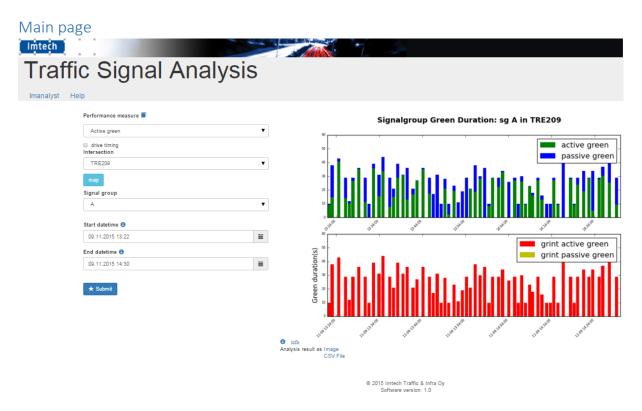# User Manual

Version 1.2

Chenlu Wang, Nov, 2015.

Introduction

ImAnalyst is a light-weight web application to analyze traffic signal performance and provide traffic engineers visualized graphics and precise data. The document is consist of two parts: layout introduction and functions report.

Overview

The following figure illustrates the main page of ImAnalyst. On the left sidebar, first there is a drop-down list of performances, users are free to select any performance to analyze and determine other relevant parameters based on their specified demands. The result of analysis will be shown on the right main panel, including the visualized graph and preview of calculated data. Download data as CSV files is also allowable.
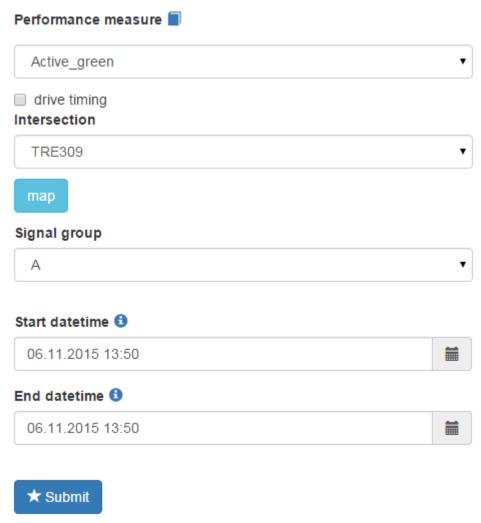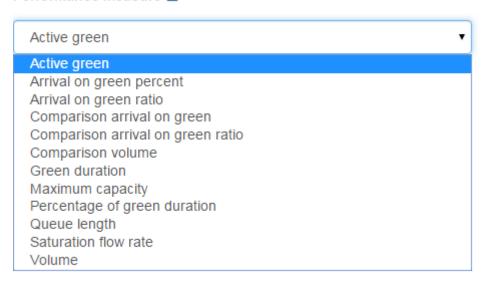
Main page

Navigator bar:

Home page is main page to analyse data, and help page shows instruction of measurements and provides user manual.

Sidebar:

Performance measure 📘

| Active_green ▾ |

☐ drive timing
Intersection

| TRE309 ▾ |

[map]

Signal group

| A ▾ |

Start datetime ℹ️

| 06.11.2015 13:50 | 📅 |

End datetime ℹ️

| 06.11.2015 13:50 | 📅 |

[★ Submit]

1. "Performance measures" dropdown list: Performance measures list is the first selector. When selected one specified measures, the page will update once for displaying required selectors under it.   The list includes:

Performance measure 🔖

```
Active green                                          ▼
Active green
Arrival on green percent
Arrival on green ratio
Comparison arrival on green
Comparison arrival on green ratio
Comparison volume
Green duration
Maximum capacity
Percentage of green duration
Queue length
Saturation flow rate
Volume
```

2. "Book" sign 🔖 : Click it to link to the instruction page with the definition of every performance measure in the dropdown list, press the question sign to link to the instruction page.

Saturation Flow Rate: It estimates saturation flow rate, the number of vehicles per hour that could cross the line if number of vehicles remained green all the time. It is achieved by introducing the idea of lost time and effective green time. The implementation is based on an assumption that the initial queue at the start of green is at least ten vehicles long. The first few vehicles are excluded because the transient effect of starting up the queue. Vehicles beyond the tenth are exclude because they may represent the arrival rate instead of the departure rate. This ideal condition is hard to be satisfied by real data.

Green duration: it shows green duration of every signal group in the selected intersection during the specified time span.

