

@ GSDI - 2016/12/01

Profiling Topological Characteristics of Street Network to Identify Urban Traffic Congestion in Taipei City

Session: S05504b-3

Smart Transportation - *SDI for the Smart Homeland*

room: 504b time: 13:30-15:00

Authors: Tzai-Hung Wen, Wei-Chien-Benny Chin

Benny Chin, PhD student

NTU Geography

wcchin.88@gmail.com

about this talk

- the data: detecting urban mobility
- the analysis: modelling movements on urban street system
- the visualization: seeing vehicle movement in urban street system

detecting urban mobility

- source of data -- Taipei City Open Data Platform
- getting the data

The Taipei City open data platform

link: data.taipei

Public transportation system related:

- bus service
- mass rapid transit (MRT)
- bicycle sharing system (Youbike)

Private transportation related:

- streets' status (vehicle detector, VD)
- changeable-message-sign (CMS)
- parking lot information

The open data portal

link: [a list of the Taipei City open data API](#)

- The real-time data are updated in every 5 minutes.
- The real-time data are all in xml/json (gzipped format).
- The non-real-time data (e.g. MRT ridership data) are in ods/csv format.

Tools for interfacing the open data API

- getting data (python)
- preparing table and push to database and csv (python-pandas)
- storing data (postgresql)
- operating system (lubuntu)
- remote backup (openmediavault+rsync)

Focus on the four moving modes

Dataset	format	source	time resolution
Street status (VD)	gzipped XML	http://data.taipei/tisv/VDDATA	every 5 minutes
Bus Location	gzipped JSON	http://data.taipei/bus/BUSDATA	every minute
Youbike station status	gzipped JSON	http://data.taipei/youbike	every 1 minutes
MRT station riderships	csv	http://data.taipei/opendata/datalist/datasetMeta?oid=1d71c478-205f-42c5-8386-35f86d74fdd1	every hour

Street status (Vehicle Detector)

No.	column	data type	info.
1	timestamp	bigint	time of record (unix timestamp)
2	vdid	text	ID code of VD
3	LaneNo	integer	lane number of the street
4	AvgSpeed	numeric	average speed
5	Lvolume	integer	volume of large vehicle
6	Mvolume	integer	volume of medium vehicle
7	Svolume	integer	volume of small vehicle
8	Volume	integer	total volume
9	datetime2	timestamp	time of record ('%Y-%m-%d %H:%M:%S')

Bus location

No.	column	data type	info.
1	timestamp	bigint	time of record (unix timestamp)
2	busID	text	bus plate no.
3	carID	integer	bus id
4	routelD	integer	route id
5	goBack	text	outbound/inbound
6	dutyStatus	text	In-service/not-in-service
7	longitude	double precision	current location (longitude)
8	latitude	double precision	current location (latitude)
9	speed	double precision	current speed
10	azimuth	double precision	Current heading (azimuth)
11	datetime2	timestamp	time of record ('%Y-%m-%d %H:%M:%S')

Youbike station status

No.	column	data type	info.
1	timestamp	bigint	time of record (unix timestamp)
2	sno	text	station ID
3	tot	smallint	total docks
4	bemp	smallint	available docks
5	sbi	smallint	available bicycles
6	act	boolean	in service
7	datetime2	timestamp	time of record ('%Y-%m-%d %H:%M:%S')

