GeoVisual Analytics for the Exploration of Complex Movement Patterns on Arterial Roads

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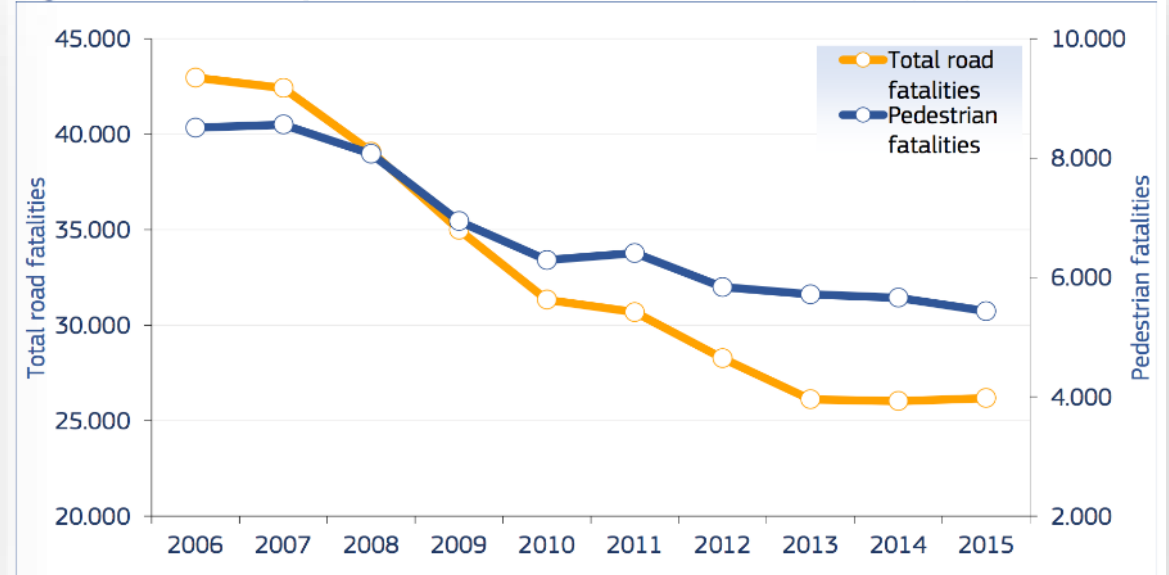
State of the problem

European Commission Report

In 2015, 5.435 pedestrians were killed in road accidents in the EU, which is 21% of all road fatalities.

Source: https://ec.europa.eu/transport/road_safety/users/pedestrians_en

Figure 1: Number of pedestrian fatalities and all road fatalities, EU, 2006-2015

Source: CARE database, data available in May 2017

State of the problem

European Commission Report

The annual data of pedestrian fatalities in the EU

The number of pedestrians who were killed in road accidents decreased by 36% from 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
BE	122	104	99	101	106	113	104	99	106	92
BG	278	278	278	198	198	198	198	198	198	198
CZ	202	232	238	176	168	176	163	162	130	150
DK	60	68	58	52	44	33	31	33	22	27
DE	711	695	653	591	476	614	527	561	527	545
EE	64	38	41	23	14	26	29	23	26	24
IE	72	81	49	40	44	47	29	31	31	31
EL	267	255	248	202	179	223	170	151	125	128
ES	614	591	502	470	471	380	370	371	336	367
FR	535	561	548	496	485	519	489	465	499	466
HR	124	124	136	103	105	71	72	69	73	61
IT	758	627	646	667	621	589	576	551	578	602
CY	19	17	16	9	13	13	10	8	10	16
LV	153	158	105	82	79	60	62	70	71	63
LT								96	109	81
LU	10	7	6	12	1	6	6	5	3	7
HU	296	288	251	186	192	124	156	147	152	149
MT	4	3	1	4	2	2	2	2	2	2
NL	66	86	56	63	62	65	64	51	50	60
AT	110	108	102	101	98	87	81	82	71	84
PL	1802	1951	1882	1467	1236	1408	1157	1140	1116	915
PT	156	156	155	148	195	199	159	144	145	146
RO	1034	1113	1067	1015	868	747	728	726	697	649
SI	36	32	39	24	26	21	19	20	14	16
SK	214	217	204	113	126	126	126	126	126	126
FI	49	48	53	30	35	41	29	34	36	32
SE	55	58	45	44	31	53	50	42	52	52
UK	697	663	591	524	415	466	429	405	464	427