Queue length: it estimates the amount of vehicles and length of every queue according to selected detector during specified time span.

Active green: It counts the active green time of signal group when there is any detector associated with the signal occupied, compared with passive green in every cycle during specified time span.
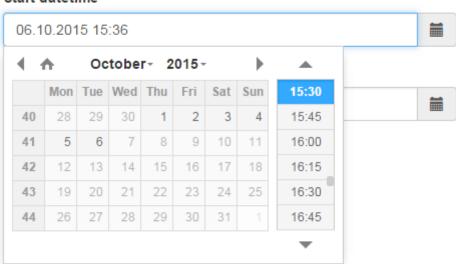
Maximum capacity: It estimates the maximum amount of vehicles being able to pass by the detector in a specified time interval (i.e. every 5 minutes, 20 minutes and I hour).

Arrival on green: it calculates the percentage of vehicles arriving the specified detector during green duration, comparing the number of vehicles arriving on green with the number of all the vehicles in specified time interval.

Volume: It measures the number of vehicles passing by the detector in specified time interval, which indicates the traffic flow changes on a location in different time span.
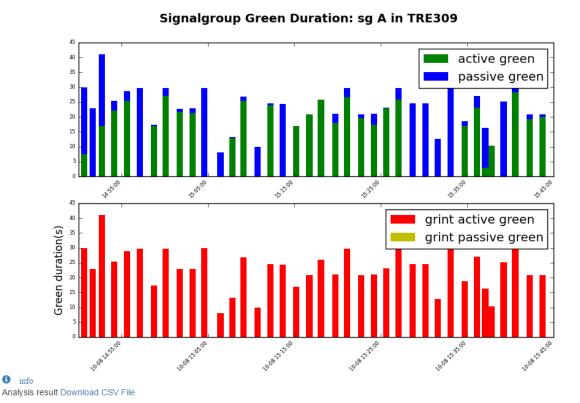
3. Checkbox "drivetime" as the snapshot . The drive time is a concept similar to green time but different. Driving time means the time phases that drivers could be able to drive, which includes green phases and some other signal statuses allowing drive behavior. Those signal statuses are: Red/amber, Fixed amber, Vehicles actuated amber. If users prefer using this definition instead of the pure green timing, they are able to click this check box.
4. "Intersections" dropdown list: It includes all the recorded intersection in the database. When selected the specified intersection, press the map button you can observe the layout of this intersection.
5. "Map" button:
6. "Signal group" dropdown list: It includes all the recorded signals in the selected intersections.
7. "Detector" dropdown list: It includes all the recorded detectors associated with the selected signal group.
8. "Multiple choices of detectors: it is for some measurements supporting multiple selection of detectors. Press "Ctrl" + click on keyboard to select detectors.
9. "Time interval" dropdown list: Time interval is used in a part of measures and its unit is minutes.
10. Start time selector and end time selector: The range of date and time for analyzing is selected in them.

11. Info sign : Hover cursor on this sign, it reminds you to input time in 'Europe\Helsinki' time zone.

12. "Submit" button : Until you press the submit button, the program to analyze runs.

Main panel

Signalgroup Green Duration: sg A in TRE309
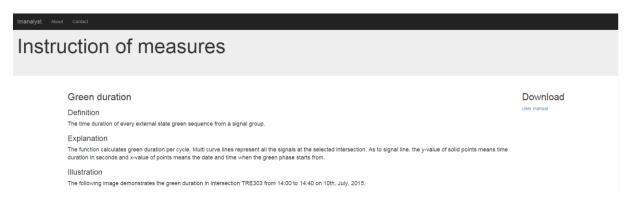
info

Analysis result Download CSV File

1. Plot: It illustrates the analysis results using the parameters you input.
2. Info sign ⓘ: This info sign provides complementary explanation for the plot.
3. Link for download. "analysis result" you could download csv file of analyzed results.
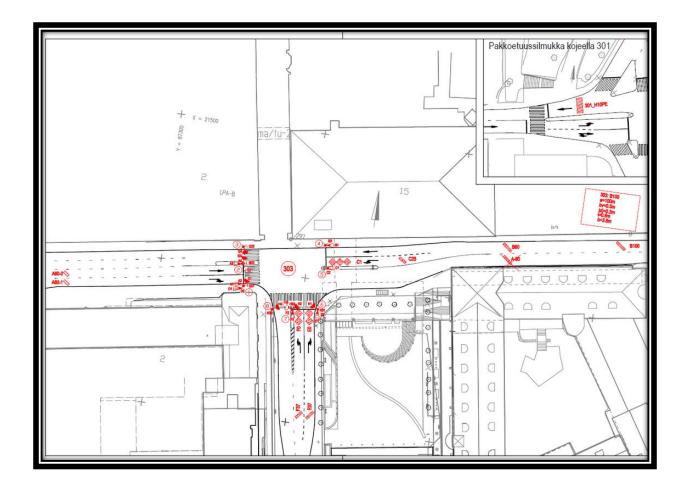
Measurement information