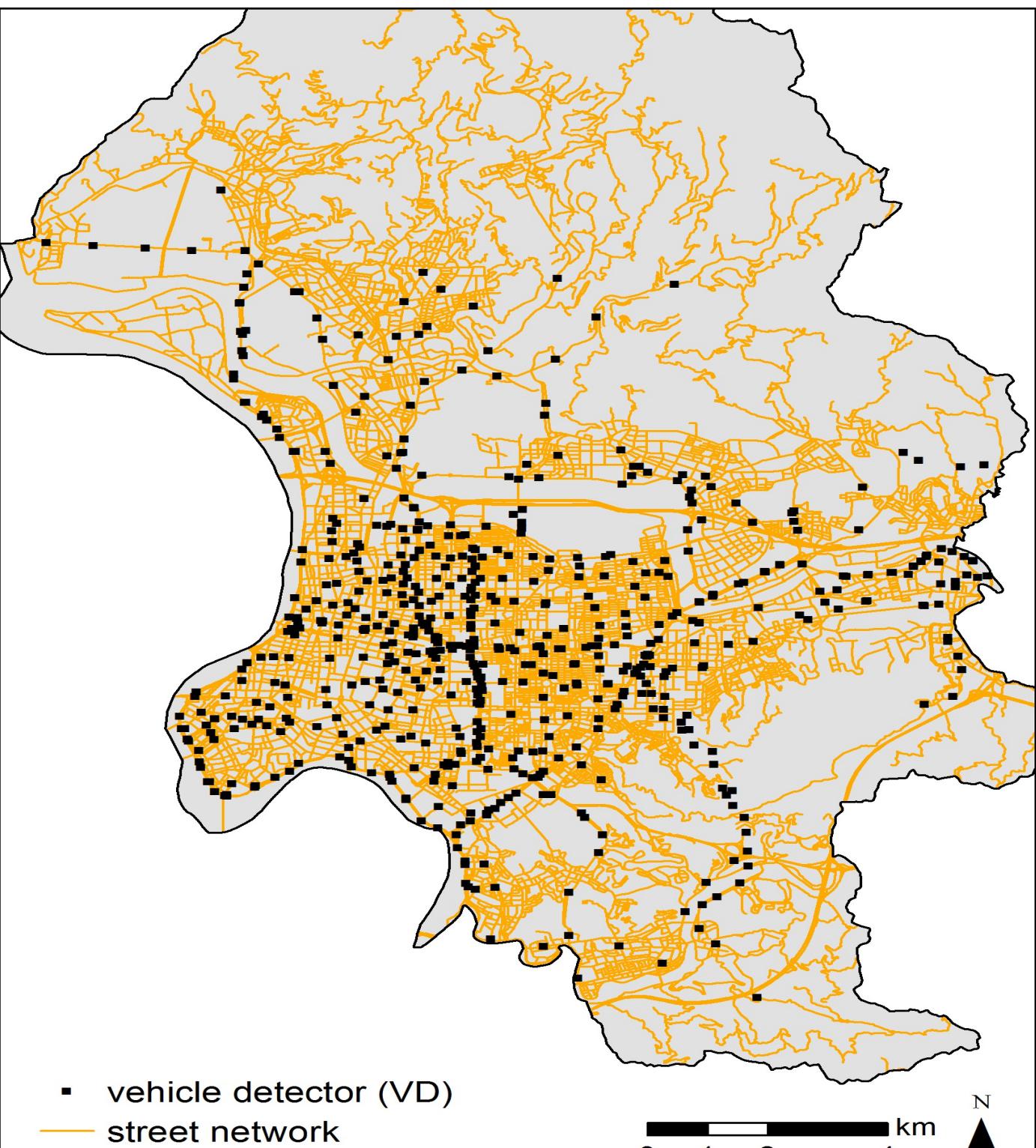
MRT station riderships

No.	column	data type	info.
1	date	timestamp	time of record ('%Y-%m-%d')
2	hour	smallint	hour of record
3	station	text	station name
4	leave	bigint	ridership (leaving)
5	enter	bigint	ridership (entering)

