is illustrated in Figures 2- 1 and 2-2. The dynamic display is a data collection aide. This display is called dynamic because it displays speed verses distance data as it is collected. The cross streets (roadway link delineators} provided via the roadway profile are displayed across the bottom of the graph and the next cross street from the roadway profile is identified at the top of the display. The highlighted boxes indicate the location at which the corresponding delineator was encountered as indicated by the user. The user does this by pressing any letter key <alpha key>. Having the user identify the exact location of the delineator with respect to the data being collected helps to justify the data more precisely between delineated segments. At the end of the run the last delineator or end point is also to be identified by the user.

After initializing a recreation of a speed run, a dynamic display is created that includes the identified delineators. During a recreation, delineators do not need to be re-identified by operator entry.

There are some nuances associated with identifying delineators.

- If a delineator is not marked by operator entry, the summary display will not correctly correlate with the delineated segments identified in the roadway profile. This can be remedied by editing the associated roadway profile and deleting the references concerning the missed delineator.
- In the opposite case when an extra delineator is identified by operator entry, to correctly correlate the roadway segment information displayed to the summary report, the new delineator must either be added to the roadway profile or the delineator indication in the saved data must be removed. Removing a delineator indication in the saved data is explained in the input/output data file format information in Appendix C.
- Also, accidental double key hits (key hits within 2 seconds of each other) are treated as one key hit by the program and the second hit is dropped.

Section 4

Data Display Menu Options

After a run is completed a series of displays can be invoked. At the completion of a field run pressing the escape key, or pressing any key after the dynamic screen is displayed during a re-creation, invokes the main option menu. The four static display options are highlighted in the illustration below.

- 1 Collect data (road name and direction) Rt50_East_Bound
2. Collect data (road name and opposite direction) Rt50_West_bound
3. Obtain new profile
- 4. Display time and speed versus distance**
- 5. Display time versus speed**
- 6. Display path taken - plan view**
- 7. Display summary report**
8. Annotate current data file
9. Exit

Just enter the designated number to view the corresponding screen. Currently the Display time versus speed option, number 5, has not been enabled so choosing option 5 does nothing. At any time while viewing a static display, hitting any key will redisplay the static display option menu.

4.1 Static Displays

The static graphical display choices include:

- option 4 for a Speed Profile and Travel Time graph, as illustrated in Figure 4- 1,
- option 5 for Time versus speed graph (not implemented),
- option 6 for the plan view of the path traversed, as illustrated in Figure 4-2, or
- option 7 for a tabular summary of average speeds between delineators, as illustrated in Table 4- 1.

The first static output display, option 4, is similar to the display provided during data collection. The difference is that on this graph both the speed and travel time related to distance are illustrated, as shown in Figure 4-1.