Source: https://ec.europa.eu/transport/road_safety/users/pedestrians_en

State of the problem

**European Commission Report** Percentage of pedestrian fatalities of all road fatalities in the EU

The percentage of pedestrian fatalities of all road fatalities differs widely across Europe

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
BE	11	10	10	11	13	13	14	14	15	13
BG			26	22						
CZ	19	19	22	20	21	23	22	25	19	20
DK	20	17	14	17	17	15	19	17	12	15
DE	14	14	15	14	13	15	15	17	16	16
EE	31	19	31	23	18	26	33	28	33	36
IE	20	24	18	17	21	25	18	16	-	-
EL	16	16	16	14	14	20	17	17	16	16
ES	15	15	16	17	19	18	19	22	20	22
FR	11	12	13	12	12	13	13	14	15	13
HR		20	20	19	25	17	18	19	24	18
IT	13	12	14	16	15	15	15	16	17	18
CY	22	19	20	13	22	18	20	18	22	28
LV	38	38	33	32	36	34	35	39	33	34
LT								38	41	33
LU	23	15	17	25	3	18	18	11	9	19
HU	23	23	25	23	26	19	26	25	24	23
MT	36	25	11	27	15					
NL	9	12	8	10	12	12	11	11	11	11
AT	15	16	15	16	18	17	15	18	17	18
PL	34	35	35	32	32	34	32	34	35	31
PT	16	16	18	18	21	22	22	23	23	25
RO	40	40	35	36	37	37	36	39	38	34
SI	14	11	18	14	19	15	15	16	13	13
SK	35	33	34	29	34					
FI	15	13	15	11	13	14	11	13	16	12
SE	12	12	11	12	12	17	18	16	19	
UK	21	22	22	22	22	24	24	23	25	24

Source: https://ec.europa.eu/transport/road_safety/users/pedestrians_en

User interest

- ## To observe and understand the use of the arterial roads by vehicle drivers and pedestrians

  - Where, when and how often do Vulnerable Road Users (VRU) cross the streets by neglecting traffic rules on arterial roads.

  - Do vehicle drivers obey speed limit rules on the arterial roads.

