Pedestrian crossing behaviour in signalized crossings in middle size cities in Greece

UNIVERSITY OF THESSALY

Department of Civil Engineering

Pedion Areos, Volos, Greece

Nikolaos Eliou

Associate Professor

neliou@uth.gr

Athanasios Galanis

Dr Transportation Engineer

atgalanis@uth.gr

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Introduction

- Pedestrians cross the streets without noticing the incoming traffic, usually because their attention is distracted.
- Pedestrians usually miscalculate the traffic gaps.
- Pedestrians walk across the street, usually due to lack of space on sidewalks.
- Pedestrians cross the streets in midblock location or out of designated crosswalks.
- Pedestrians do not follow the indications of the traffic lights.

Objective

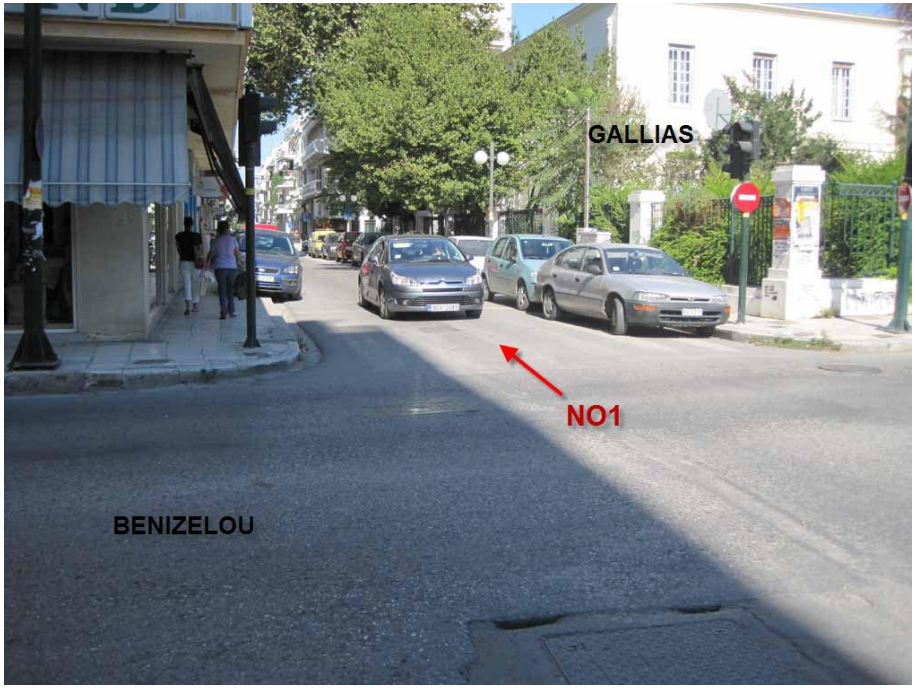
- Examination of the pedestrian crossing behaviour in 12 signalized crosswalks across main and collector urban arterials in the center of the city Volos, Greece.
- Collection of video data and analysis with a new software: Captiv L2100.
- Pedestrians were categorized according to their sex and age:
  - Sex (men, women).
  - Age (<20, 20-50, >50 years old).
  - Traffic light (green, red).
- Main questions of the study:
  - How much is the pedestrian crossing time.
  - How much is the pedestrian crossing speed.
  - Do pedestrians cross the street with red or green traffic light.

Study area: City of Volos

- Medium scale Greek city
- Thessaly, central Greece
- Important harbor
- Population of 120.000 citizens

