Driver Eye Gaze and Driver Behaviour on Rural and National Roads

Dr Catherine Deegan

Senior Lecturer, Institute of Technology Blanchardstown

itb Institute of Technology Blanchardstown
Institiúid Teicneolaíochta Baile Bhlainséir

Summary of research activity within SimRG

Dr. Catherine Deegan: Department of Engineering, IT Blanchardstown

Dr. Charles Markham: Department of Computer Science Maynooth University

Dr. Sean Commins: Department of Psychology Maynooth University

Maynooth University
National University of Ireland Maynooth

SIMRG
SIMULATOR RESEARCH GROUP

itb
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Aims

To understand the anatomy of a road accident.

data fusion, statistics

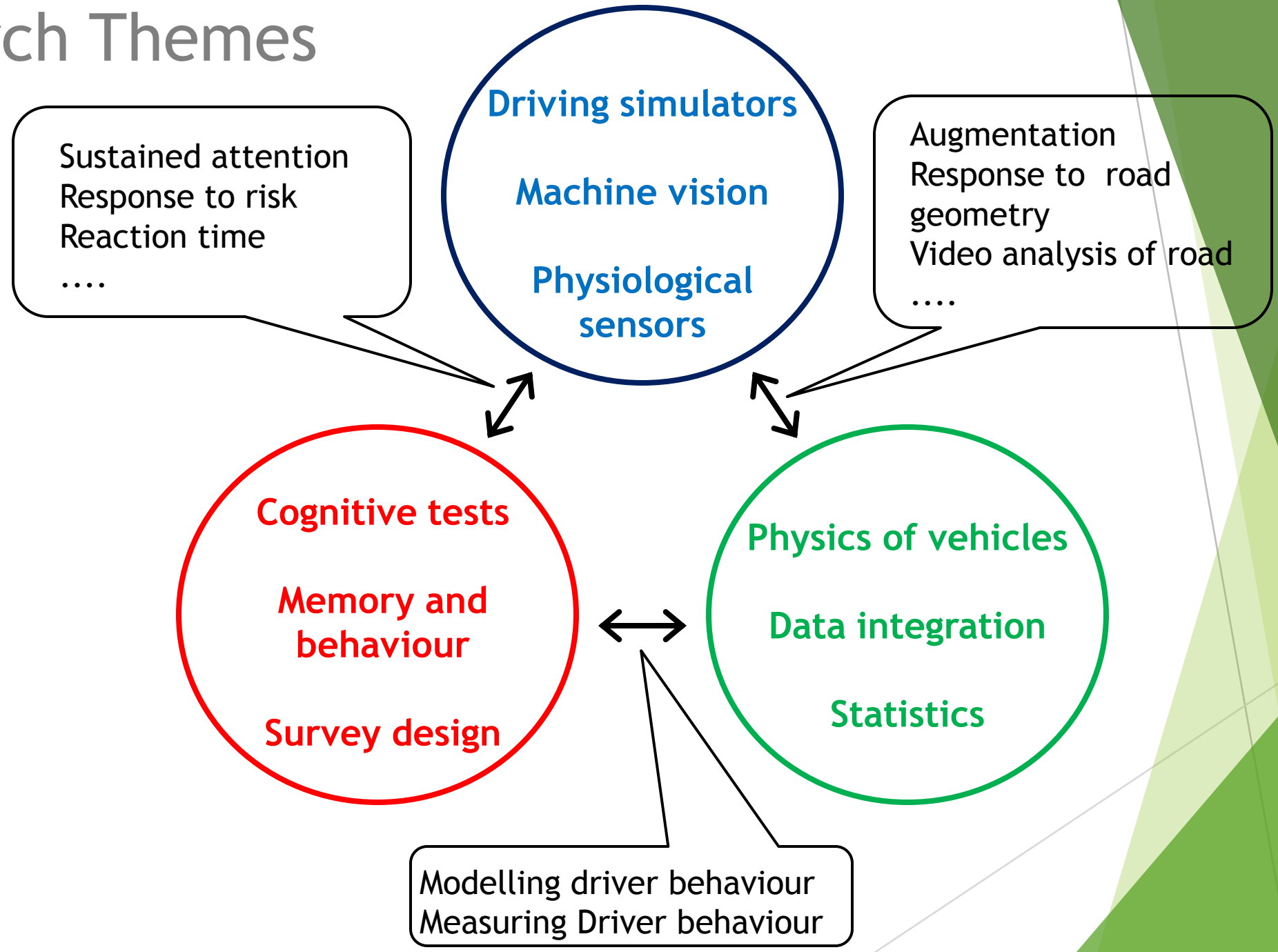
To build a model of the Irish Road Network based on cognitive and physical models.

