

This is a readme file to explain the trajectory data set.

A detailed description to the hardware and software system in developing the trajectory dataset, and a scene-based lane change analysis by using the dataset can be found at

Zhao,H., Wang,C., Lin,Y., Guillemard,F., Geronimi,S., Aioun,F., On-road Vehicle Trajectory Collection and Scene-based Lane Change Analysis: Part I, IEEE Trans on Intelligent Transportation Systems, 18(1), 192-205, 2017.

Yao,W., Zeng,Q., Lin,Y., Xu,D., Zhao,H., Guillemard,F., Geronimi,S., Aioun,F., On-road Vehicle Trajectory Collection and Scene-based Lane Change Analysis: Part II, IEEE Trans on Intelligent Transportation Systems, 18(1), 206-220, 2017.

Preliminary reports of the work can also be found at

H.Zhao, C.Wang, W.Yao, F.Davoine, J.Cui, H.Zha, Omni-directional detection and tracking of on-road vehicles using multiple horizontal laser scanners, IEEE Intelligent Vehicles Symposium, 57-62, 2012.6

Yao, W., Zhao, H., Bonnifait, P., Zha, H., Lane Change Trajectory Prediction by using Recorded Human Driving Data, IEEE Intelligent Vehicles Symposium (IV), 430-436, 2013.

Yao,W., Zhao,H., Davoine,F., Zha,H., Learning Lane Change Trajectories From On-road Driving Data, IEEE Intelligent Vehicles Symposium, 885-890, 2012.6.

However, due to IPR issue, the full dataset in the above articles are not able to be published at the moment. We publish the datasets that are sole authored by POSS @PKU that are collected using the vehicle described in this material.

If you use the data, you are obligated to cite our research in your report.

For any questions or comments, please contact: zhaohj@cis.pku.edu.cn

■ Experimental Profile

[Dataset 20121109]

Road: the 4th Ring Road of Beijing

Date: 2012.11.09

Time: 9:50-10:50am, 60min

Distance: 65km

[Dataset 20130510]

Road: the 4th Ring Road of Beijing

Date: 2013.5.10

Time: 10:20-11:57am, 97min

Distance: 69238meters

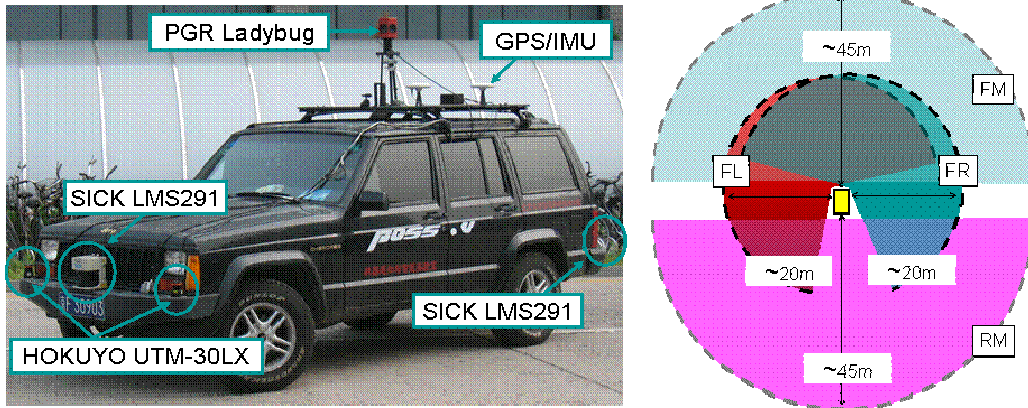


Fig. 1 The instrumented vehicle, sensor setting

■ Sensing Platform

Sensor data and the purpose:

- Gps/Imu: collect a trajectory of the ego (i.e. the instrumented) vehicle
- 4 Lidars (2 Lms291, 2 Utm-30lx) + Gps/Imu: extract trajectories of all-around environmental vehicles
- Ladybug : an omni-vision system to capture all-around visual data as the reference

All sensors' data are synchronized and calibrated.