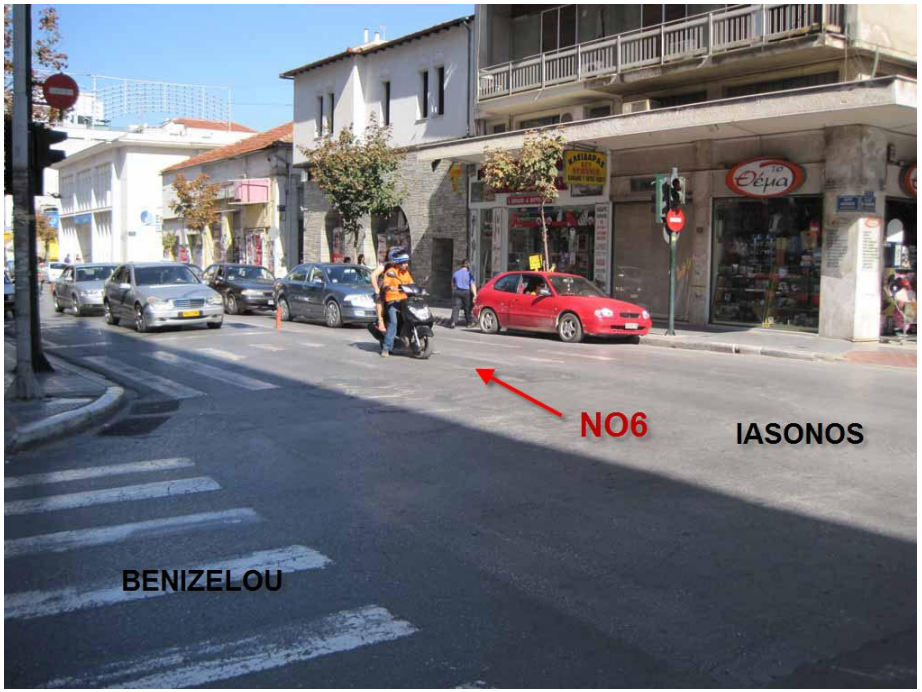
Study area: Center of the city

Crosswalks No1 and No2

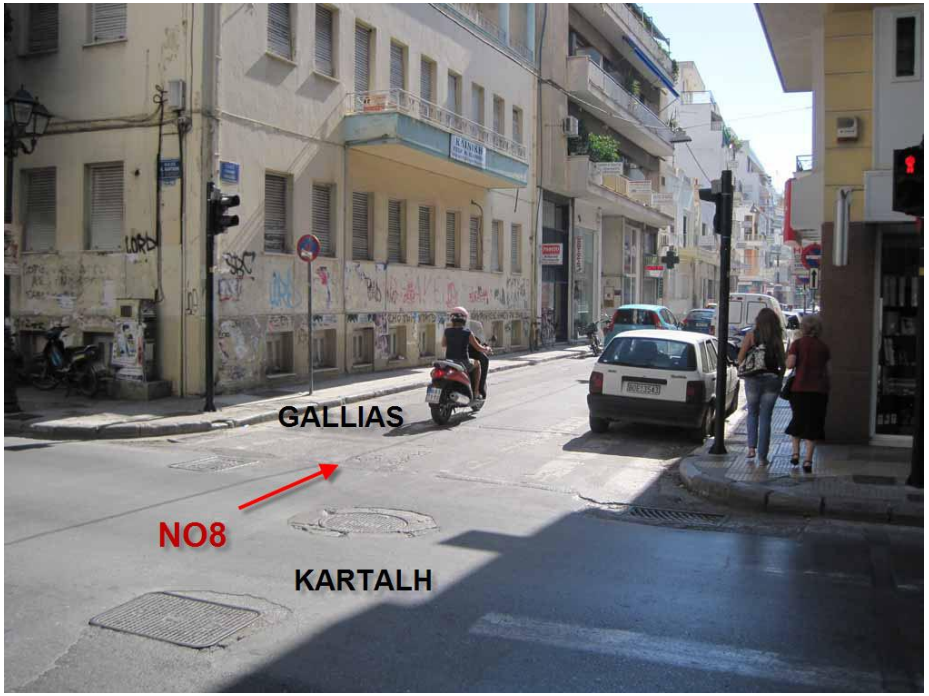


Crosswalks No3 and No4

Crosswalks No5 and No6

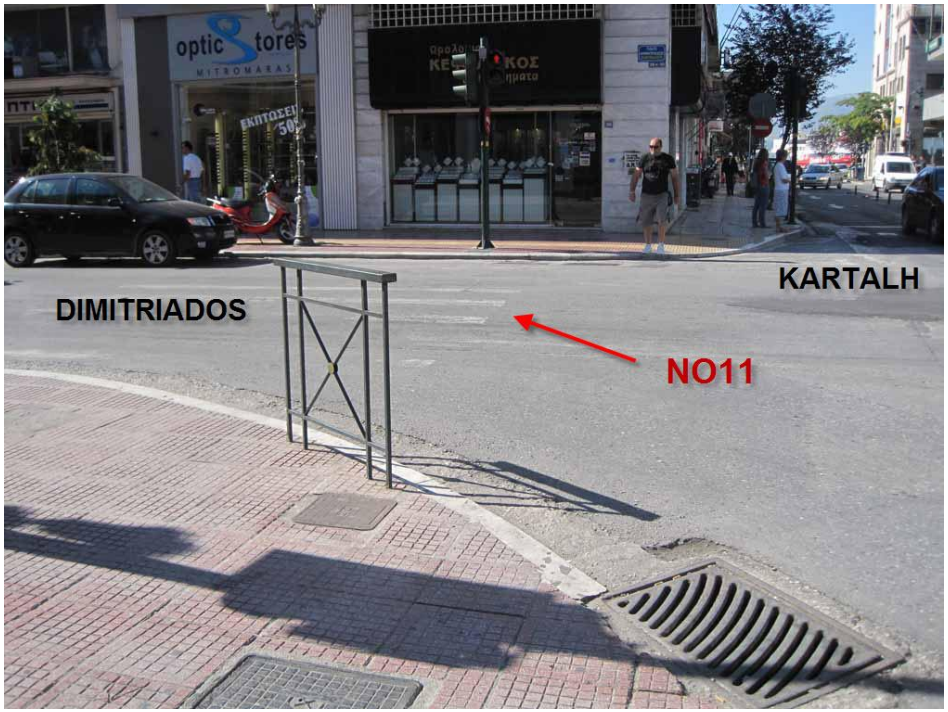


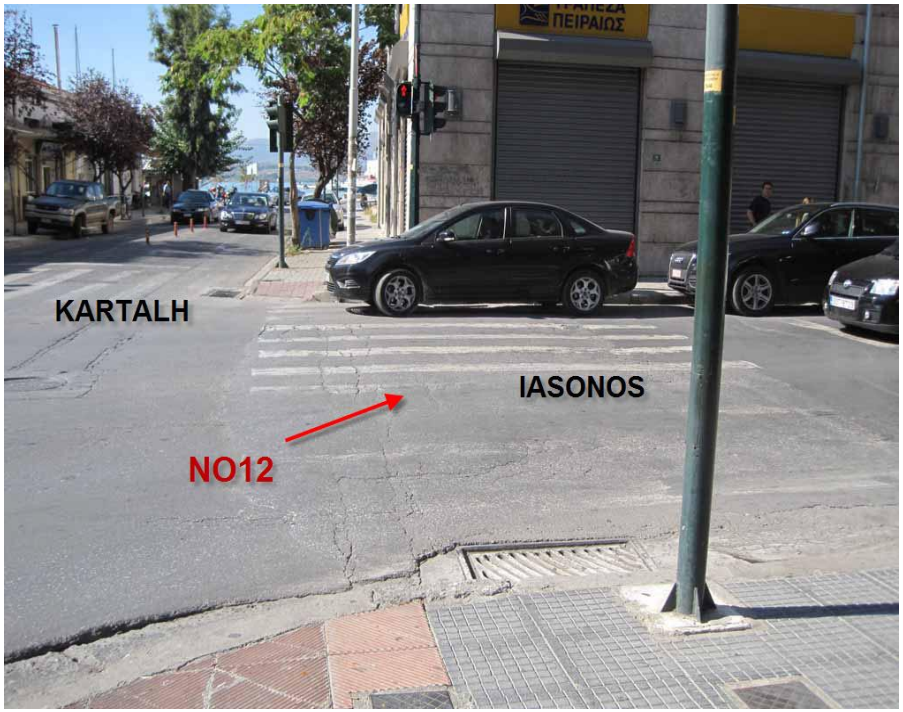
Crosswalks No7 and No8



Crosswalks No9 and N10

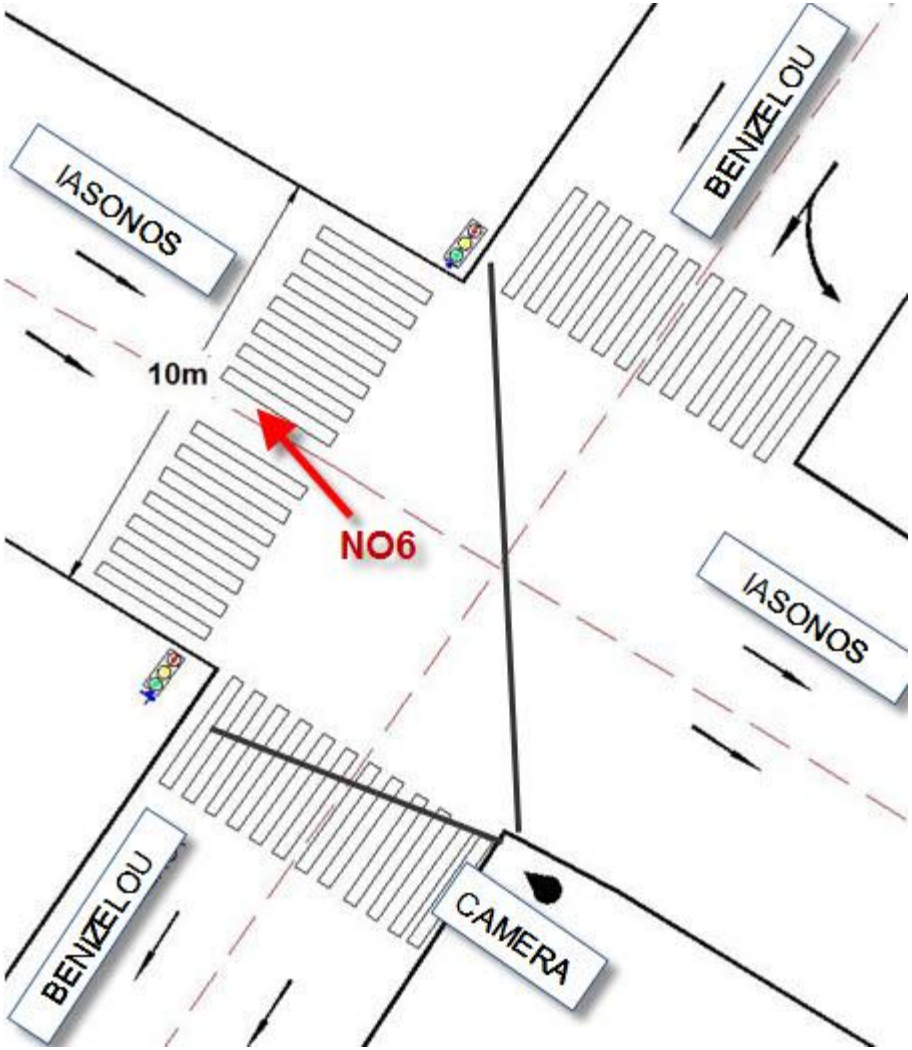
Crosswalks No11 and No12





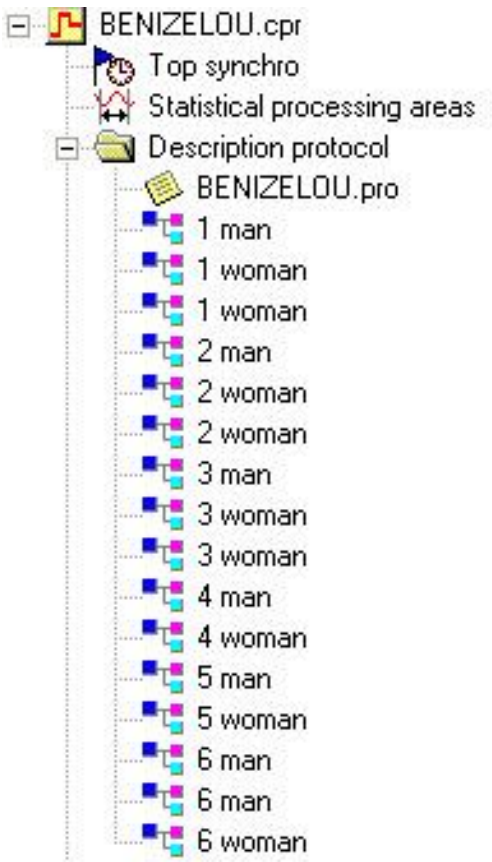
Collection of Video Data

- June 2010
- Peak traffic hours:12:00-14:00
- Video camera
- Full vision of each crosswalk
- Duration of video data in each crosswalk: 30 min



Data analysis (Captiv L2100)

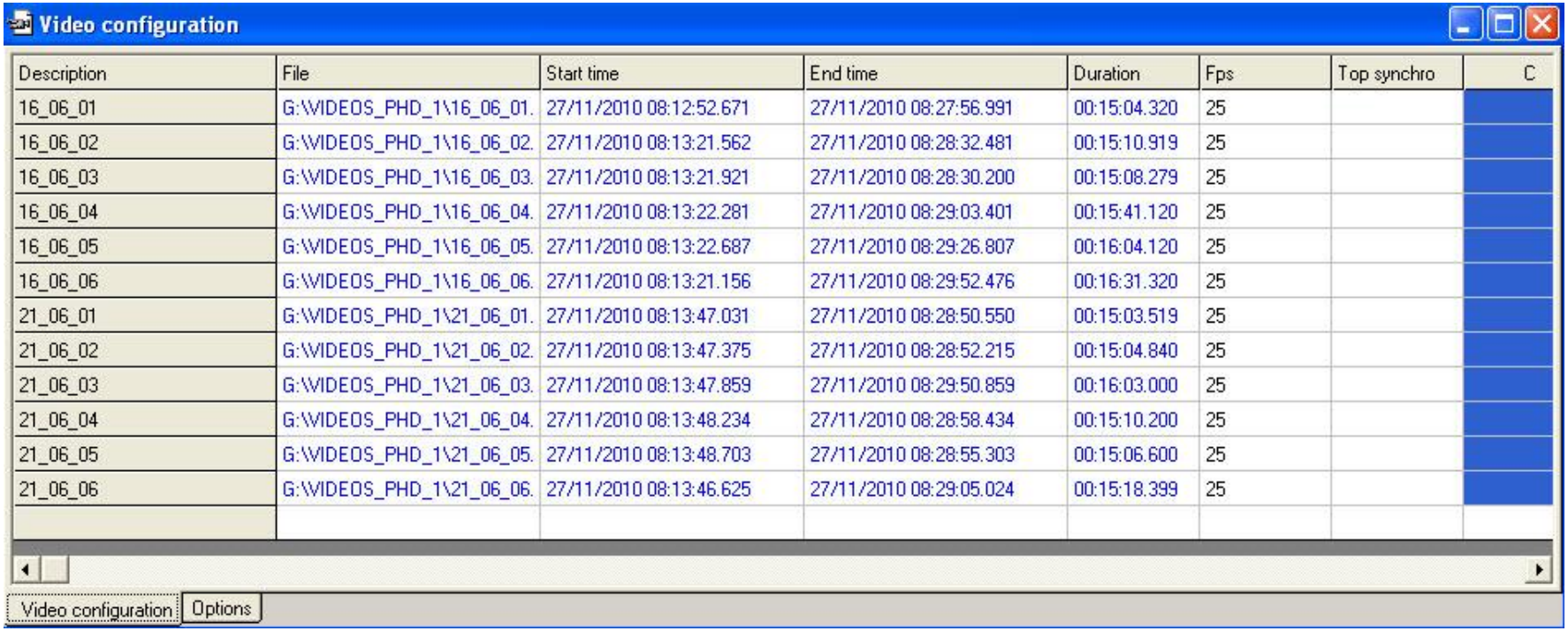
- Description Protocol
- Code: 020mrs (abbreviation of the characteristic)
- Coding: 020 man red start (analytic presentation of the characteristic)
- Class: 1man
- C: Colour of each code



Code	Coding	Recoding	Class	Init	P	C
020mrs	020 man red start	020 man red start	1 man			
020mrt	020 man red stop	020 man red stop	1 man			
2050mrs	2050 man red start	2050 man red start	2 man			
2050mrt	2050 man red stop	2050 man red stop	2 man			