driver behaviour, physics of car

Provide new methods for assessment, training and rehabilitation

returning to driving, novice drivers

Research Themes



Photorealistic simulation of Irish Roads

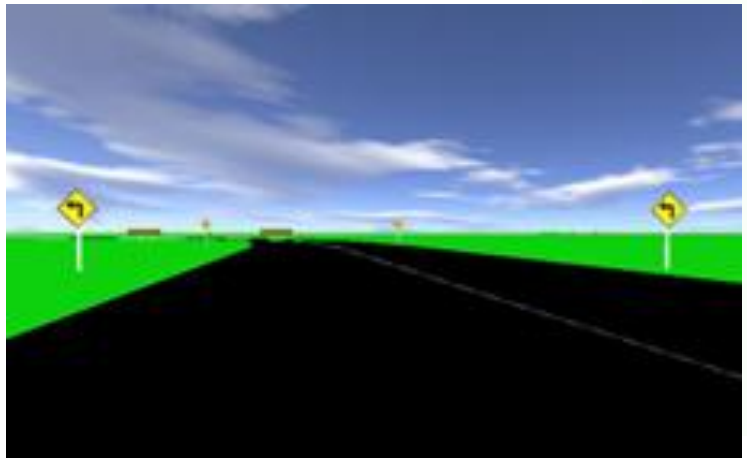
Most commercial driving simulators use model data

Benefits of video over model based simulators?