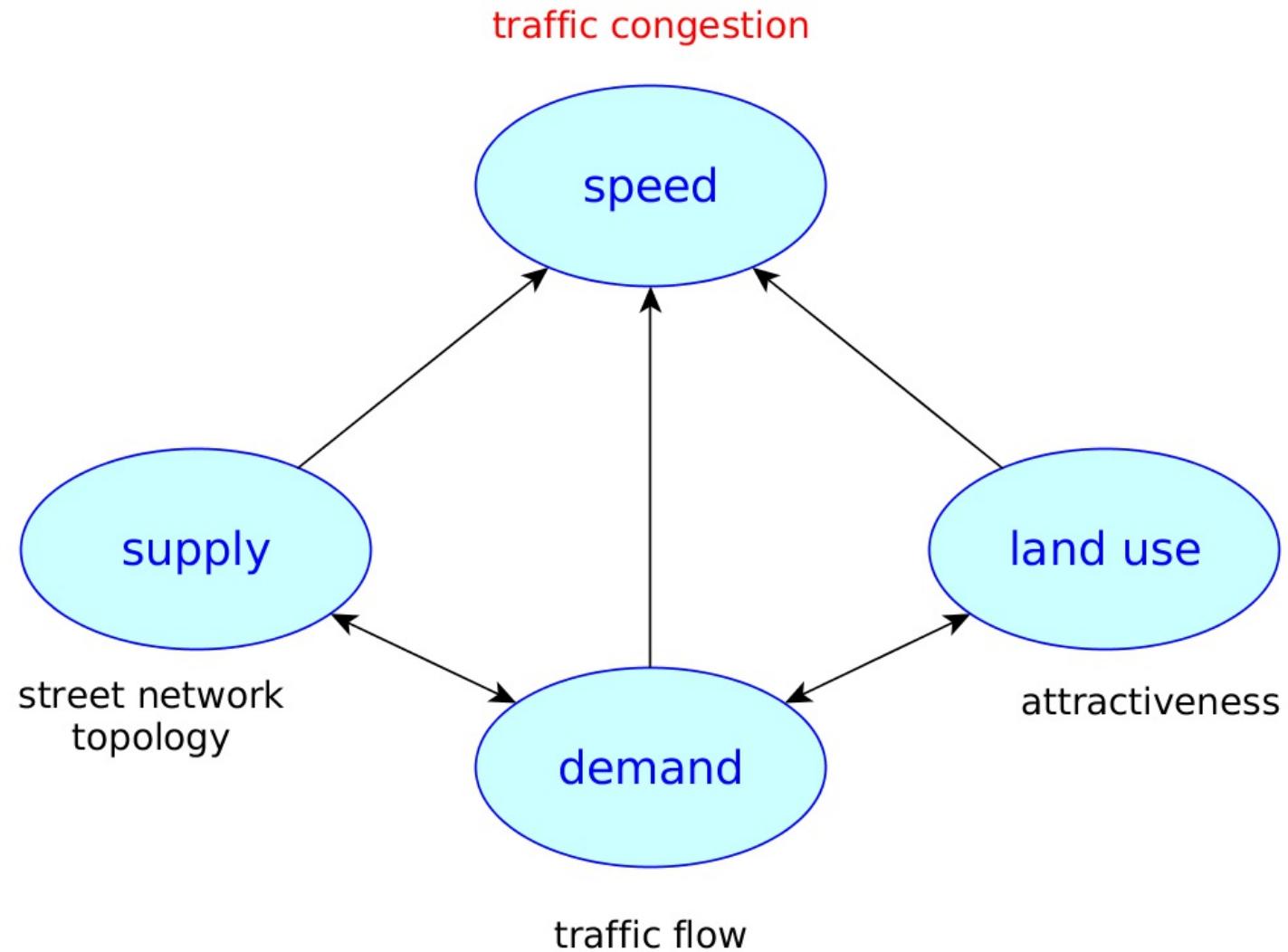
modelling movements on street system

- the movements
- the congestions

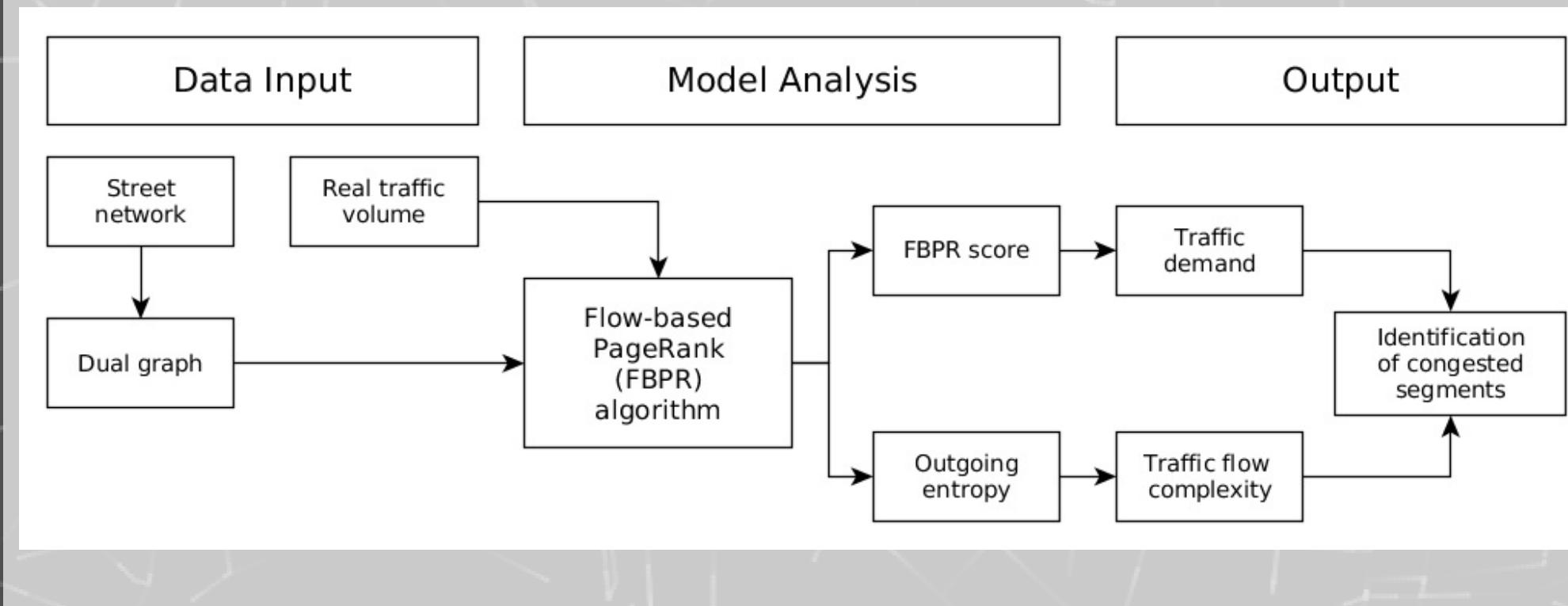
Locations of Vehicle Detector (VD)