50mrs	50 man red start	50 man red start	3 man			
50mrt	50 man red stop	50 man red stop	3 man			
020mgs	020 man green start	020 man green start	4 man			
020mgt	020 man green stop	020 man green stop	4 man			
2050mgs	2050 man green start	2050 man green start	5 man			
2050mgt	2050 man green stop	2050 man green stop	5 man			
50mgs	50 man green start	50 man green start	6 man			
50mgt	50 man green stop	50 man green stop	6 man			
020wrs	020 woman red start	020 woman red start	1 woman			
020wrt	020 woman red stop	020 woman red stop	1 woman			
2050wrs	2050 woman red start	2050 woman red start	2 woman			
2050wrt	2050 woman red stop	2050 woman red stop	2 woman			
50wrs	50 woman red start	50 woman red start	3 woman			
50wrt	50 woman red stop	50 woman red stop	3 woman			
020wgs	020 woman green start	020 woman green start	4 woman			
020wgt	020 woman green stop	020 woman green stop	4 woman			
2050wgs	2050 woman green start	2050 woman green start	5 woman			
2050wgt	2050 woman green stop	2050 woman green stop	5 woman			
50wgs	50 woman green start	50 woman green start	6 woman			
50wgt	50 woman green stop	50 woman green stop	6 woman			