If you need raw sensor data, please contact: zhaohj@cis.pku.edu.cn

■ The Trajectory Dataset

A directory tree of the data set is as below

```

root ----- egotraj ----- 950.nav
      |           |----- ...
      |           |----- 1050.nav
      |--- envtraj ----- 950.traj
      |           |----- ...
      |           |----- 1050.traj
      |--- rdb ----- 950.poly
      |           |----- ...
      |           |----- 1050.poly
      |--- lanechange ----- egotraj ----- env.nav
      |           |----- envtraj ----- 3.traj
      |           |           |----- ...
      |           |           |----- N.traj
      |           |----- exe
      |           |----- LC-log.txt
      |
  
```

```

|---- kml ----- egotraj -----950.kml
      |           |----- ...
      |           |----- 1050.kml
      |----- envtraj ----- 950-traj.kml
      |           |----- ...
      |           |----- 1050-traj.kml
      |----- rdb -----left ---- 950-l.kml
      |           |---- ...
      |           |---- 1050-l.kml
      |-----right ----950-r.kml
      |           |---- ...
      |           |---- 1050-r.kml

```

Naming of the folders and files are explained below.

egotraj : trajectories of the ego (i.e. the instrumented) vehicle

envtraj : trajectories of the environmental vehicles that are collected from the ego

rdb : the road bound lines that are extracted (with manual correction) from the simultaneously estimated road maps (OGM, occupancy grid map)

lanechange : lane change trajectory samples and viewer programs, explained in details in a next section

kml : the data that are converted in KML format to be visualized on Google Earth

1020,...: a segment containing the data started from 10:20am within 10mins

If you have a Google Earth software, load the kml files and setting colors at their attributes, you may see the following views.