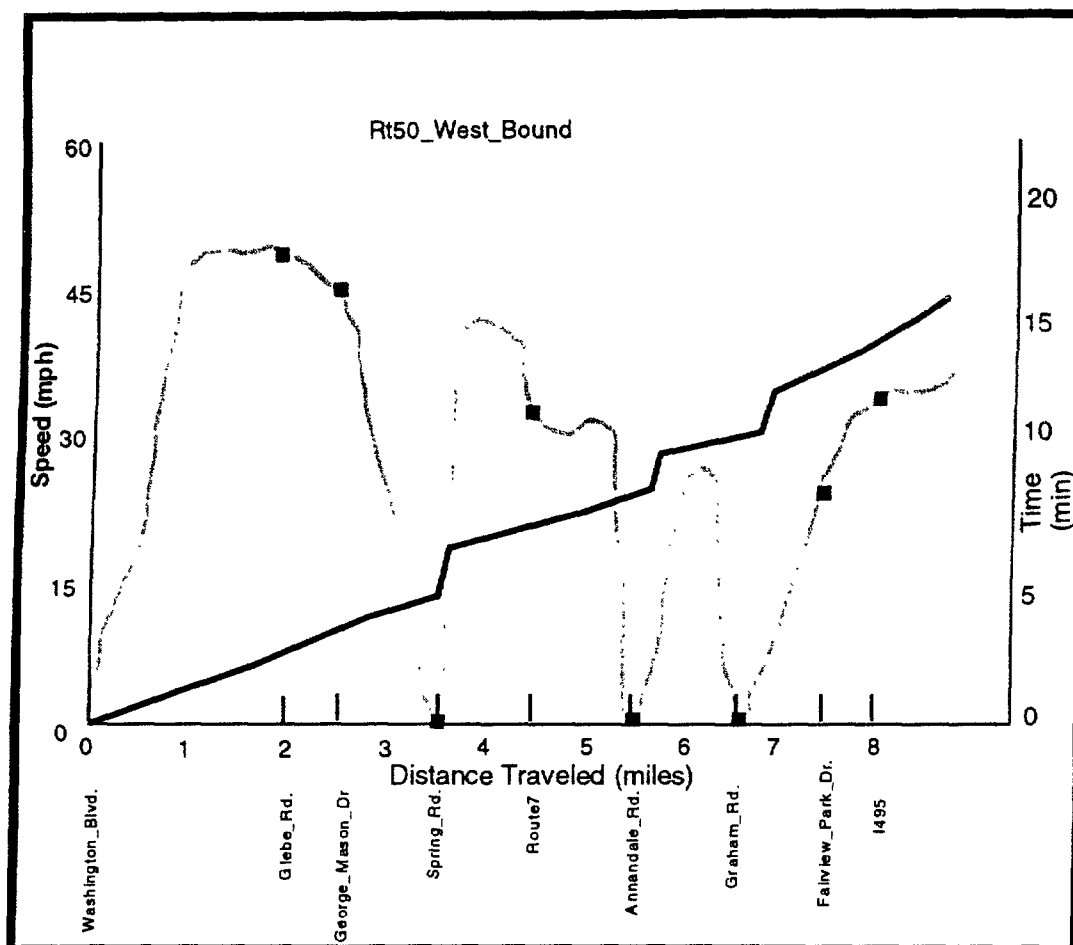


Figure 4-1. Speed Profile and Travel Time Graph

The next display available to view is the plan view. This display indicates the roadway curvature. Visualizing the plan view of the route taken may lend insight to decreases in speed or increases in time. Figure 4-2 is an example of the plan view.

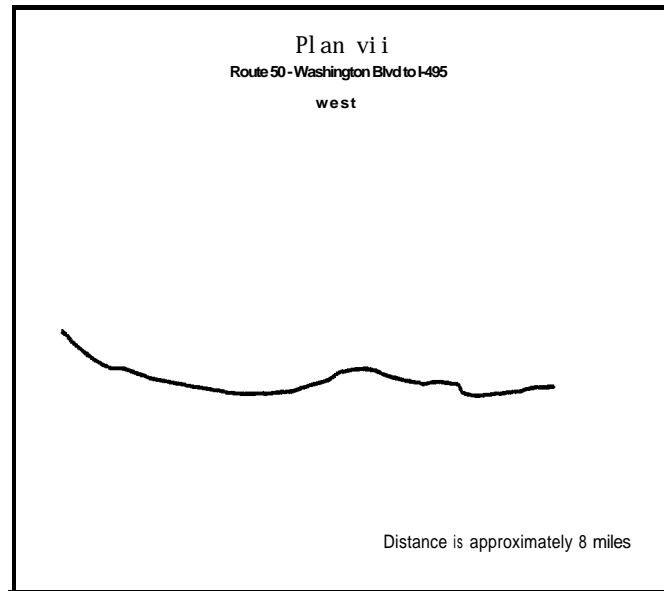


Figure 4-2. Plan View

The last display is the summary table. This table will provide the actual average values of speed, travel time, distance traveled and stop delay for each roadway link between delineator points. Table 4- 1 is an example of the summary report table. This report can be saved as an ASCII text file by indicating yes (y) to the instructions at the bottom of the summary report screen display. The file will be designated as report**.rep, where the ** indicate the number of the speed run conducted. Therefore the first report file would be designated as report00.rep.