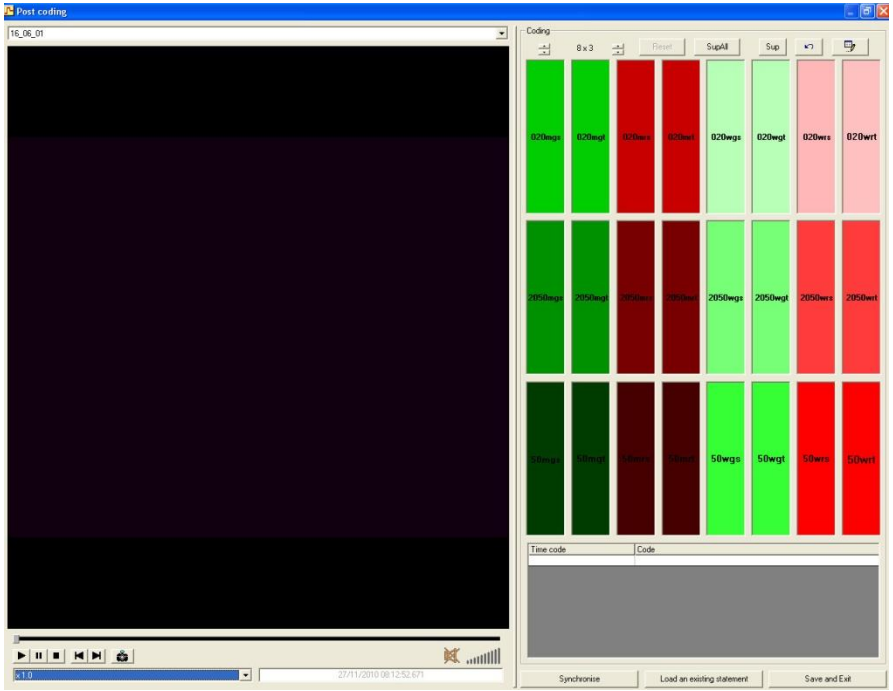
Video Configuration

- Formation of the “Video Configuration” file.
- Creation of the file with the entrance of the videos in the project.
- Characterization of each video according to its description name, the save location of the file, the start and end time and its duration (about 15min).

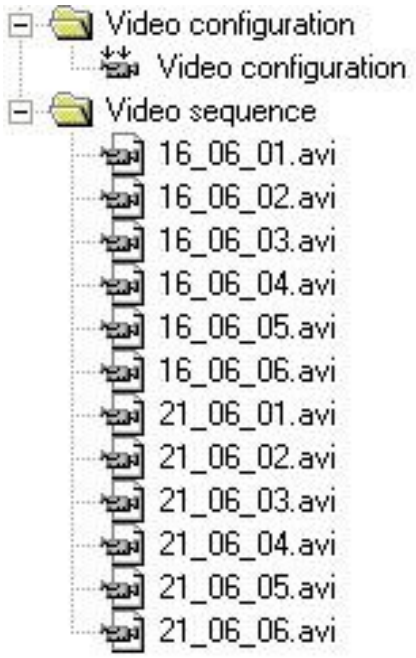


Video Sequence

- Reference of each button to a coding and its identification colour.
- Running of the videos and marking of each pedestrian start and stop time, based on the coding.
- Ability to stop the video (pause), play it back or synchronize it in a selected time when a pedestrian crossed the street.
- All the registrations were saved in a “Post Coding” file, which refers to the start and stop time of the pedestrian crossing according to the coding.