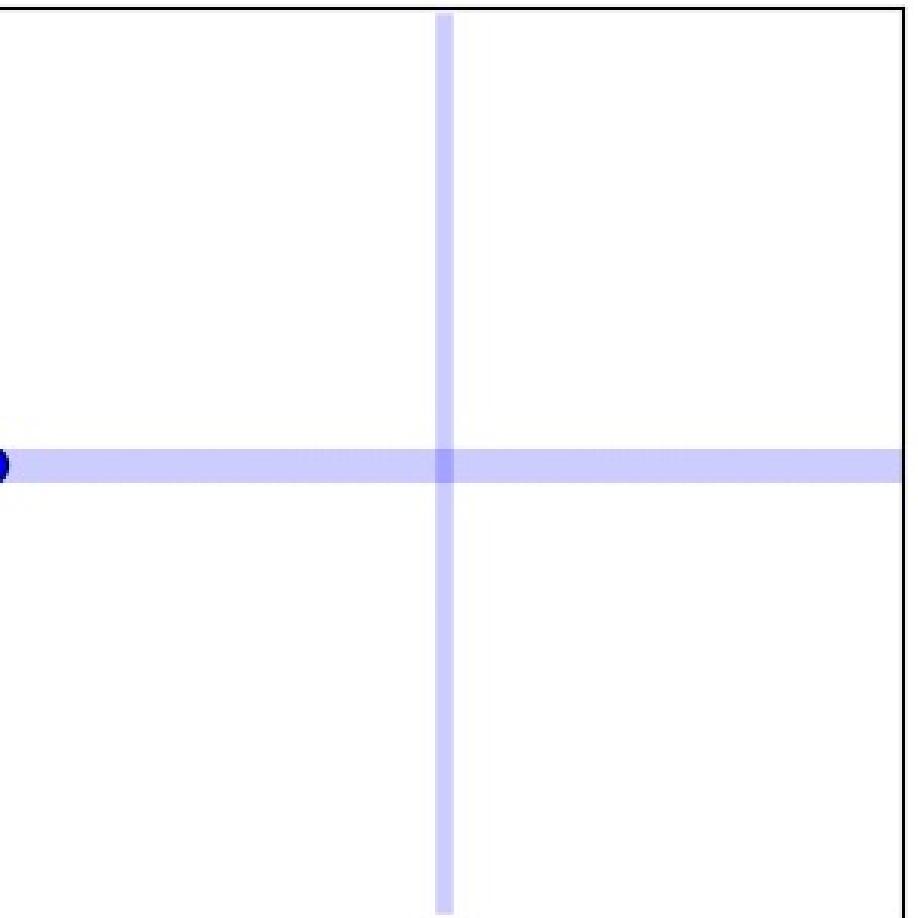
modelling vehicle movements



study framework



A random walk model





A random walk model on Taipei City street system <https://vimeo.com/168713881>

Google's PageRank and traffic flow

PageRank is an algorithm for identifying where people would gather under the movement within a networked space.

It uses a random move model (random surfer), and analyses the hyperlink connectivity, namely the referencing network to identify the key webpages

basic form of PageRank algorithm

$$PR_t(i) = \sum_{j \in IN(i)} PR_{t-1}(j) \times \frac{1}{outdeg(j)}$$

$IN(i)$: incoming node set of i ;

$outdeg(j)$: the out-degree of j .