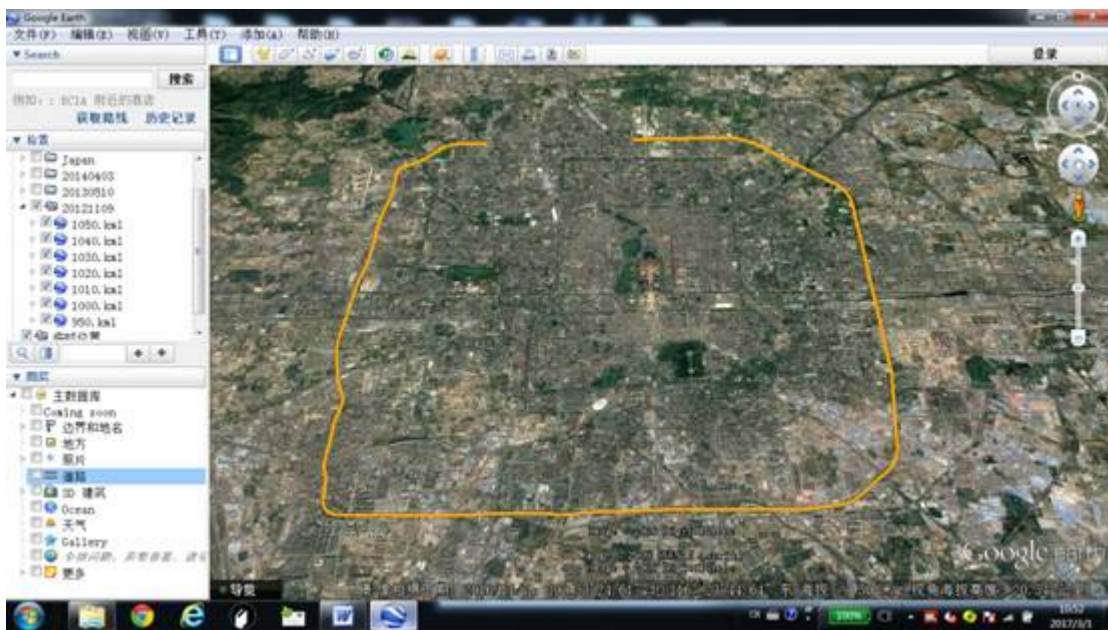


Fig. 1 Driving route

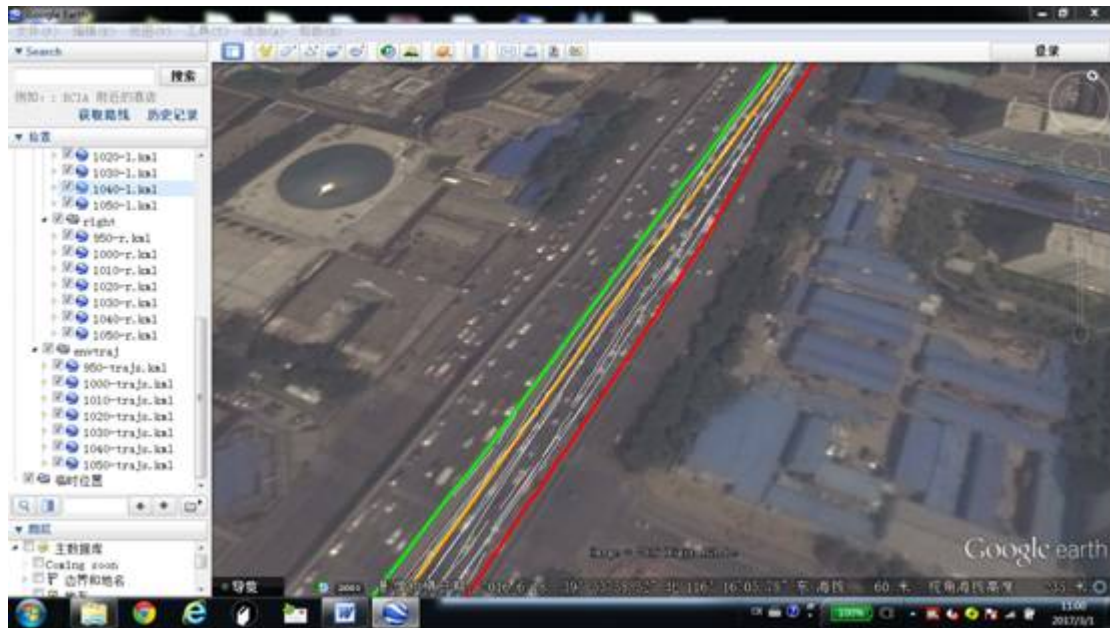


Fig. 2 Visualization of the resultant data set (Orange: egotraj, Green/Red: rbd, White:envtraj)

■ File Formats

Formats of the data files are user defined. They are explained below.

- ***.nav** // the sequence of vehicle pos.

Example:

| Time | ang.x | ang.y | ang.z | shv.x | shv.y | shv.z |
|----------|--------|-------|-------|----------|----------|--------|
| 37200094 | -0.044 | 0.01 | -4.18 | 24785.99 | -2140.94 | -81.97 |
| ... | | | | | | |

Explanation:

time is in millisec, angles are in radian, shift parameters are in meter.
the data is in a global coordinate system.

- ***.traj** //trajectories of the environmental vehicles.

Example:

```
milli,fno,gp.x,gp.y,glen0,glen1,gv1.x,gv1.y,ep.x,ep.y,ev1.x,ev1.y,interfrmspd
tno=7
37205326,3,24734.44,-2183.32,0.30,0.30,-0.09,-0.99,-6.08,-13.75,-0.78,0.62,2.08
...
```

Explanation:

A trajectory is started from:

tno=N

where, N is the trajectory ID.

It is followed by the state sequence at each time instance. At each time instance,

milli : a time log in millisec

fno : might not be necessary in your processing

gp.x,gp.y : the center point location of the vehicle in a global coordinate system at the time

glen0,glen1 : estimated longitudinal and lateral length of the vehicle; the estimation changes along frames

gv1.x,gv1.y : direction of the longitudinal edge vector of the vehicle in a global coordinate system at the time

ep.x,ep.y : the center point location of the vehicle at the ego's coordinate system at the time

ev1.x,ev1.y : direction of the longitudinal edge vector of the vehicle at the ego's coordinate system at the time

interfrmspd : inter-frame speed, m/s

- ***.poly** // **polylines of road boundaries**

Example:

```
#POLY TYPE PTNUM \ TYPE: 0=_POLYGON, 1=_POLYLN, 2=_RDLNLF,  
3=_RDLNRG
```

```
#PT x y \ [m], (0,0) means invalid point.
```

```
POLY 2 2074
```

```
PT 24777.005 -2135.597
```

Explanation:

A polyline is started from:

```
POLY TYPE PTNUM
```

where, TYPE could be 0 for a closed polygon, 1-3 for an open polyline. However, 2 and 3 are special polylines, which have meaning of the left and right road boundary lines.

It is following by PTNUM node points

```
PT x y
```

where, x and y are in a global coordinate system.

- ***.kml** // a standard KML format

Explanation:

The data are for the purpose of visualization on a commercial GIS map. However, after data conversion, many information in the original data files are lost. It is not suggested to process directly on this data.

■ Lane Change Trajectory Samples

- LC-log.txt // a log file of the lane change samples

Each line is a record of a lane change sample.