If you would like to learn more details about those measurements for traffic signal performance, you are suggested to click the book sign 📕 on main page. It links to the page of measurements instruction.

The PDF version of user manual is also available on right side of this page as the following figure:

Instruction of measures

Use cases:

In this report, all the cases are selected at intersection TRE303. Press map button to open the map image of TRE303 in a new window:

Green duration

Definition:

´Green duration is the time duration of every external state "green" sequence from a signal group.
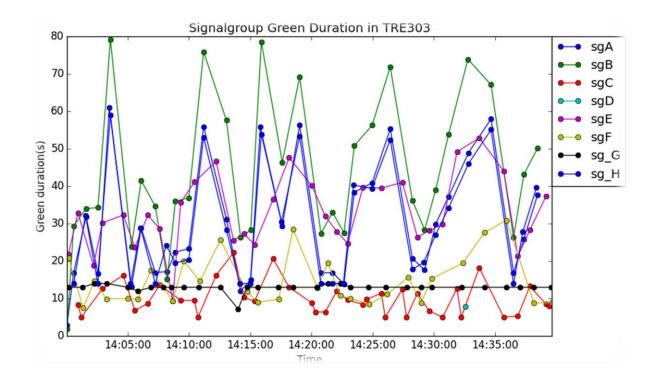
Explanation:

The function calculates green duration per cycle. Multi curve lines represent all the signals at the selected intersection. Two measures serve the performance, which are "Green duration" and "Percentage of green duration".

Green duration calculates green timing in seconds and another calculates the percentage of green per cycle or per interval.Green duration can be measured as exact timing in every green phase level or as cumulative timing in certain time interval. It depends on which time interval you select.

If you would like to check green timing in every phase, please select 'None' on time interval drop-down list; if you would like to check the timing in a wider time span, it had better to define a actual time interval.

Illustration:

The following image demonstrates the green duration in seconds in intersection TRE303 from 14:00 to 14:40 on 10th, July, 2015.

Signalgroup Green Duration in TRE303

Active green

Definition:

1. From general knowledge, it is defined that active green is the green timing from green start time to the time when last vehicle comes. Oppositely, passive green is the green timing after the last vehicle comes until the end of green.
2. From internal state of signal group (grint) from traffic signal controller, the active green timing is to the contrary of passive green timing during a green sequence. Passive green is green timing when the internal state of signal remains ''PASSIVE_GREEN''.

Explanation:

The function calculates active green length per cycle of the selected signal, comparing its timing of passive green based on the two different definitions. This stacked bar chart shows proportion of both active green and passive green. The x-axis is actual time of a day, and y axis is time duration in seconds.
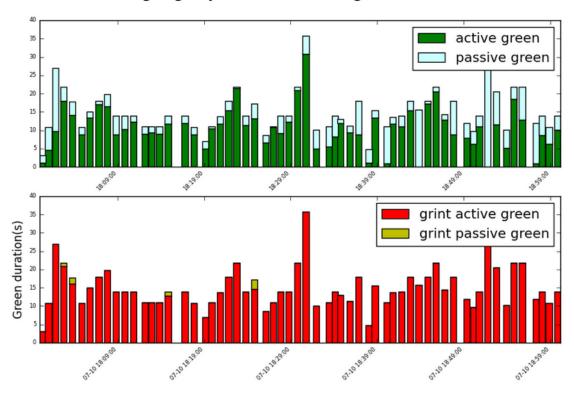
The upper chart is for definition-1, every bar represent length of an entire green sequence. During "active green" (dark green), there is request received by any associated detector. Conversely, during "passive green" (light blue), no detector is occupied at all.

The second chart is for definition-2, red part means grint-active green timing when signal state are included in active green state. And yellow part is for the time duration when the signal state is "PASSIVE_GREEN".