FBPR equation

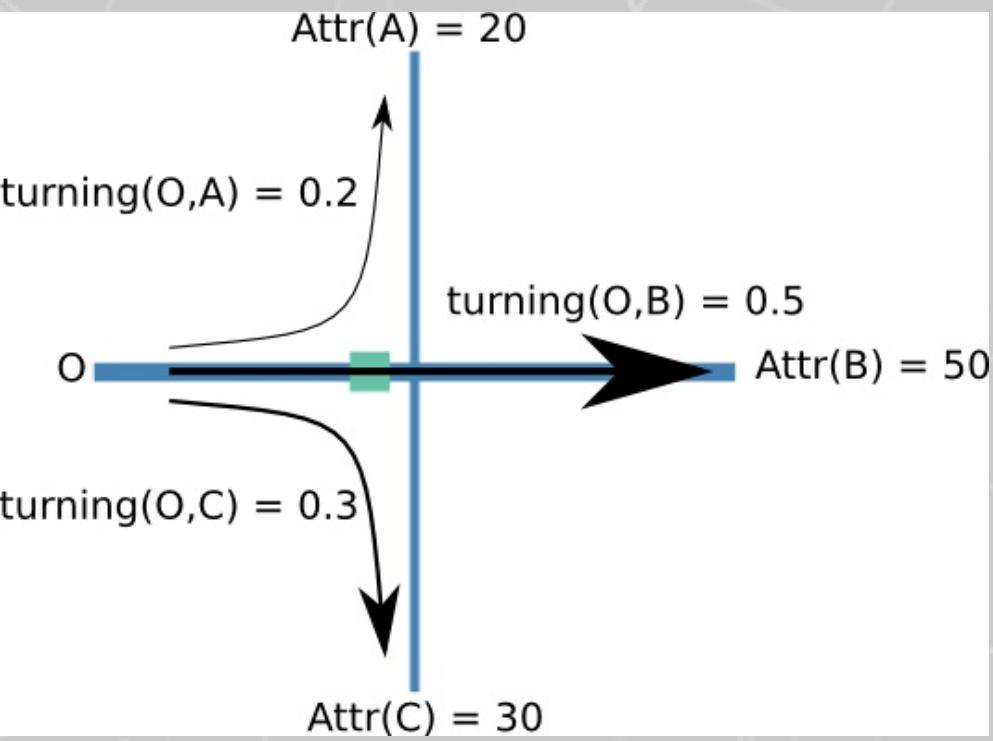
$$FBPR_t(i) = \sum_{j \in IN(i)} FBPR_{t-1}(j) \times turning(j, i)$$

$$turning(j, i) = \frac{Attr(i)}{\sum_{p \in OUT(j)} Attr(p)}$$

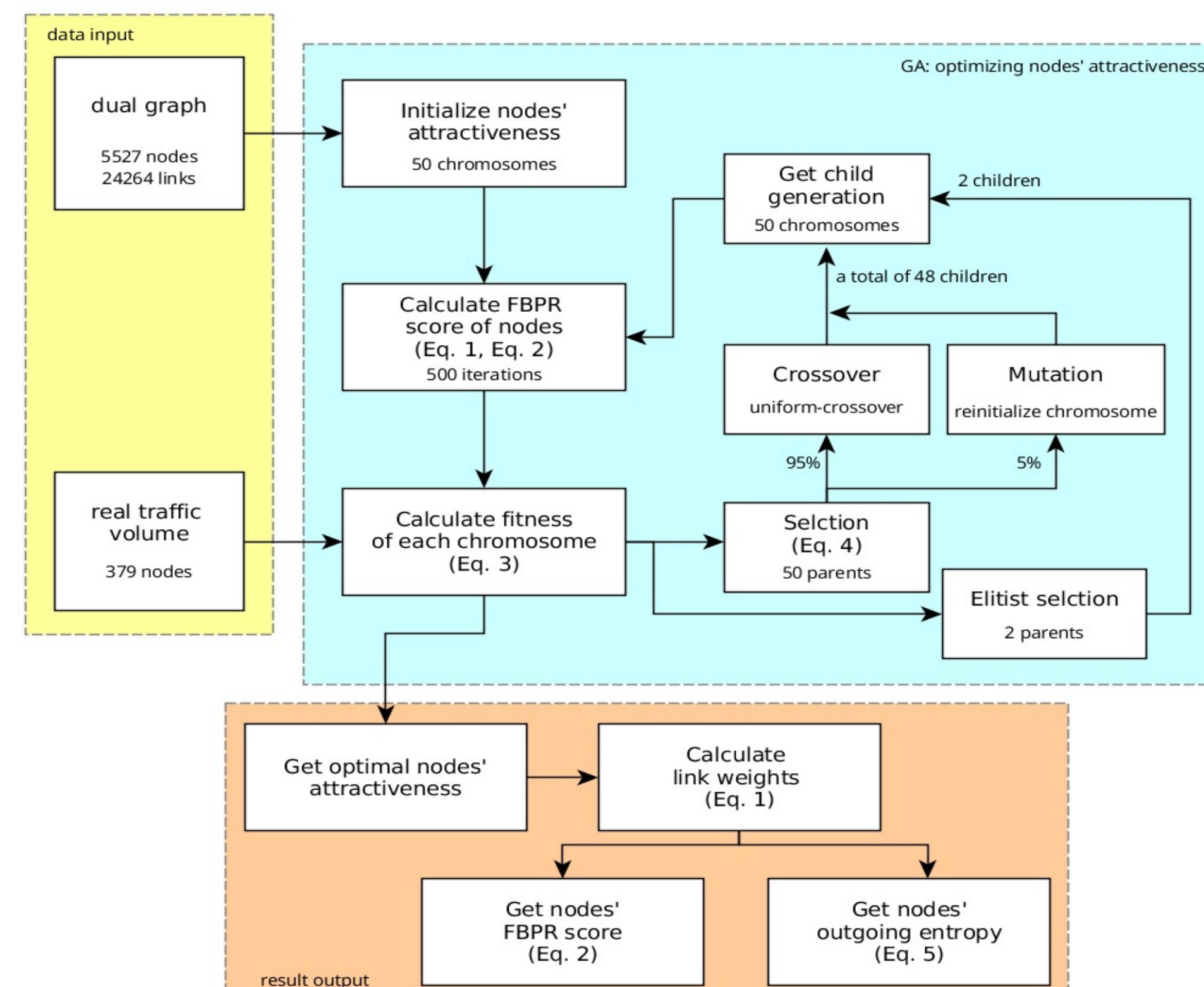
$Attr(k)$: attractiveness of node k ;

$out(j)$: outgoing node set of j .