Table 4-1. Sample Summary Report

Rt50_East_Bound		Data time 9:55:04		Report date 12/08/95					
Segment		Average Speed		Travel Time		Distance		Signalized f	
From	To	seg.	cum.	seg.	cum.	seg.	cum.	int.	stop l
		(mph)		(min:sec.s)		(miles)		delay(sec)	g
Graham_Rd	- Annandale_	17.2	17.2	3:57.1	3:57.1	1.13	1.13	87	
Annandale_	- Route7	47.2	24.5	1:16.6	5:13.7	1.00	2.13	n/a	
Route7	- P._Henry_C	51.7	27.5	0:39.2	5:52.9	0.56	2.70	0	
P._Henry_D	- Olin_Dr	43.1	28.7	0:28.9	6:21.8	0.35	3.04	0	
Olin-Dr	- Montague(P	34.7	29.0	0:19.1	6:40.9	0.18	3.23	0	
Montague(P	- Manchester	18.0	28.1	0:36.9	7:17.8	0.18	3.41	11	
Manchester	- Carlin_Spr	41.9	28.8	0:26.4	7:44.2	0.31	3.72	n/a	
Carlin_Spr	- Edison_St	51.1	30.0	0:26.2	8:10.4	0.37	4.09	0	
Edison_St	- Park_Dr	46.0	30.8	0:24.6	8:35.0	0.31	4.40	0	
Park_Dr	- Pershing_								
D	47.4 31.2	0:11.6	8:46.6	0.15	4.56	0			
Pershing_D	- Geo._Mason	52.8	32.1	0:22.7	9:09.3	0.33	4.89	n/a	
Geo._Mason	- Glebe_Rd	54.9	33.0	0:23.8	9:33.1	0.36	5.25	n/a	
Glebe_Rd	- Irving_St	51.0	33.8	0:26.9	10:00.0	0.38	5.63	0	
Irving_St	- Filmore_St	23.3	33.2	0:36.2	10:36.2	0.23	5.87	2	
TOTALS			33.2		10:36.2		5.87	100	

Appendix A

Abbreviated User Instructions

A.1 Connect the Hardware

- First connect the serial cable to the serial port on the computer and serial port on the GPS receiver.
- Connect the GPS receiver and the computer to the vehicle's power source or the computer may be battery powered.
- Connect the antenna to the GPS receiver and place the antenna on the roof of the vehicle. Center the antenna on the car roof to give optimum satellite visibility.
- Turn on the computer.

A.2 Doing the Data Collection Run

A.2.1 Doing the Run With Minimum Preparation (Without the Roadway Profile)

A.2.1.1 Starting the Software

- To minimize preparation effort, it is assumed that the user has neither a profile file or a batch command file, although preparation and use of the profile file is highly recommended.
- Insert the disk with the GOP software into the disk drive, usually the A: drive.
- Switch the computer to the A: drive
- Type the command line inputs at the A:> prompt as follows:

A:>gopexe f

Note that the command fields are separated by spaces.

(When you just enter gopexe or gopexe f, the program prompts you for additional information.)

- The first command field is the name of the executable file that runs the GOP. (gopexe)
- The second command field indicates the mode the GOP will operate, f - for field run **and** r - for re-creating a field run from a data file.
- The program will use a default profile. The operator will still be prompted to supply an output data file name.
- After the **software** is started the main menu will appear:

1. Collect data (road name and direction)
 2. Collect data (road name and opposite direction)
 3. Obtain new profile
 4. Display time and speed versus distance
 5. Display time versus speed
 6. Display path taken - plan view
 7. Display summary report
 8. Annotate current data file
 9. Exit
- To select the collection of data, select options 1 or 2, i.e., press 1 or 2 and enter.

A.2.1.2 Perform the Field Data Collection

- The instruction “When vehicle is in position, press any key” on the bottom of the screen is accompanied by an annoying sound. This indicates to the operator that the unit will begin recording data as soon as any key, except the esc key, is hit. The key should be hit when the vehicle is at the starting point and is starting the run..
- Without the profile file designating the roadway link end points, the cross streets or other link end designators will not be available or shown on the display. The program will use the default set-up. When using the default set-up the user can identify the location of each roadway link delineator by pressing any key. (Note that without the profile file, the summary report will not be available.)
- To end the collection of data press the esc key. This is done at the end of the run. After the esc key is pressed, the instructions at the bottom of the screen will change to, “Press any key”. Pressing any key at this time will invoke the main menu.