Arterial roads

Use case studies

☐ Aalborg
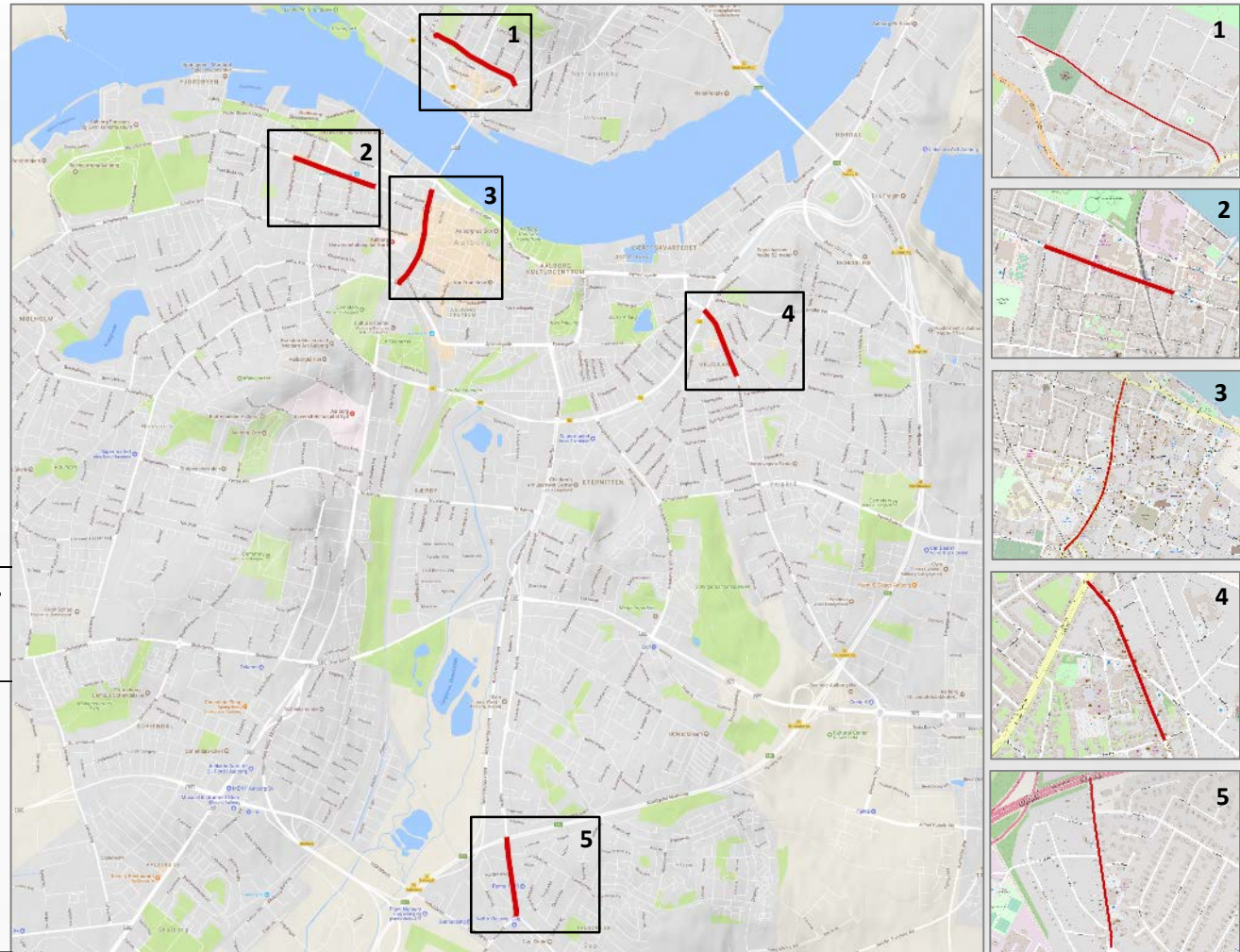
	Street name	Speed limit (km/h)	Length of the street segment (m)	Number of traffic controlling elements
1	Sankt Peders Gade	30	647,11	7
2	Kastetvej	50	569,77	2
3	Vesterbo	50	680,11	7
4	Hadsundvej	50	480,15	1
5	Gugvej	60	440,11	–

AALBORG UNIVERSITY

Floating car dataset

Data characteristics

FCD was collected:

- 3 years (2012, 2013, 2014)

- 425 cars

• **Trip ID**	a unique number that is connected to each trip. A trip is defined if there is more than 5 minutes from the prior data registration. There are no connections between trip number, time nor car.
• **Time**	counted as consecutive seconds from initiation of each trip
• **Position X, Y**	a 6-digit number, ETRS89 UTM32N.
• **Direction**	a 3-digit number, which describes the movement direction (360 degree) of the vehicle.
• **Speed**	measured in **meters/second** based on the GNSS registrations.
• …..	…….