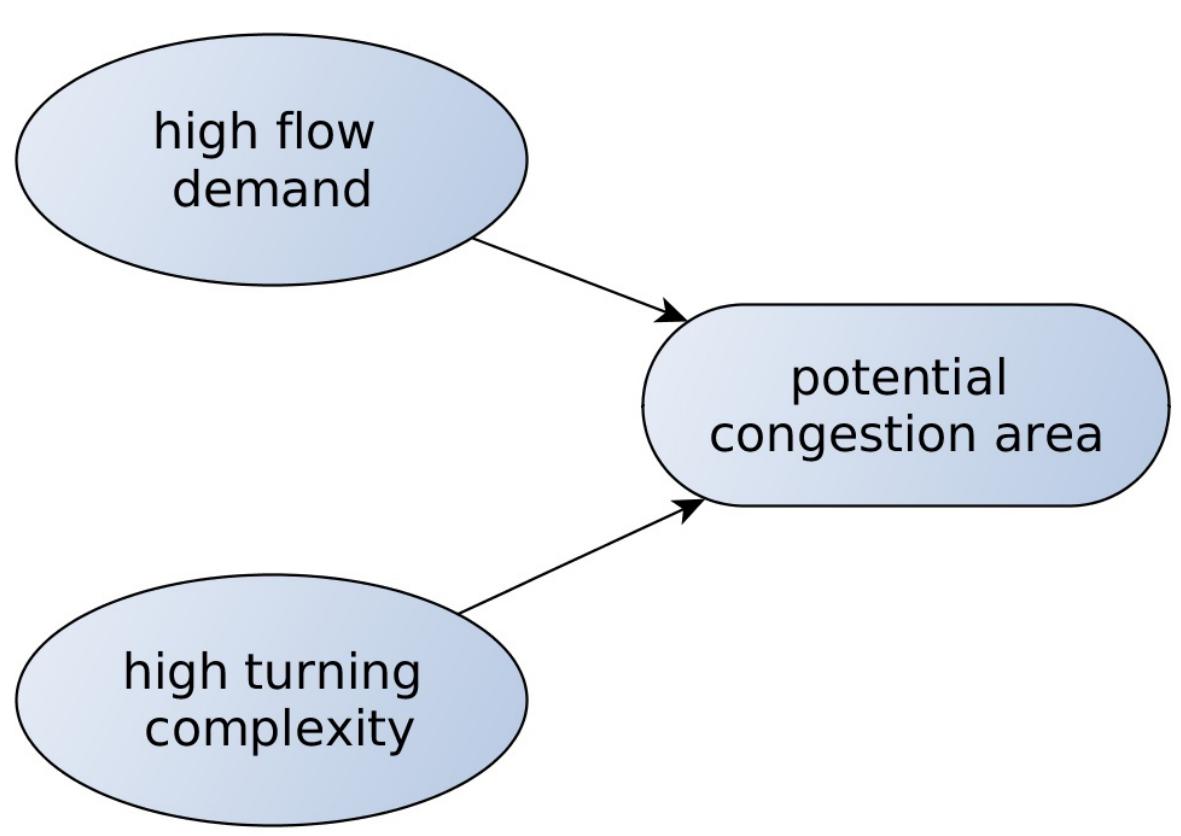
the idea



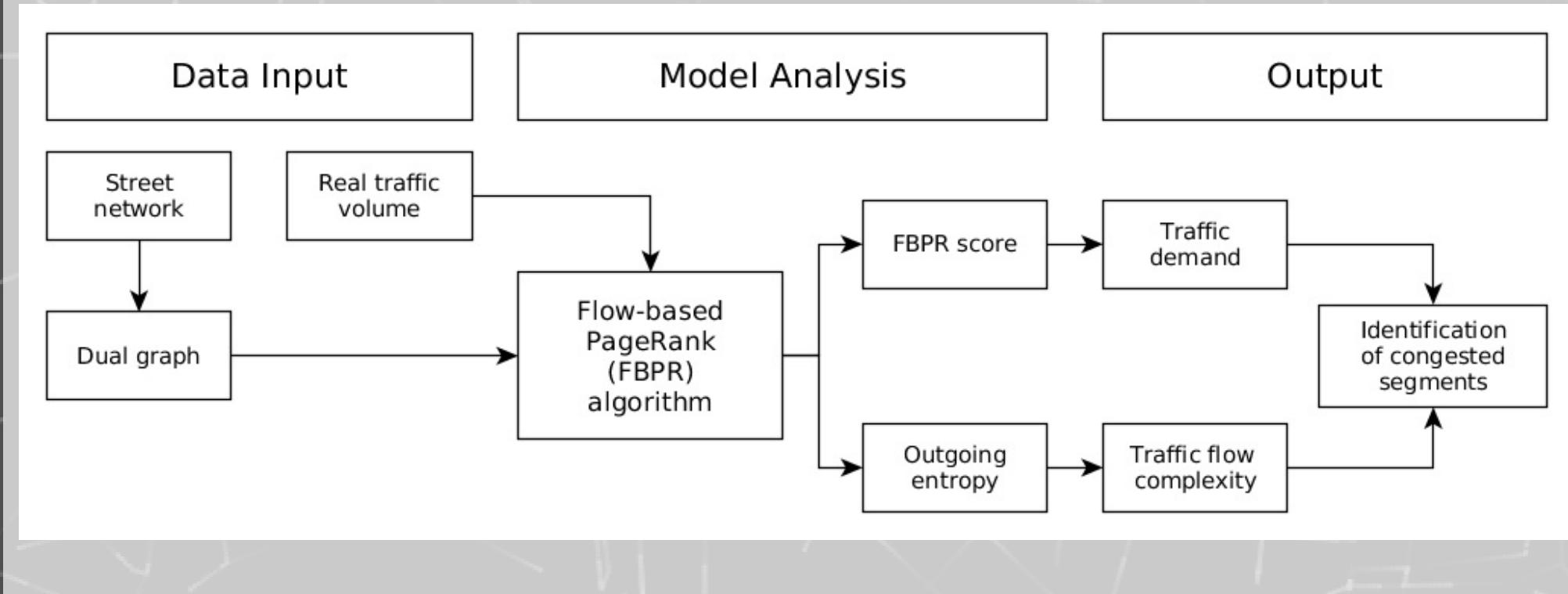