A .2.2 Doing the Run With a Roadway Profile

A .2.2.1 Starting the Software

- Insert the disk with the GOP software and the roadway profile into the disk drive, usually the A: drive.
- Switch the computer to the A: drive
- Type the command line inputs at the A:> prompt as follows (example Rt.50 EW):
A:>gopexe f Rt50 EW

Note that the command fields are separated by spaces.

(If you just enter gopexe the program prompts you for the other information.)

- The first command field is the name of the executable file that runs the GOP.
(gopexe)

- The second command field indicates the mode the GOP will operate, f - for field run and r - for re-creating a field run from a data file.
- The third command field indicates the route or road identification, e.g. Rt50 (up to 6 characters). This indicates to the software what profile file to use. This identification is also used for the output data files.
- The last command field, EW, indicates the directions of the input profile file that will be used. e.g. Rt50eb.plf and Rt50wb.plf
- After the software is started the main menu will appear:
 1. Collect data (road name and direction) Rt50_East_Bound
 2. Collect data (road name and opposite direction) Rt50_West_bound
 3. Obtain new profile
 4. Display time and speed versus distance
 5. Display time versus speed
 6. Display path taken - plan view
 7. Display summary report
 8. Annotate current data file
 9. Exit
- To initiate the collection of data select options 1 or 2, i.e. press 1 or 2 and enter.

A.2.2.2 Perform the Field Data Collection

- The instruction “When vehicle is in position, press any key” on the bottom of the screen is accompanied by an annoying sound. This indicates to the operator that the unit will begin recording data as soon as any key, except the esc key, is hit. The key should be hit when the vehicle is at the starting point and is starting the run.
- The association of roadway link delineators such as cross streets with GPS data points is accomplished by the operator pressing any letter key c alpha > when the vehicle reaches the point of interest. This is done during the collection of data. When an alpha key is pressed marking a delineator point, an indication of this is displayed on the screen by a highlighted box (n) as shown in Figure 2-2. Note that the next reference point identified in the roadway profile as a delineator is indicated at the top of the display.
- To otherwise code data points for future reference, select and press a number key from 1 to 9, to be associated with the specific data point.
- To end the collection of data press the esc key. This is done at the end of the run. After the esc key is pressed, the instructions at the bottom of the screen will change to, “Press any key”. Pressing any key, except the esc key, at this time will invoke the main menu.

Appendix B

Roadway Profile

There are many ways to obtain the information for the roadway profile. It can be completed by looking at a map. If the map is detailed enough signal location, street names, and the estimated distances between the streets can all be obtained. Another method is to drive the route and to visually survey the route and obtain the distances between delineators by using the GPS Odograph. This can be done by not specifying a roadway profile during initialization of the software. Not specifying a profile will cause the program to use the default set-up. When using the default set-up the user can identify the location of each delineator by pressing any key. This data can then be taken back to the office and the distances between delineators can be calculated and entered into the roadway profile file. Another alternative is to use a profile file with the delineator names and dummy distances for a field run and have the GOP determine the distances needed for the profile file. The distances may be printed in the summary report, see Section 4.

One thing to remember is that the roadway profile data is an enhancement that customizes the data files and displays. It does not alter any of the data collected but does make the data easier to use. It also enables the software to do the calculations needed to provide the summary report showing the measured characteristics of each roadway link identified in the roadway profile.

B.1 The Roadway Profile Format

The Roadway Profile is an ASCII text file that contains specific information concerning the characteristics of the route on which a speed/travel time survey is to be conducted. The intent of the file is to enhance the data collection effort by providing parameters that will customize the screen displays to the route being surveyed, as shown in Figure 2- 1. The cross street names indicate the location of reference points as well as for calculations used to produce the summary report. The number of signals and their locations invokes determination of delay data related to each identified signal to be processed. Text designations such as direction and title are displayed on various output screens to identify the route the data is associated with.