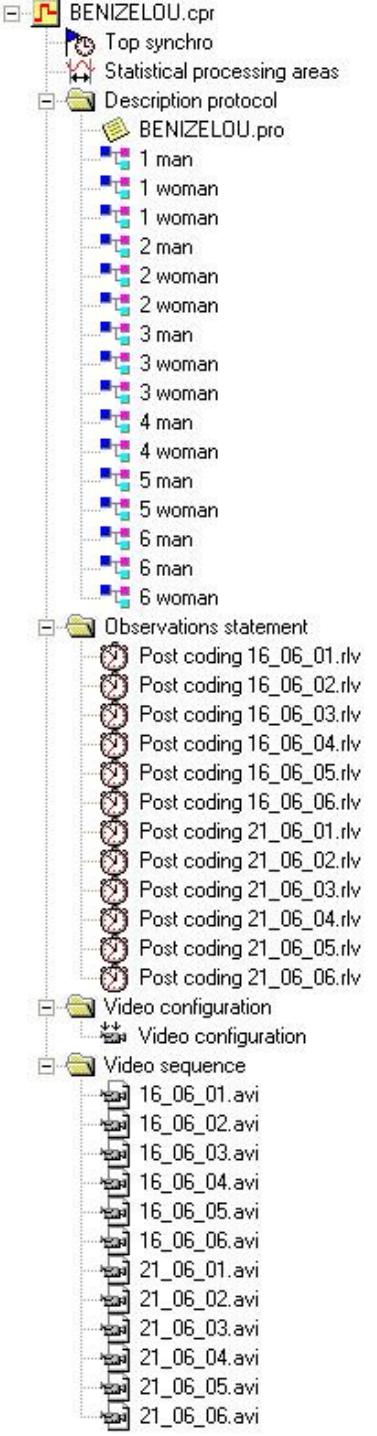
Video Sequence



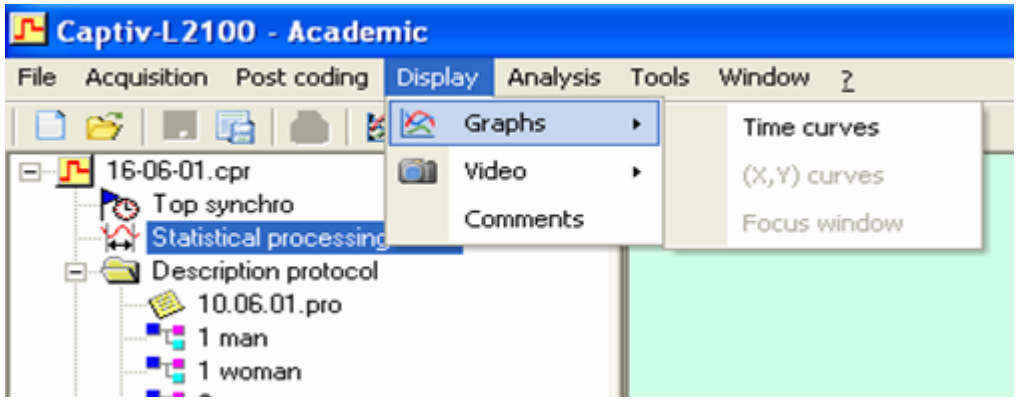
Post Coding

C:\...\Captiv-L2100\Projet\BENIZELOU\Post coding 16_06_01.rlv

Time code	Code	Coding	Recoding	Class
27/11/2010 08:13:16.761	50mgs	50 man green start	50 man green start	6 man
27/11/2010 08:13:21.286	50mgt	50 man green stop	50 man green stop	6 man
27/11/2010 08:13:24.129	2050wgs	2050 woman green start	2050 woman green start	5 woman
27/11/2010 08:13:29.333	2050wgt	2050 woman green stop	2050 woman green stop	5 woman
27/11/2010 08:13:39.490	020wgs	020 woman green start	020 woman green start	4 woman
27/11/2010 08:13:43.963	020wgt	020 woman green stop	020 woman green stop	4 woman
27/11/2010 08:13:49.179	50mgs	50 man green start	50 man green start	6 man
27/11/2010 08:13:52.763	50wgs	50 woman green start	50 woman green start	6 woman
27/11/2010 08:13:54.374	50mgt	50 man green stop	50 man green stop	6 man
27/11/2010 08:13:57.973	50wgt	50 woman green stop	50 woman green stop	6 woman
27/11/2010 08:14:30.998	50mrs	50 man red start	50 man red start	3 man
27/11/2010 08:14:31.661	50wrs	50 woman red start	50 woman red start	3 woman
27/11/2010 08:14:33.496	50mrs	50 man red start	50 man red start	3 man
27/11/2010 08:14:35.039	50mrt	50 man red stop	50 man red stop	3 man
27/11/2010 08:14:36.535	50wgt	50 woman green stop	50 woman green stop	6 woman
27/11/2010 08:14:37.853	50mrt	50 man red stop	50 man red stop	3 man
27/11/2010 08:14:55.239	50wgs	50 woman green start	50 woman green start	6 woman
27/11/2010 08:14:55.239	50wgs	50 woman green start	50 woman green start	6 woman
27/11/2010 08:15:01.337	50wgt	50 woman green stop	50 woman green stop	6 woman
27/11/2010 08:15:01.337	50wgt	50 woman green stop	50 woman green stop	6 woman
27/11/2010 08:15:01.337	2050wgs	2050 woman green start	2050 woman green start	5 woman
27/11/2010 08:15:06.416	2050wgt	2050 woman green stop	2050 woman green stop	5 woman
27/11/2010 08:17:15.994	020mgs	020 man green start	020 man green start	4 man
27/11/2010 08:17:17.088	2050wgs	2050 woman green start	2050 woman green start	5 woman
27/11/2010 08:17:19.799	020mgt	020 man green stop	020 man green stop	4 man



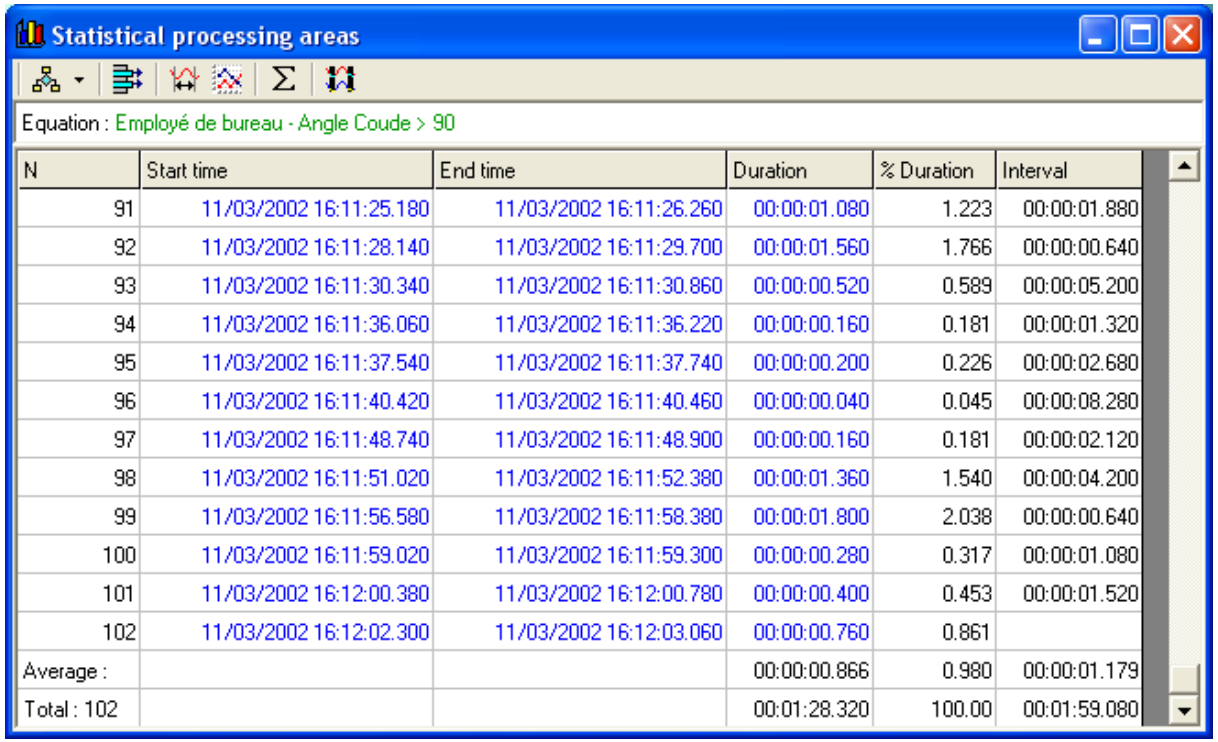
Time curves


Captiv-L2100 - Academic
File
Acquisition
Post coding
Display
Analysis
Tools
Window
?
Graphs
Video
Comments
Time curves
(X,Y) curves
Focus window
16-06-01.cpr
Top synchro
Statistical processing
Description protocol
10.06.01.pro
1 man
1 woman


Time curves
21/6/2010 22:22:51.380
1 man
020 man red start-
020 man red stop-
1 woman
020 woman red start-
020 woman red stop-
2 man
2050 man red start-
2050 man red stop-
2 woman
2050 woman red start-
2050 woman red stop-
3 man
50 over man red start-
50 over man red stop-
3 woman
50 over woman red start-
50 over woman red stop-
4 man
020 man green start-
020 man green stop-
4 woman
020 woman green start-
020 woman green stop-
5 man
2050 man green start-
2050 man green stop-
5 woman
2050 woman green start-
2050 woman green stop-
6 man
50 over man green start-
50 over man green stop-
6 woman
50 over woman green start-
50 over woman green stop-
22:08:09.218
22:10:39.278
22:12:19.978
22:14:00.678
22:15:41.378
21/6/2010 22:18:42.540
20:43.477
22:23:13.538

Statistical processing areas

- After the creation of the post coding file, all the data were exported in the excel software for further analysis.
- The basic benefit of this analysis procedure was the speed, convenience and reliability of the process, comparing to the manually video analysis.