the FBPR algorithm



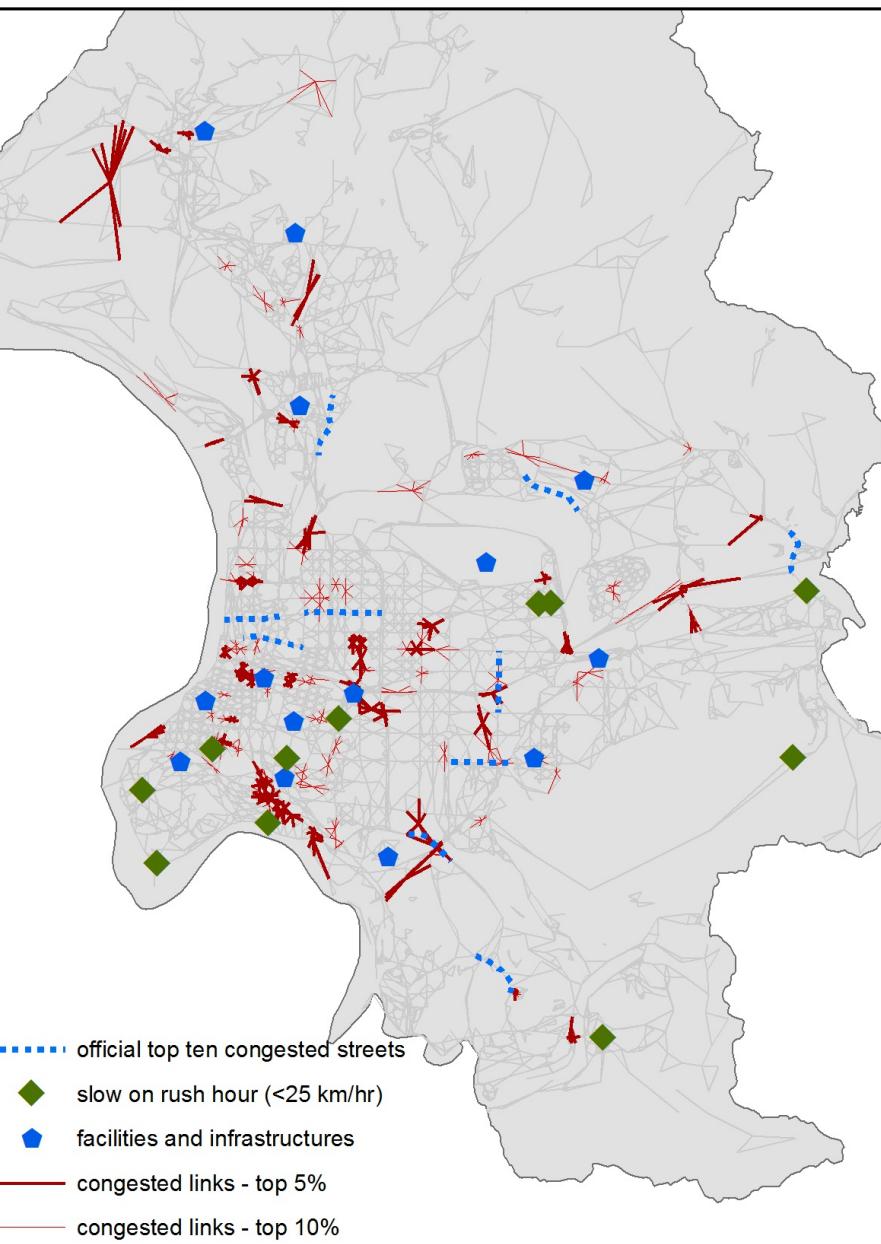
put together the result to find congestions