Data limitation – due to the anonymisation certain information is removed from the database

Floating car dataset

Data processing – MapMatching

Mapillary's freely available map-matching algorithm based on PostgreSQL, Postgis and pgRouting was adapted

Visual Solution
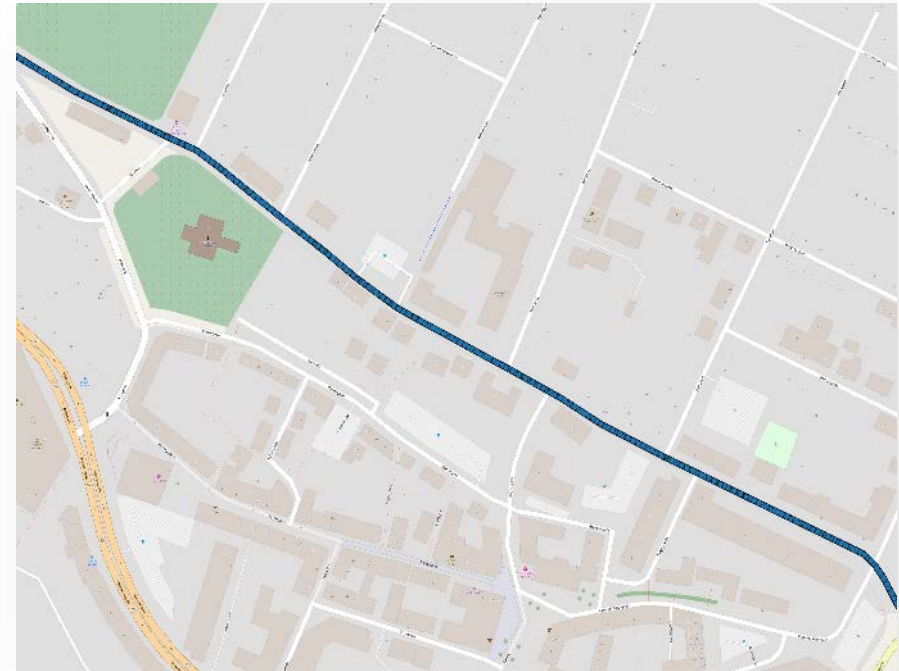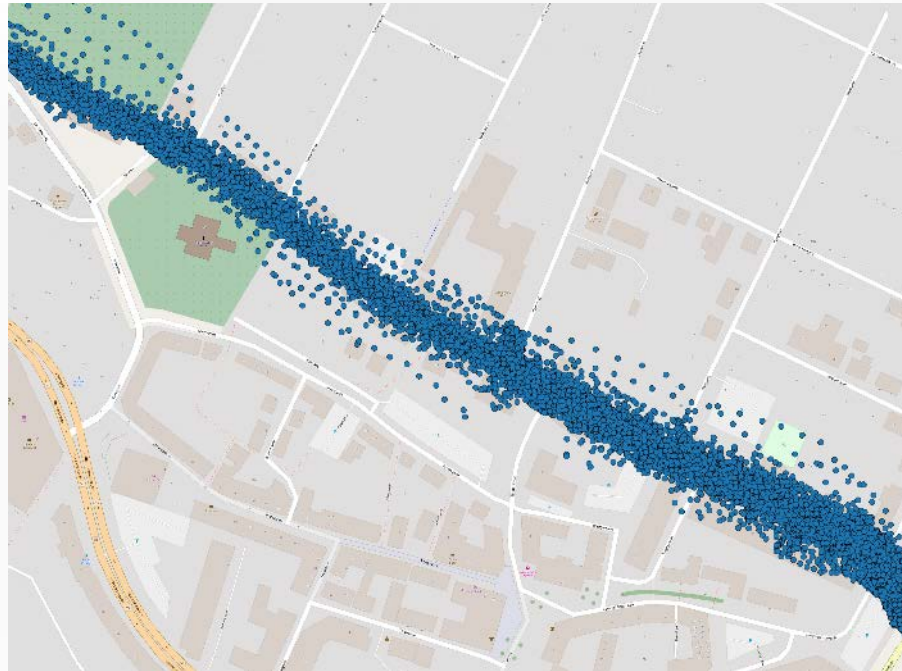
Develop street profile graph to reveal high-low movement speed on arterial roads