Illustration:

The following image shows the result of this measure for signal group B at intersection TRE309 in Tampere from 18:00 to 19:00 on 10th, July, 2015.

Signalgroup Green Duration: sg B in TRE309

Queue length

Definition:

At signalized intersections, queue lengths is the queue of vehicles at the end of red time (red -end) by lanes according to detectors.
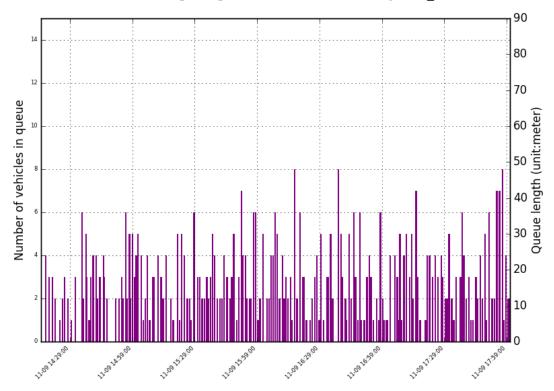
Explanation:

This measure calculates the length of queue in meters and the amount of vehicles forming the queue at the end of red time. Queue length could be presented with or without time interval. If you would like to see the value of every queue, please select "None" time interval. While selecting an actual interval, the average queue in interval will be shown in bar, and maximum queue in every period will be shown on a red curve line with * markers.
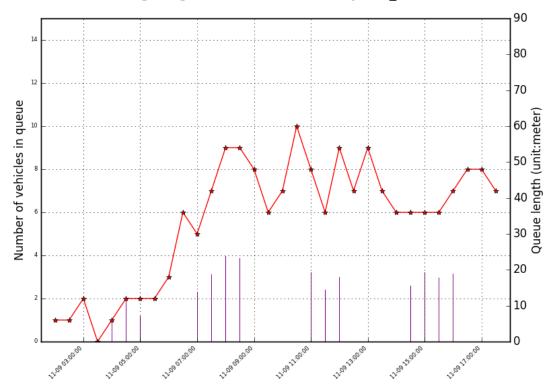
Illustration:

The following image shows the result of this measure via detector A60_2 under controlling of signal group A at intersection TRE209 in Tampere from 14:15 to 18:00 on 9th, November, 2015. The plot of this measure has dual y-axis. The left y-axis is number of vehicles and right y-axis is length of queue in meters, while x-axis is actual time of a day, indicating when the red time ends.

Queue length: sg A in TRE209 detected by A60_1

The next graph shows average queue and its maximum value in every 30 minutes at TRE209 in Tampere from 1:30 to 18:00 on 9th, November, 2015:

Queue length: sg A in TRE209 detected by A60_1 in 30 mins

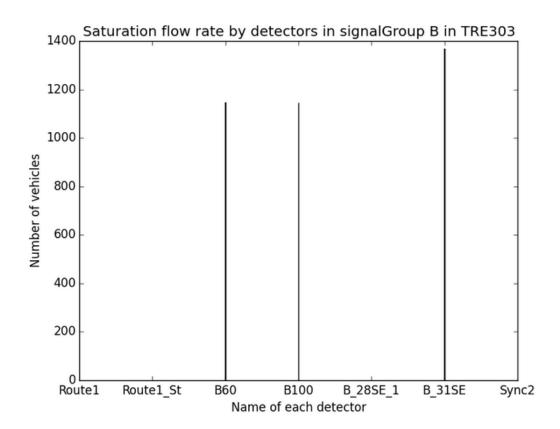## Saturation flow rate

Definition

The saturation flow rate crossing a signalized stop line is defined as the number of vehicles per hour that are able to cross the line if the signal remained green all of the time.

Explanation

It estimates the saturation flow rate for each lane controlled by the selected signal group at intersections using real data. The algorithm requires real data satisfy a high restrict with a relative long traffic flow. Hence, according to some selections, the result returns null because no data satisfy the calculation conditions. As to the plot, x-ticks are the names of detectors associated to the specified signal group, y-axis shows the number of vehicle.