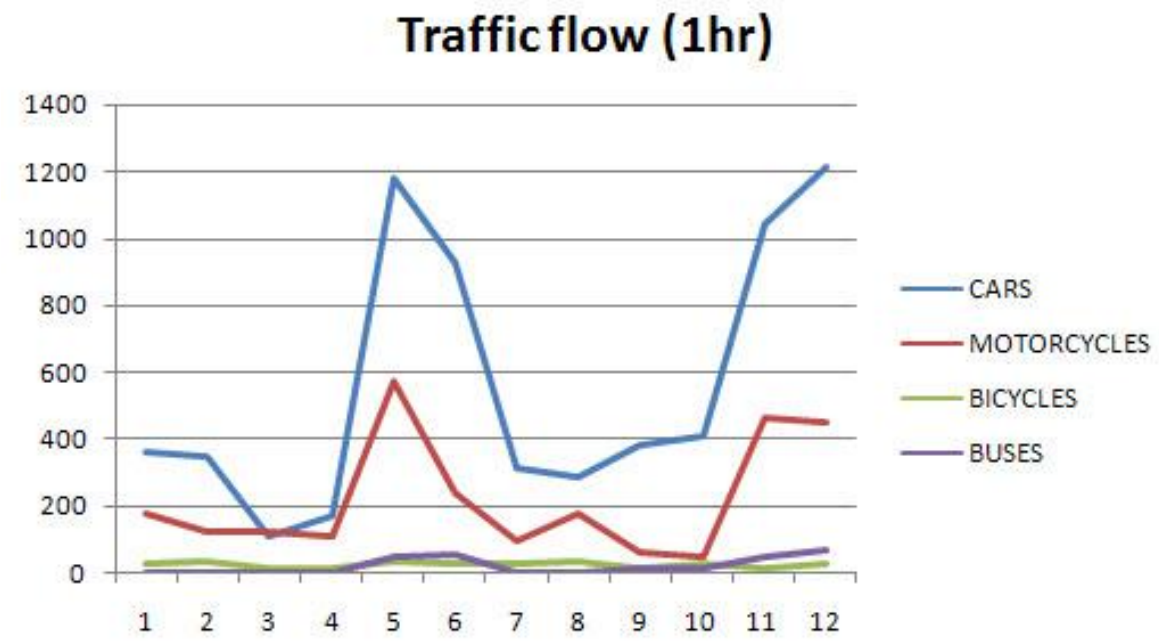
N	Start time	End time	Duration	% Duration	Interval
91	11/03/2002 16:11:25.180	11/03/2002 16:11:26.260	00:00:01.080	1.223	00:00:01.880
92	11/03/2002 16:11:28.140	11/03/2002 16:11:29.700	00:00:01.560	1.766	00:00:00.640
93	11/03/2002 16:11:30.340	11/03/2002 16:11:30.860	00:00:00.520	0.589	00:00:05.200
94	11/03/2002 16:11:36.060	11/03/2002 16:11:36.220	00:00:00.160	0.181	00:00:01.320
95	11/03/2002 16:11:37.540	11/03/2002 16:11:37.740	00:00:00.200	0.226	00:00:02.680
96	11/03/2002 16:11:40.420	11/03/2002 16:11:40.460	00:00:00.040	0.045	00:00:08.280
97	11/03/2002 16:11:48.740	11/03/2002 16:11:48.900	00:00:00.160	0.181	00:00:02.120
98	11/03/2002 16:11:51.020	11/03/2002 16:11:52.380	00:00:01.360	1.540	00:00:04.200
99	11/03/2002 16:11:56.580	11/03/2002 16:11:58.380	00:00:01.800	2.038	00:00:00.640
100	11/03/2002 16:11:59.020	11/03/2002 16:11:59.300	00:00:00.280	0.317	00:00:01.080
101	11/03/2002 16:12:00.380	11/03/2002 16:12:00.780	00:00:00.400	0.453	00:00:01.520
102	11/03/2002 16:12:02.300	11/03/2002 16:12:03.060	00:00:00.760	0.861	
Average :			00:00:00.866	0.980	00:00:01.179
Total : 102			00:01:28.320	100.00	00:01:59.080

	AGE	SEX	R/G	TIME	V
1	2	A	K	4,98	1,81
2	2	A	K	7,91	1,14
3	3	A	K	6,86	1,31
4	3	A	K	4,83	1,86
5	2	Г	K	5,08	1,77
6	2	Г	K	5,76	1,56
7	2	Г	K	6,49	1,39
8	3	Г	K	7,23	1,24
9	3	Г	K	4,83	1,86
10	1	A	П	6,93	1,30
11	1	A	П	7,86	1,15
12	1	A	П	6,71	1,34
13	1	A	П	6,81	1,32
14	1	A	П	6,93	1,30
15	1	A	П	7,47	1,20
16	1	A	П	7,20	1,25
17	2	A	П	7,63	1,18
18	2	A	П	7,63	1,18
19	2	A	П	5,66	1,59
20	2	A	П	9,38	0,96
21	2	A	П	6,41	1,40
22	2	A	П	7,45	1,21
23	2	A	П	7,71	1,17
24	2	A	П	6,23	1,44
25	2	A	П	6,01	1,50
26	2	A	П	5,41	1,66
27	2	A	П	6,26	1,44
28	2	A	П	7,24	1,24
29	2	A	П	8,42	1,07
30	2	A	П	7,74	1,16
31	2	A	П	5,46	1,65
32	2	A	П	7,21	1,25
33	3	A	П	5,84	1,54
34	3	A	П	7,03	1,28
35	3	A	П	7,24	1,24
36	3	A	П	7,93	1,13
37	3	A	П	5,23	1,72

Results

Traffic flow (1hr)

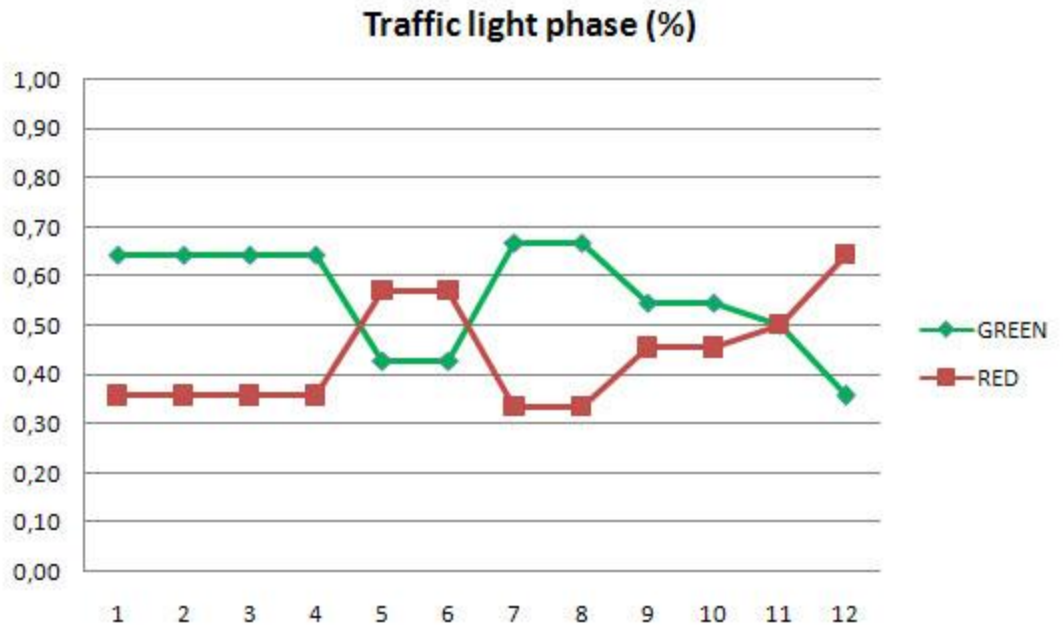
Traffic (1hr)	1	2	3	4	5	6	7	8	9	10	11	12
Vehicle	360	348	108	168	1176	924	312	288	384	408	1044	1212
Motorcycle	180	120	120	108	576	240	96	180	60	48	468	456
Bicycle	24	36	12	12	36	24	24	36	12	24	12	24
Bus	0	0	0	0	48	60	0	0	12	12	48	72



Results

Traffic light duration (sec)

Time (sec)	1	2	3	4	5	6	7	8	9	10	11	12
Green	45	45	45	45	30	30	50	50	30	30	35	25
Red	25	25	25	25	40	40	25	25	25	25	35	45
Sum	70	70	70	70	70	70	75	75	55	55	70	70
%Green	0,64	0,64	0,64	0,64	0,43	0,43	0,67	0,67	0,55	0,55	0,50	0,36
%Red	0,36	0,36	0,36	0,36	0,57	0,57	0,33	0,33	0,45	0,45	0,50	0,64