The software can be used without a roadway profile; however, there are no screen indications for when a segment delineator should be identified and the dynamic display screen utilized while collecting data defaults to a length and speed that may not be appropriate for viewing the collection of a particular survey. Note also that without the profile file, the summary report will not be available.

Table B-1 is a listing of the parameters to be included in the roadway profile. Parameters that designate distance and speed should be designated as floating point numbers. Parameters that designate the number of segments, delineators, or signals should be designated as integers. Since spaces are used as field dividers, text designations must not contain any white spaces. A street name such as Steven Martin Dr. must be designated as Steven-Martin-Dr. The route and cross street names are limited to 20 characters. The roadway type, and direction parameters are

limited to 15 characters. The title is limited to 60 characters. The number of segment names and cross street names is limited to 39 and 40, respectively. An example profile, Table B-2 has been provided. This example profile is for demonstration only and does not accurately depict the actual route named.

Table B-1. Roadway Profile Parameters

Data file parameter	Parameter Definition	Format
1.	Estimated travel distance of run in miles	floating point number
2.	Posted speed limit in mph	floating point number
3.	Number of segments	integer - limited to 39
4.	Route name for each segment	character data - limited to 2C each, no white spaces, one name per line
5.	Number of segment delineators (include start and end point)	integer - limited to 40
6.	List of delineators identifications in order from start location	character data - limited to 20 each, no white spaces, one name per line
7.	Estimated distance between delineators	floating point number separated by one space
8.	Type of road: Highway, Arterial	character data - limited to 15
9.	Number of signals	integer
10.	Sequence numbers of delineators which are signalized intersections (indicate 0 if none)	integer - number corresponding to intersection location, start location is designated as 1
11.	Indicate direction of run: north, south, east, west	character data - limited to 15
12.	Specify title for graphs and table	character data - limited to 60, no white spaces

Table B-2. Example Roadway Profile

8
40
8
route50
route50
route50
route50
route50
route50
route50
9
Washington_Blv
Glebe_Rd
George_Mason_Dr
Spring_Rd
Route7
Annandale_Rd
Graham_Rd
Fairview_Park_Dr
I495
2.0 0.5 1.0 1.0 1.0 1.0 1.0 0.5
Arterial
4
6 7
west
Route_50_Washington-Blvd._to_I495

Appendix C

Input/Output Data File Format

This section provides a detailed description of the standard GPS Odograph data file format. The data file format is valid for both input to, and output from, the prototype. This is not to be confused with the roadway profile file which follows a different format. The data in these GPS Odograph data files consist of information from a GPS receiver. This information includes parameters that indicate time, location, speed and heading. A field has also been included that identifies those records that correspond to delineators or codes identified by the user during collection of the data. The specifics of the data file format are specified below. An accompanying example file that identifies data fields is also presented in Table C- 1.

Data File Format Conventions

1. The standard GPS Odograph data file is in ASCII.
2. The standard data file consists of a series of records (lines) terminated by a new line character. There are two types of records: comment records, and data records.
3. There is no required order for the two types of records. However, in the prototype, comment records are only entered at the beginning and end of the file.
4. Comment records will begin with a pound symbol (#) as the first character in column 1.
5. Data records will begin with a space character as the first character and end with a CR.
6. Successive data records will have a non-zero difference in the recorded time value.
7. Data fields are separated by one space.

Table C-1. Sample Data File

```
#This is a sample standard GOP data file
#This data was collected on Route 110 NB
#
#TIME Latitude Longitude Alt. Spd Vspd Hdg Flg
643160 +38.87902 -077.03874 +00126 051 +000 239 0
643182 +38.87880 -077.03910 +00125 050 +000 230 0
643193 +38.87859 -077.03934 +00126 052 +000 223 0
```

The time is expressed in seconds past midnight based on Greenwich Mean Time. The latitude and longitude are in degrees. The altitude is in meters above a theoretical ellipsoid. The (horizontal) speed and vertical velocity are in miles per hour, and the heading is expressed in degrees from true north and increases eastward (clockwise). The flag field is set to -1 when the user depresses an alpha key during a run, and is used to designate roadway segment delineators, such as intersections. The flag field can also contain a number from 1-9, corresponding to when the user depresses a number key from 1 to 9.

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