Illustration

The following images illustrates saturation flow rate for lanes associated with signal group B at intersection TRE303 in Tampere.
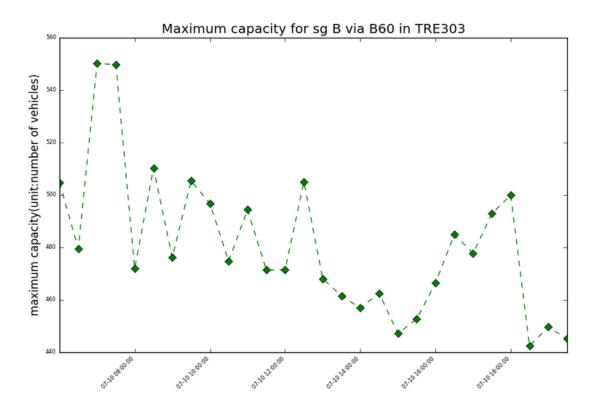

Maximum capacity

Definition

Maximum capacity is defined as the maximum number of vehicles can be reasonably expected to traverse a point or a uniform segment of a lane or roadway during a given time period under prevailing roadway, traffic control conditions.

Explanation

This measure calculates the total number of vehicles could pass over the specified detector during the sum of green timing in a certain time period (5 minutes, 10 minutes and 1 hour etc.). Maximum capacity is positive correlated with saturation flow rate on a lane and green time in a period of a signal group. As to the plot on this measure, the x-coordination of the green solid diamonds is actual starting time of every time interval, and its y-coordination indicates the number of vehicles. The dashed line passes through all diamonds by time to show the trend of maximum capacity.

Illustration

The following image shows maximum capacity every other 30-minute interval at detector B60 belonging to signal group B at intersection TRE303 in Tampere from 6:00 AM to 8:00 PM on 10th, July, 2015. The range of number of vehicles at y-axis is from 440 to 560.

Volume

Definition

Traffic volume is the procedure to determine mainly the volume of traffic moving on the roads at a particular point or a uniform segment during a particular time period.

Explanation

This measure counts the total number of vehicles could pass over the specified detector on a lane during a certain time period (5 minutes, 10 minutes and 1 hour etc.). Two function support this traffic performance measure: Volume by lanes and Volume by customized directions/detectors.
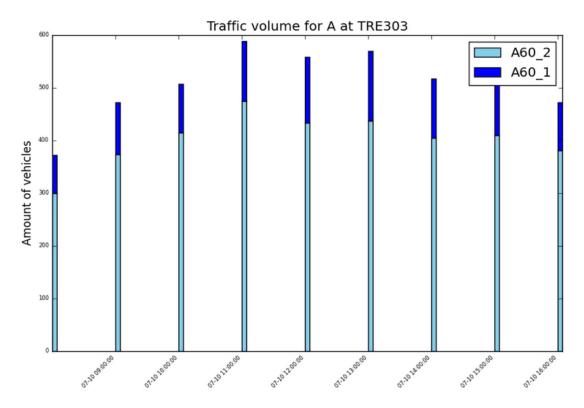
- **Volume by lanes**

If the selected detector to measure has paralleled detectors on other lanes, the function counts the volume on each lane separately and summate them as stacked bars. Thus, the traffic volume of each lane in a direction is shown directly with comparison among lanes. The x-coordination of bars is the starting time of intervals and y-axis indicates traffic volume.

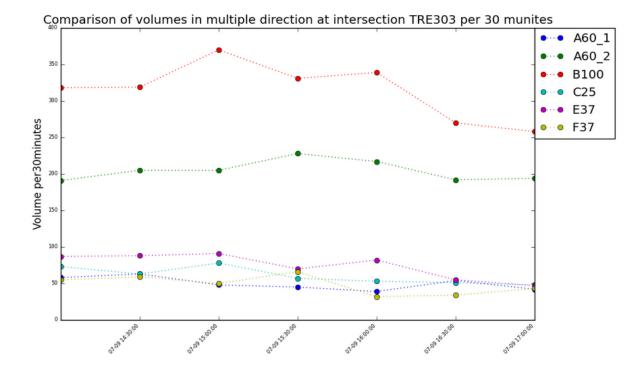- **Comparison of Volumes by customized directions(detectors)**

You can select more than one detectors on single or multiple directions using the multiple choice box of detectors to obtain the comparison of volumes in different places.

Illustration

The following image demonstrates that traffic volume per hour on lane-1 and lane-2 of the direction controlled by signal group A at the place with 60-meter distance to intersection stop line from 8:00 to 18:00 on 10th, July, 2015 at intersection TRE303 in Tampere.