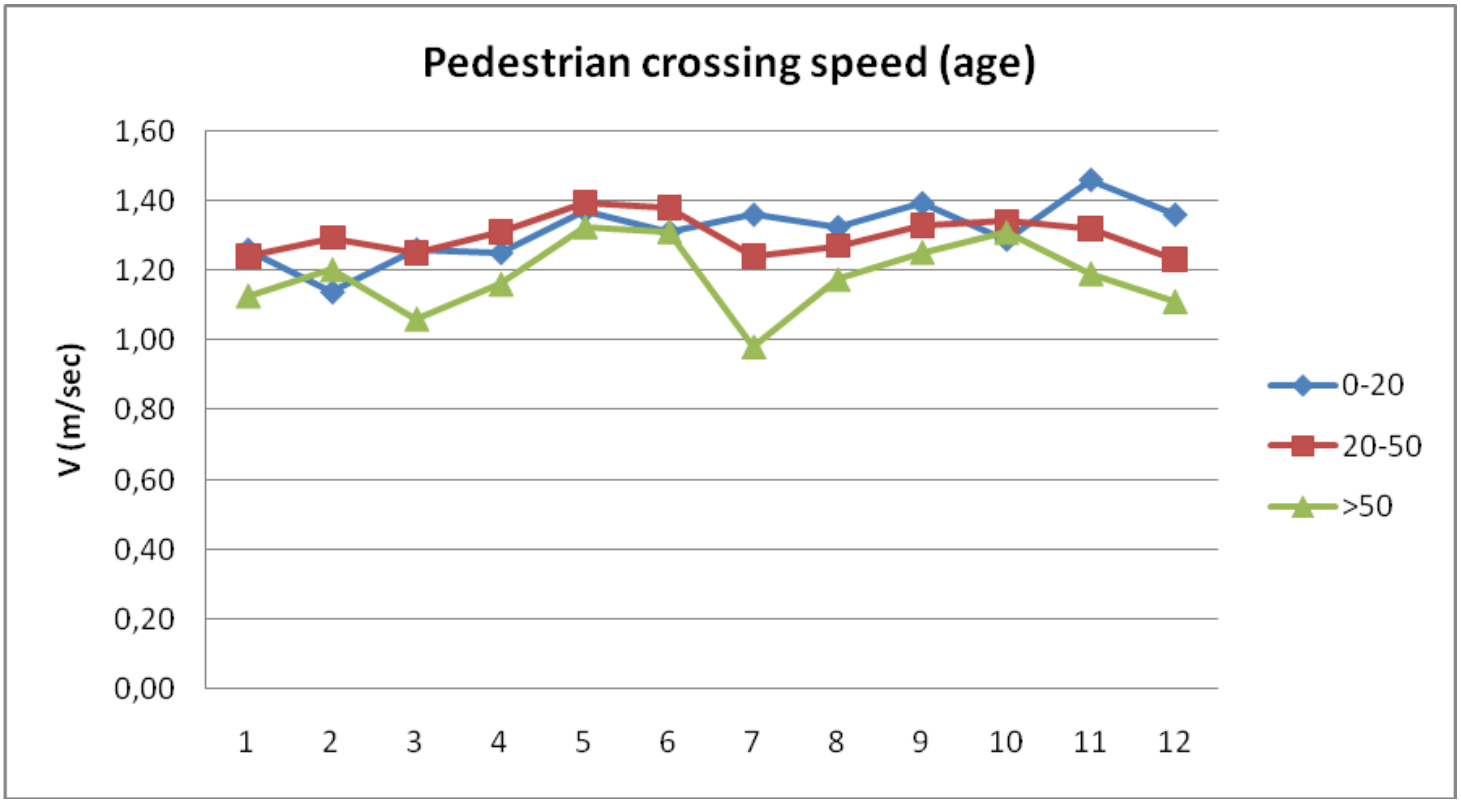
Results

Pedestrians crossing during the red traffic light (%)

Red%	1	2	3	4	5	6	7	8	9	10	11	12	AV
0-20	0,63	0,00	0,21	0,30	0,00	0,24	0,08	0,44	0,44	0,17	0,18	0,00	0,23
20-50	0,25	0,59	0,5 7	0,35	0,56	0,53	0,85	0,44	0,44	0,57	0,45	1,00	0,55
50+	0,13	0,41	0,21	0,35	0,44	0,24	0,08	0,11	0,11	0,26	0,36	0,00	0,22
Men	0,25	0,37	0,36	0,52	0,44	0,71	0,31	0,22	0,22	0,39	0,45	0,25	0,37
Women	0,75	0,63	0,64	0,48	0,56	0,29	0,69	0,78	0,78	0,61	0,55	0,75	0,63
Sum	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00

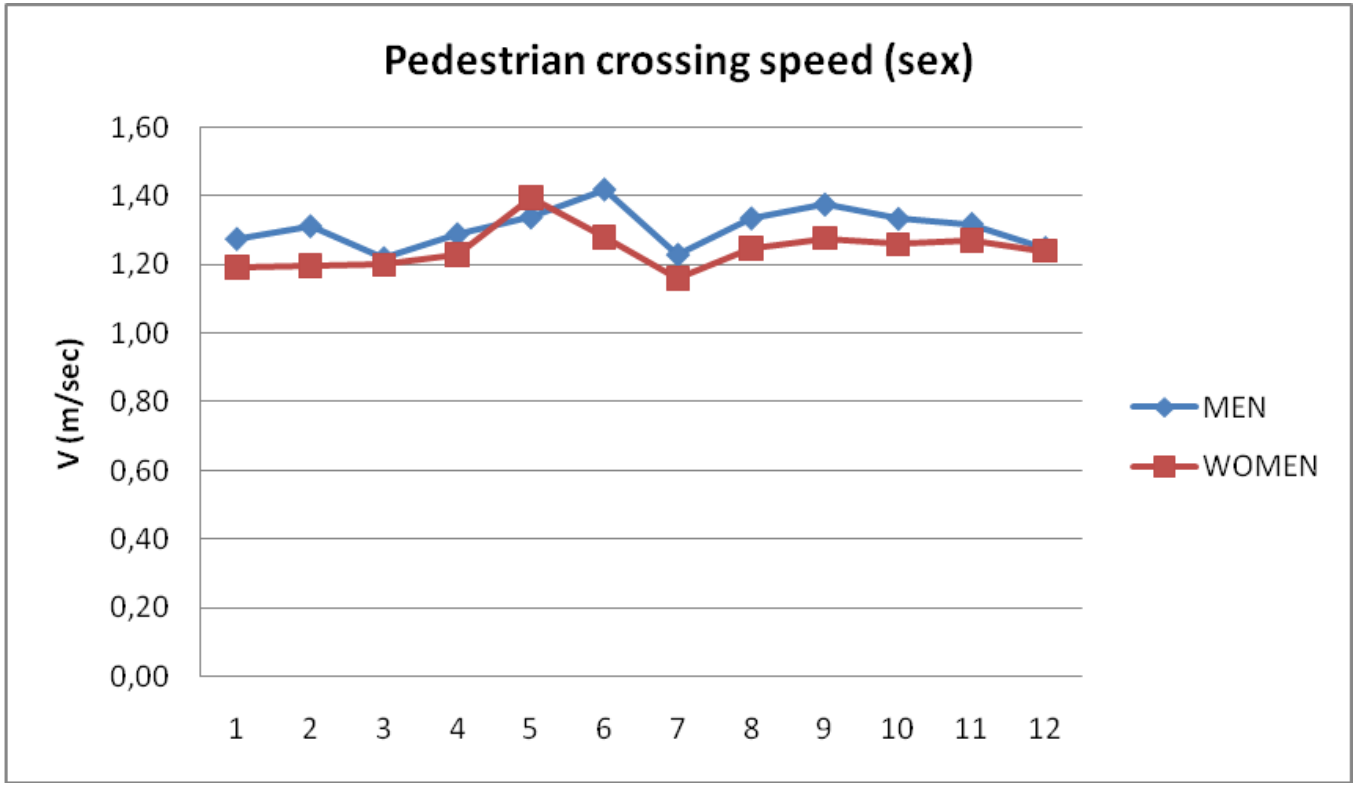
Results

L (m)	5,5m	5,5m	4,5m	4,5m	9m	10m	5,5m	5,5m	4,5m	4,5m	9m	9m	
V (m/sec)	1	2	3	4	5	6	7	8	9	10	11	12	AV
0-20	1,26	1,14	1,26	1,25	1,37	1,31	1,36	1,32	1,39	1,29	1,46	1,36	1,31
20-50	1,24	1,29	1,25	1,31	1,39	1,38	1,24	1,27	1,33	1,34	1,32	1,23	1,30
50+	1,13	1,20	1,06	1,16	1,32	1,31	0,98	1,17	1,25	1,31	1,19	1,11	1,18