Pixel Based Approach – Pixel Bar Charts
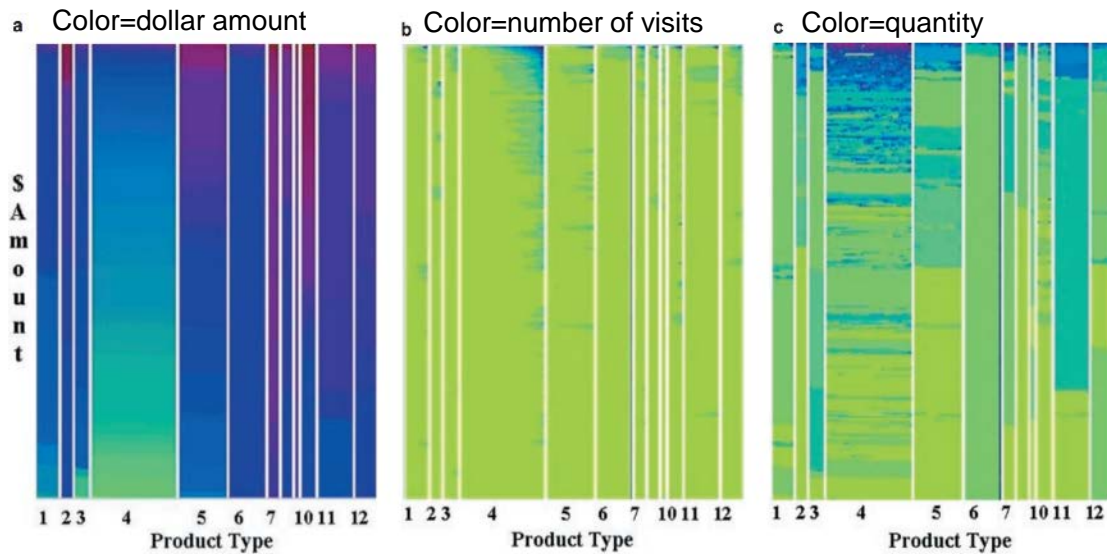
Source: Keim, et al (2002)

Stacking based approach – trajectory wall
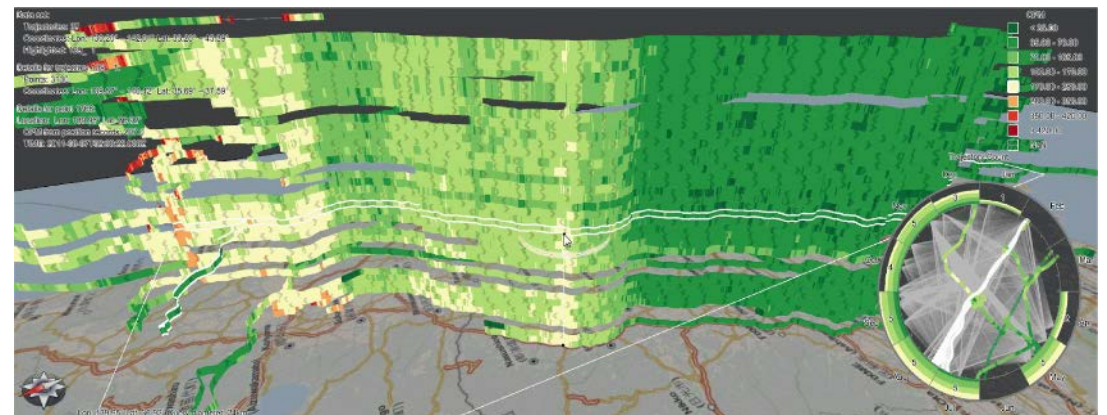
Source: Tominski, et al (2012)