Example:

| no | stime | etime | lab | orgx | orgy | yaw_ang |
|----|----------|----------|-----|-----------|-----------|---------|
| 3 | 37235699 | 37240898 | 1 | 24372.369 | -2558.082 | -3.788 |

Explanation:

no: an id. The corresponding environment trajectory file is named subsequently as "envtraj/3.traj".

stime, etime: the estimated start and end time (milliseconds) of the lane change; conversion from hh:mm:ss:ms is milliseconds = (((hh*60)+mm)*60+ss)*1000+ms

lab: 0 for a right, 1 for a left lane change

orgx, orgy, yaw_ang: the x, y coordinates of the ego vehicle's position and heading angle at the start time of the lane change

- egotraj // the ego vehicle's trajectory

The ego vehicle's trajectories of all lane change samples are in a single file in *.nav format. The corresponding segments can be extracted according to the [stime, etime] of LC-log.txt. However, the heading angle may have slight difference with the yaw_ang in LC-log.txt. The data of *.nav are the original outputs of a GPS/IMU suite, while the yaw_ang of LC-log.txt are the estimated values to compensate for gyro draft.

- envtraj // the environmental vehicle's trajectory

Each file in *.traj format records the set of environmental vehicle trajectories during the period [smilli, emilli] that is defined in LC-log.txt, and named by the id of the lane change sample.

- exe // sample programs

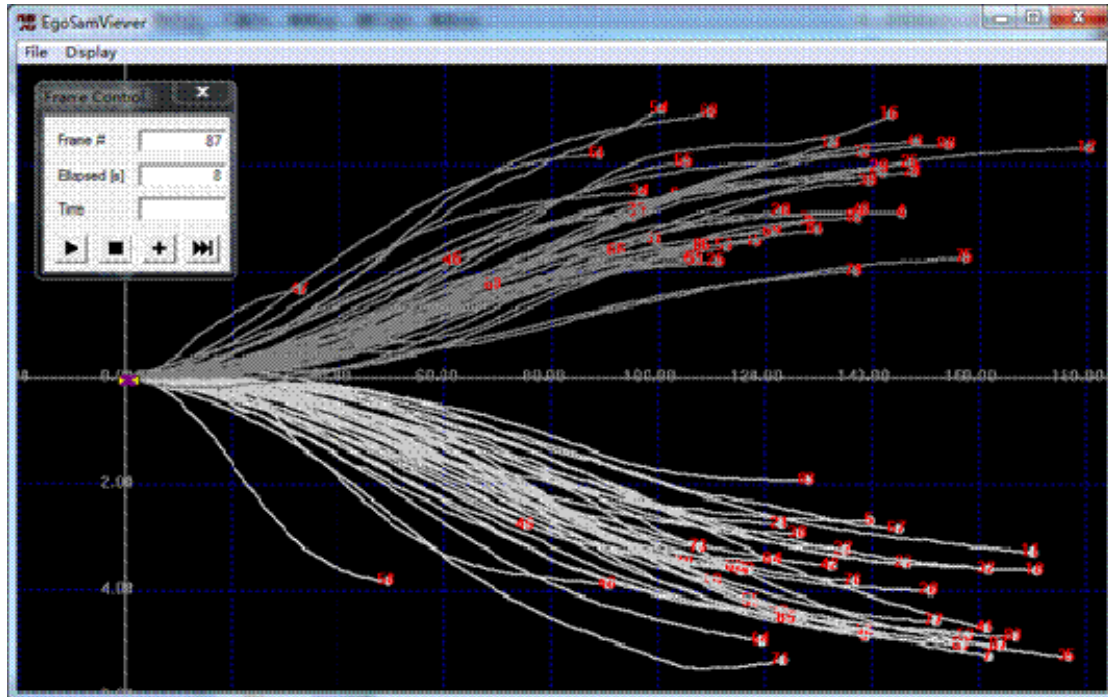
You can make use of these programs to view or re-process the trajectory data, as described below.

- EgoSamViewer.exe // a viewer of the ego vehicle's lane change trajectories

Example Usage:

1. Start the program: EgoSamViewer.exe

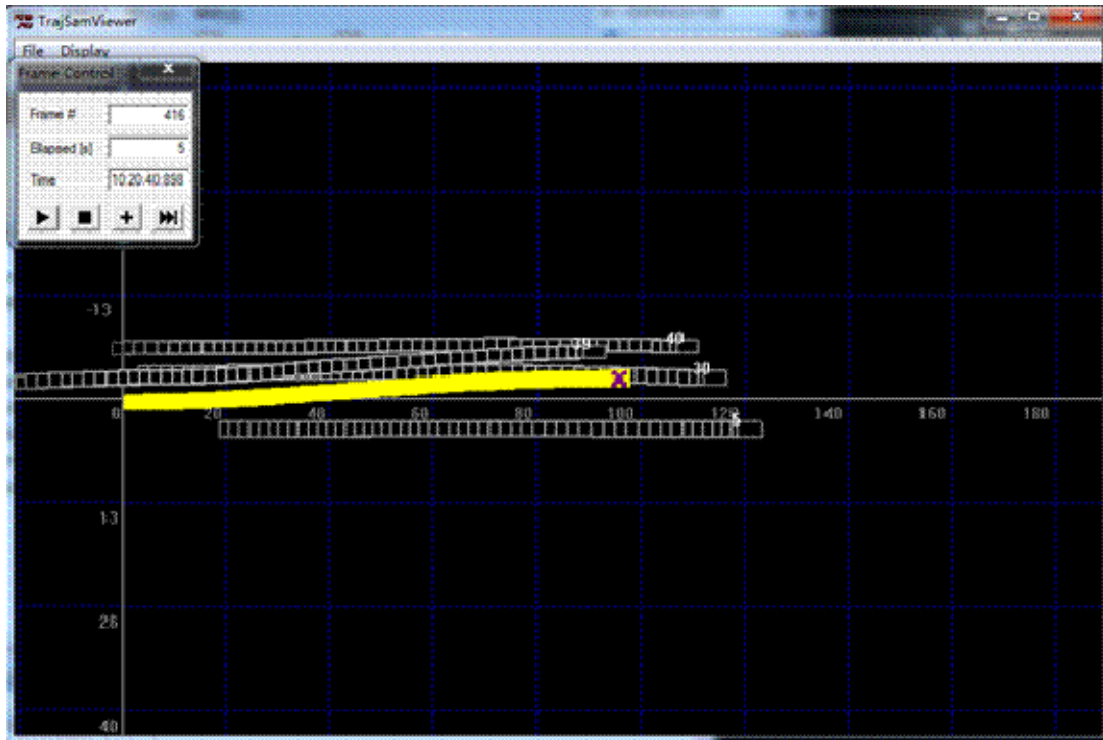
2. File->Load Ego, select the file: egotraj/ego.nav
3. File->Load Samples, select the file: LC-log.txt
4. Click the “play” button of the popup dialog “Frame Control”
5. Display->TrajID (you should see the following view)



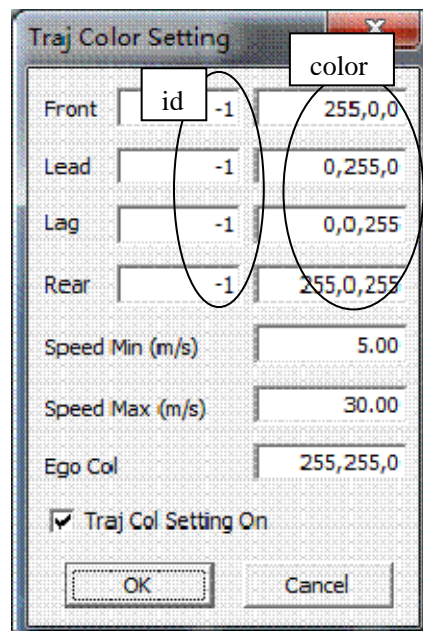
- TrajSamViewer.exe // a viewer of a lane change sample with both the ego and environmental vehicle’s trajectories

Example Usage:

1. Start the program: TrajSamViewer.exe
2. File->Load Ego, select the file: egotraj/ego.nav
3. File->Load Org, select the file: LC-log.txt (This is an optional step. If the file is loaded, the orgx, orgy and yaw_ang will be used to define a coordinate system of the viewer, otherwise, retrieve data from the ego.nav.)
4. File->Load Samples, select a sample in envtraj, e.g. envtraj/3.traj
5. Display->TrajID (you should see the following view)



6. Goto step 4 to select and view other samples
- Other functions
7. Display->ego centered: ego centered views
8. Display->set trajcol: use different color to draw the trajectories



- ExtractTrajs.exe // extract the trajectories during a given period.
// this is a command line program

Example Usage:

run-ExtractTrajs.bat: the batch file is used in generating the samples of the folder envtraj, just iteratively replace the "1050s.traj" of the batch commands to another traj file, from "10s0s.traj" to "1150s.traj" of the folder envtraj, and execute the batch commands.

```
ExtractTrajs.exe 1050s.traj 3 37235699 37240898
```

Explanation: from the file 1050s.traj, extract the trajectory segments during the period of [37235699, 37240898]. If succeeded, create a file "3.traj" and save the trajectory segments in it.

You may extract a trajectory sample on a newly defined period, and view it using the above addressed viewers.