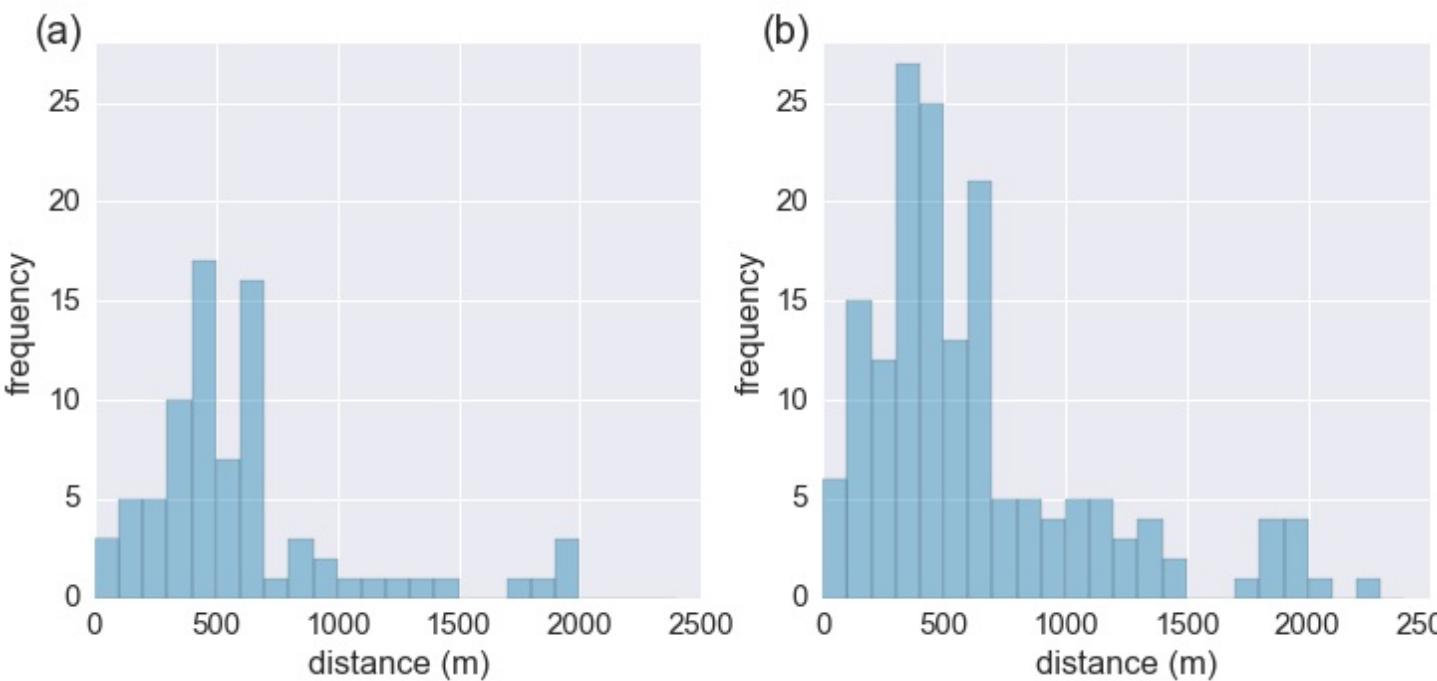
study framework



congested segments locations



distances from congested segments to the important facilities





seeing vehicle movement and congestion in urban street system <https://vimeo.com/168714357>

next...

- modelling the speed of streets by integrating the bus and VD data
- understanding the relationships between Youbike and MRT



a day of bus movement in one minute <https://vimeo.com/174331241>

Thanks for listening!

Questions or Comments?

Benny Chin,
Department of Geography, National Taiwan University.
email: wcchin.88@gmail.com