Results

Sankt Peders Gade – movement distribut
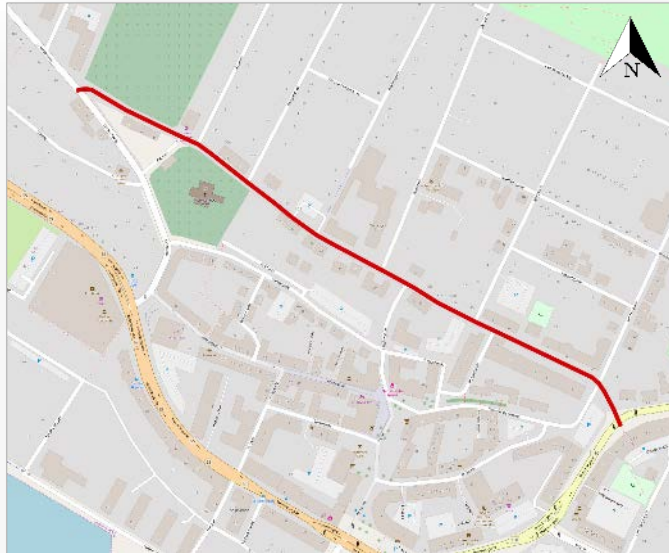
Speed limit: 30 km/h
Length: 647,11 m
Speed controling elements: 7