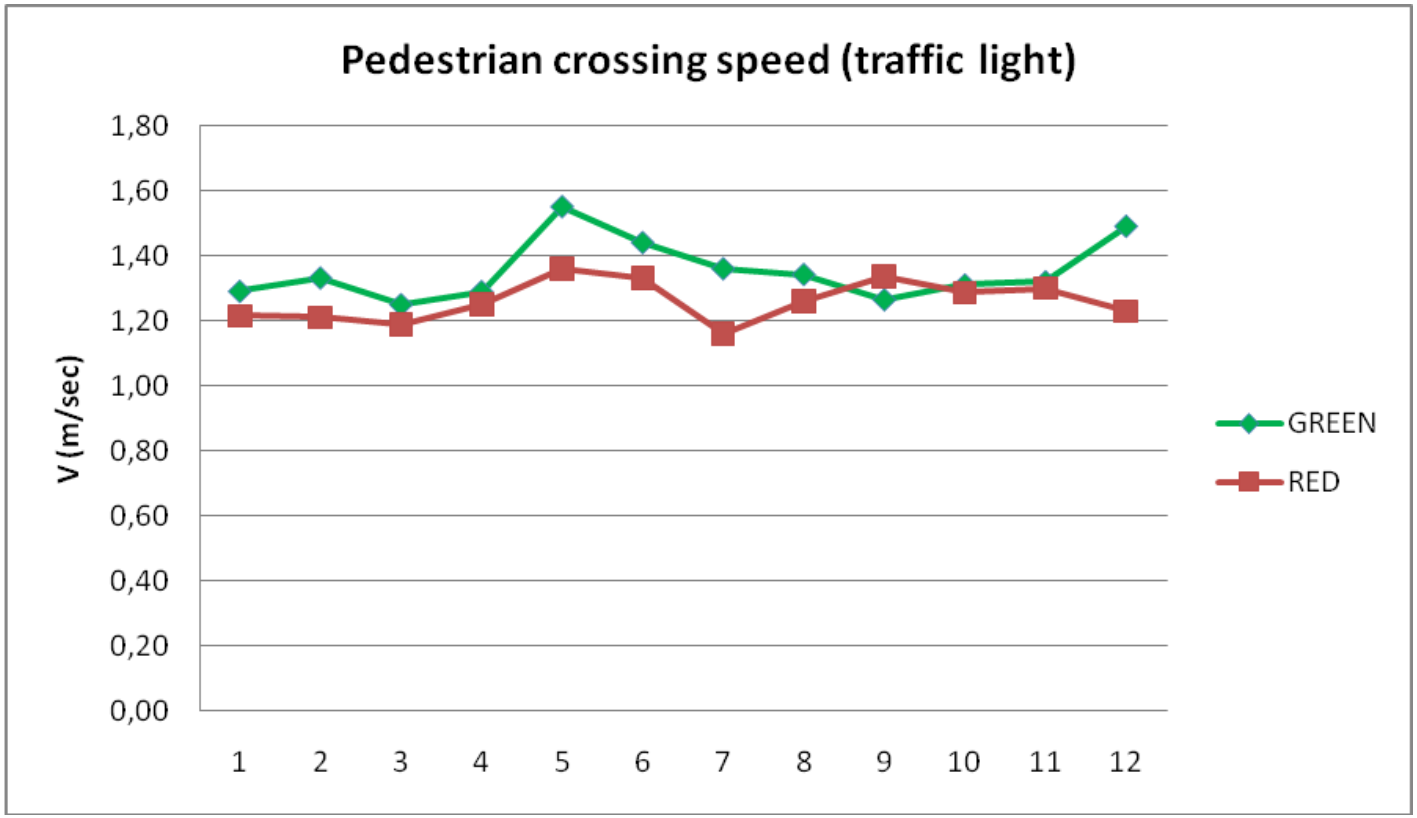
Results

L (m)	5,5m	5,5m	4,5m	4,5m	9m	10m	5,5m	5,5m	4,5m	4,5m	9m	9m	
V (m/sec)	1	2	3	4	5	6	7	8	9	10	11	12	AV
Men	1,28	1,31	1,22	1,29	1,34	1,42	1,23	1,34	1,38	1,33	1,32	1,25	1,31
Women	1,19	1,20	1,20	1,23	1,39	1,28	1,16	1,25	1,28	1,26	1,27	1,24	1,25



Results

L (m)	5,5m	5,5m	4,5m	4,5m	9m	10m	5,5m	5,5m	4,5m	4,5m	9m	9m	
V (m/sec)	1	2	3	4	5	6	7	8	9	10	11	12	AV
Red	1,29	1,33	1,25	1,29	1,55	1,44	1,36	1,34	1,27	1,31	1,32	1,49	1,35
Green	1,22	1,21	1,19	1,25	1,36	1,33	1,16	1,26	1,34	1,29	1,30	1,23	1,26



Conclusions

- The implementation of the Captiv L2100 software was a very useful tool to analyze the pedestrian crossing behaviour with convenience, reliability and speed, using video data.
- The three age groups resulted in a balanced sample:
  - 23% (<20 years old)
  - 50% (20-50 years old)
  - 27% (>50 years old)
- More women walk during the morning peak hours (shopping, unemployment, unable to drive a car):
  - 40% (men)
  - 60% (women)
- Pedestrians mainly cross the street illegally where the vehicle traffic flow and speed are lower.
  - 85% (green traffic light)
  - 15% (red traffic light)

Conclusions

- Older pedestrians cross the streets with lower speed:
  - V=1,31m/sec (<20 years old)
  - V=1,30m/sec (20-50 years old)
  - V=1,18m/sec (>50 years old)
- Men cross the streets faster than women:
  - V=1,31m/sec (men)
  - V=1,25m/sec (women)
- Pedestrians cross the street faster during the red traffic light:
  - V=1,35m/sec (red)
  - V=1,26m/sec (green)
- The highest crossing speed (1,55m/sec) was noticed during the red light phase across a main urban arterial crosswalk.
- Women and pedestrians 20-50 years old crossed the street more often during the red traffic light phase.

Conclusions

- Pedestrians usually respect the traffic light indications, crossing the street only when they judge that there is a safe traffic gap.
- Pedestrians' crossing behaviour is influenced on their physical skills and road safety education.
- Target:
  - Better understanding of pedestrian crossing behaviour in urban crosswalks
  - Implementation of focused remedial actions according to a pedestrian road safety audit procedure.

University of Thessaly

Thank you!

Contact: atgalanis@uth.gr
neliou@uth.gr