The second image illustrates the visulized results based on multile choice of directions at TRE303 in 30 minutes interval from 14:00 to 18:00 on 9, July, 2015.

Comparison of volumes in multiple direction at intersection TRE303 per 30 munites
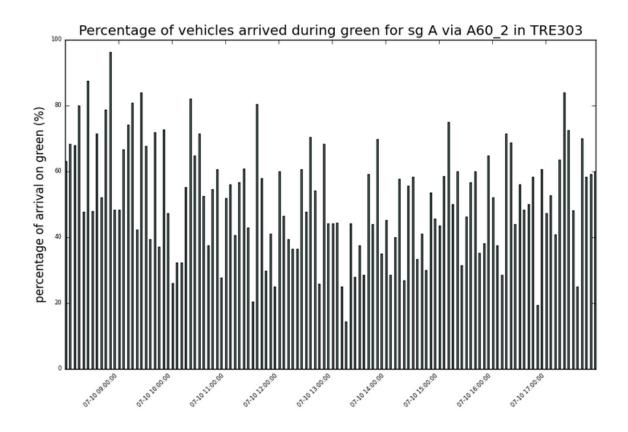
Arrival during green percent

Definition

Arrival during green is defined as vehicles arriving at intersection stop bar during green time.
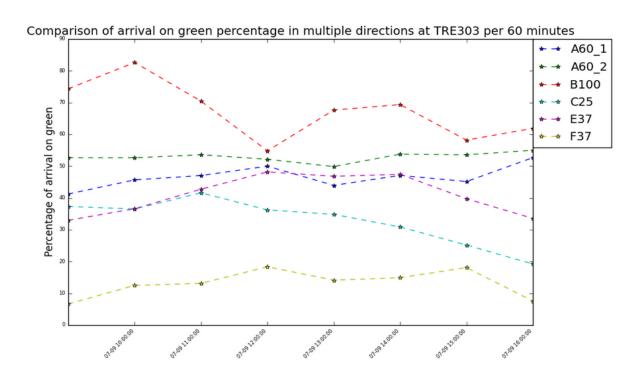
Explanation

The percentage of arrival during green is the value that number of vehicles arriving on green divides the traffic volume detected by a particular detector in a time period (5 minutes, 10 minutes and 1 hour etc.). It is a useful traffic performance to indicate the efficiency of traffic signal control and deduce the density of traffic flow. As to the plot on this measurement, the x-axis is the start date and time of every interval, and y-axis shows the percentage. Two functions support this feature: Arrival on green by single detector and Comparison of arrival on green by multiple detectors.

Illustration

The following image demonstrates that the percent of arrival during green changes over time via detector A60_2 at intersection TRE303 in Tampere from 6:00 to 18:00 on 10th, July. The time interval for counting vehicle is 5 minutes.

Percentage of vehicles arrived during green for sg A via A60_2 in TRE303

Comparison of arrival on green percentage in multiple directions at TRE303 per 60 minutes

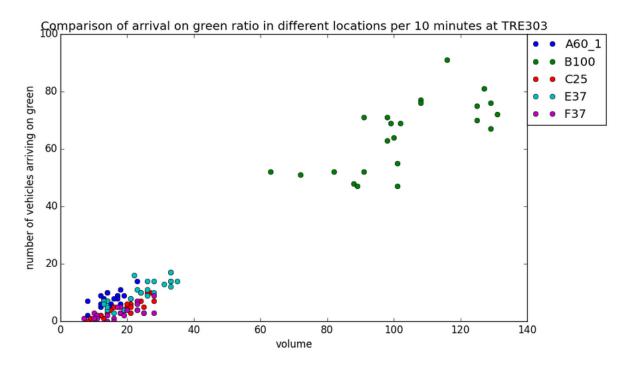## Comparison of arrival during green ratio

Definition

Arrival during green is defined as vehicles arriving at intersection stop bar during green time. The ratio is another measure from different dimensions related to arrival during green.

Explanation

The ratio of arrival during green is used to mine the relation between volume and arrival on green performance without time factor. As to the plot on this measurement, the x-axis is number of volume and y-axis shows the number of vehicle on green. The function can compare the performance in different directions. The color of dots indicate the value in different place.

Illustration

The following image is the comparison of arrival during green ratio from different places by 10 minutes interval From 14:00 to 18:00 on 10, July, 2015.

Last, original data for each plot can be obtained by downloading and viewing from the application, which we don't mention in this document.