Results

Sankt Peders Gade – street profile

Speed limit – 30 km/h

Sankt Peders Gade – 647.11m, North-West

Sankt Peders Gade – 647.11m, South-East

Time

Time
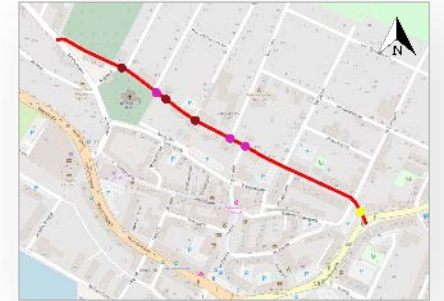
● Zebra crossings

● Traffic signal & pedestrian crossings

● Speed bumps

Results

Kastetvej – street profile
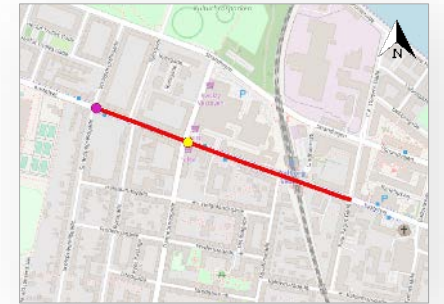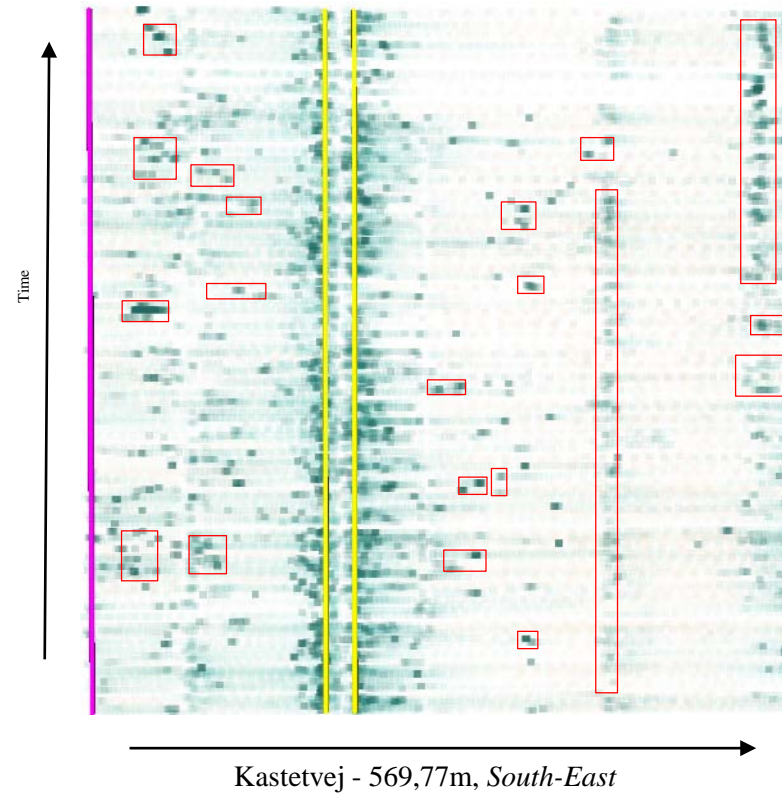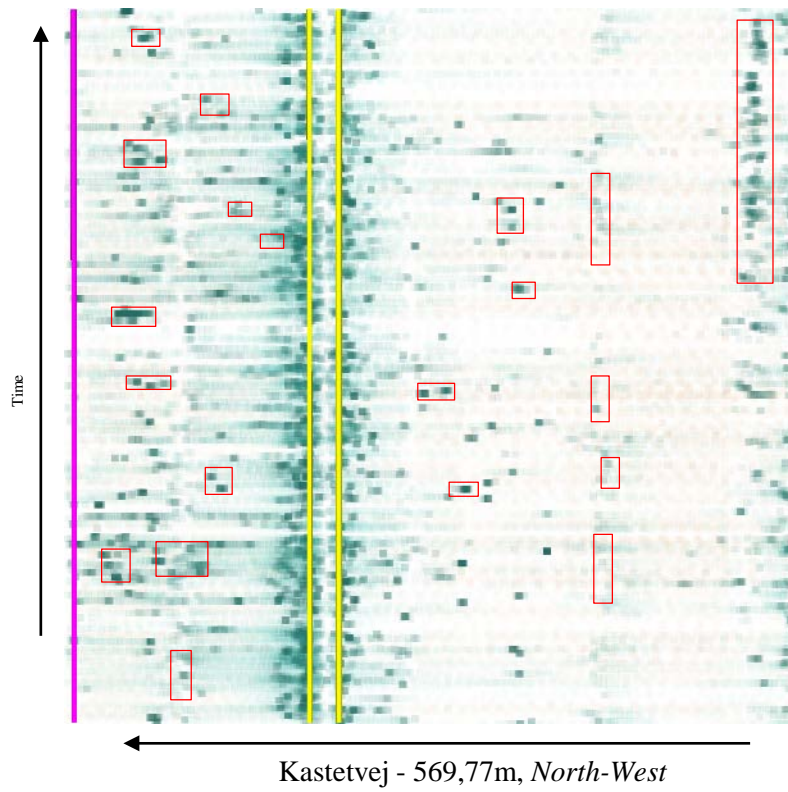
Speed limit – 50 km/h

🟣 Zebra crossings

🟡 Traffic signal & pedestrian crossings

Kastetvej - 569,77m, *North-West*

Kastetvej - 569,77m, *South-East*

Results

Gugvej – street profile

Speed limit – 60 km/h

Gugvej – 440.11m, North-West

Gugvej – 440.11m, South-East

Time

Time

Conclusions
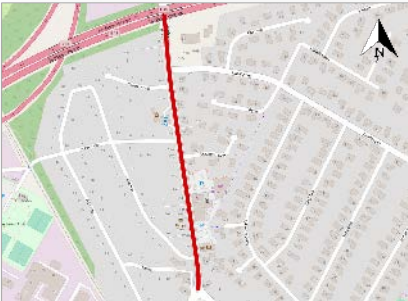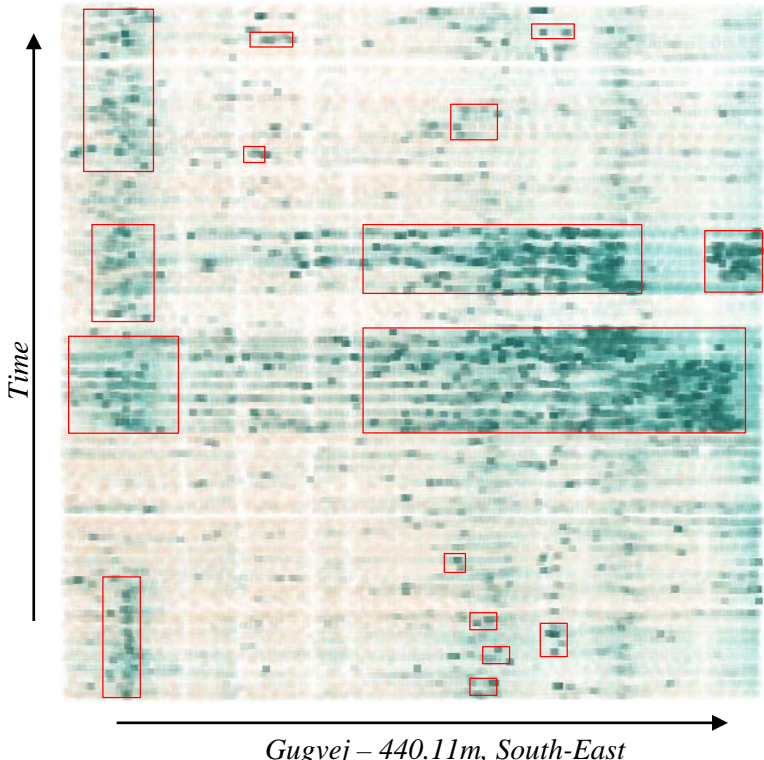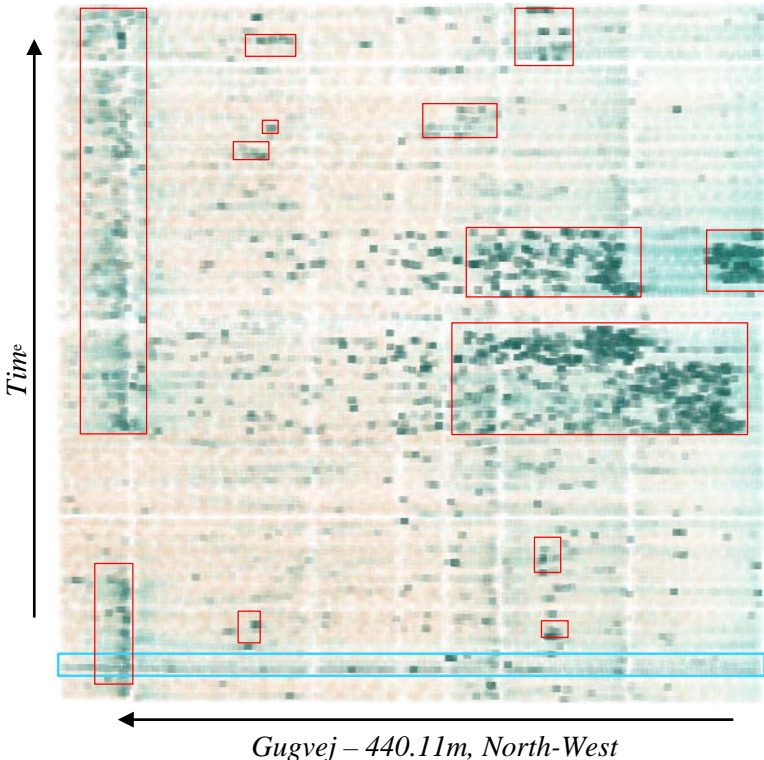
- The proposed visual solution space revealed detailed patterns of speed variations on arterial roads. The visual exploration allowed to answer the questions of the traffic engineers using a multiple visual representations

- Using FCD to investigate speed-flow and congestion patterns on road network is a prevailing way in traffic and transportation domain, however it can be challenging. To make sense of FCD suitable visual representations and tools for the analysis are needed

- The knowledge derived may help scientists in the traffic domain to gain an extensive understanding on movement patterns in traffic networks. Revealed movement patterns can be used by domain experts in better planning and design of road network.

Thank you!