Model based driving simulator

Digital Map

GPS Data

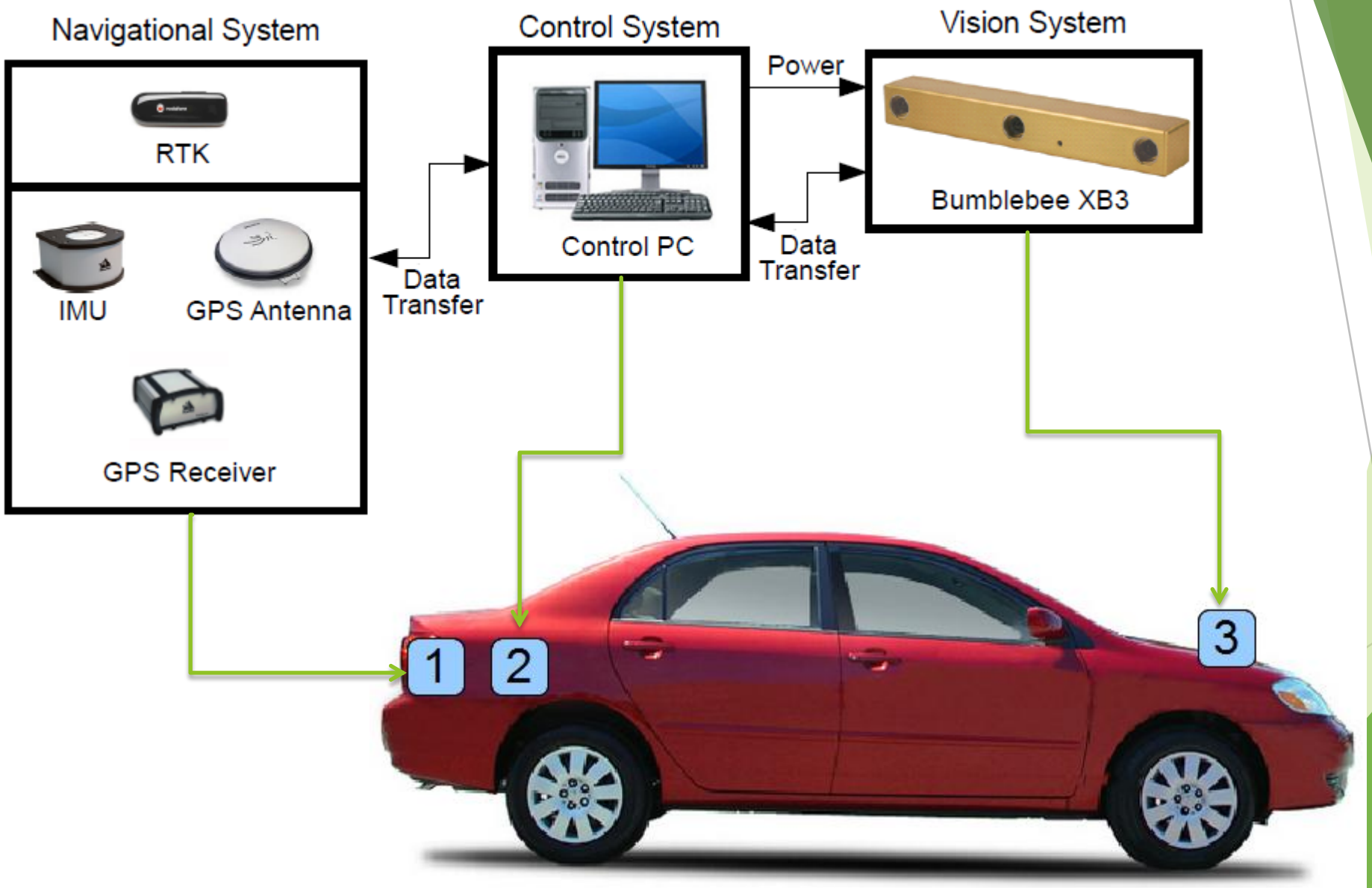


Augment model

2/3D Model of road

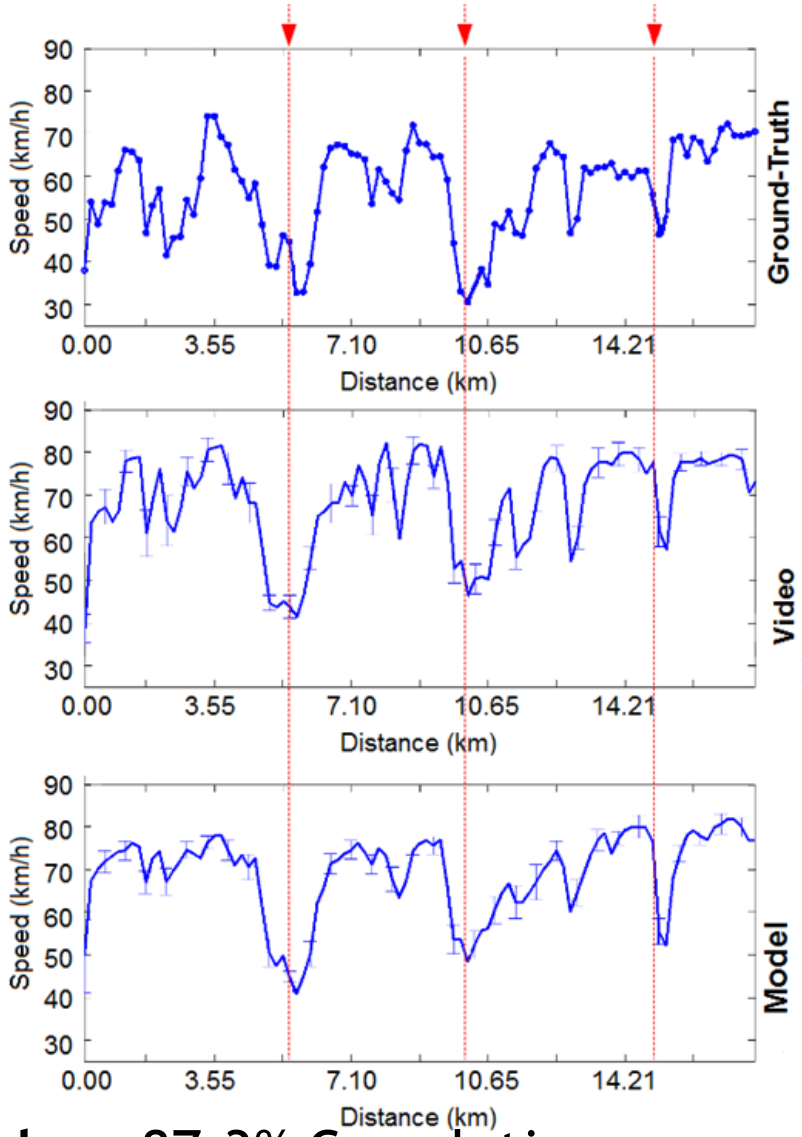
Drive road network

Video Acquisition System



Acquisition of Video Stream

Comparison Among Three Data Sets



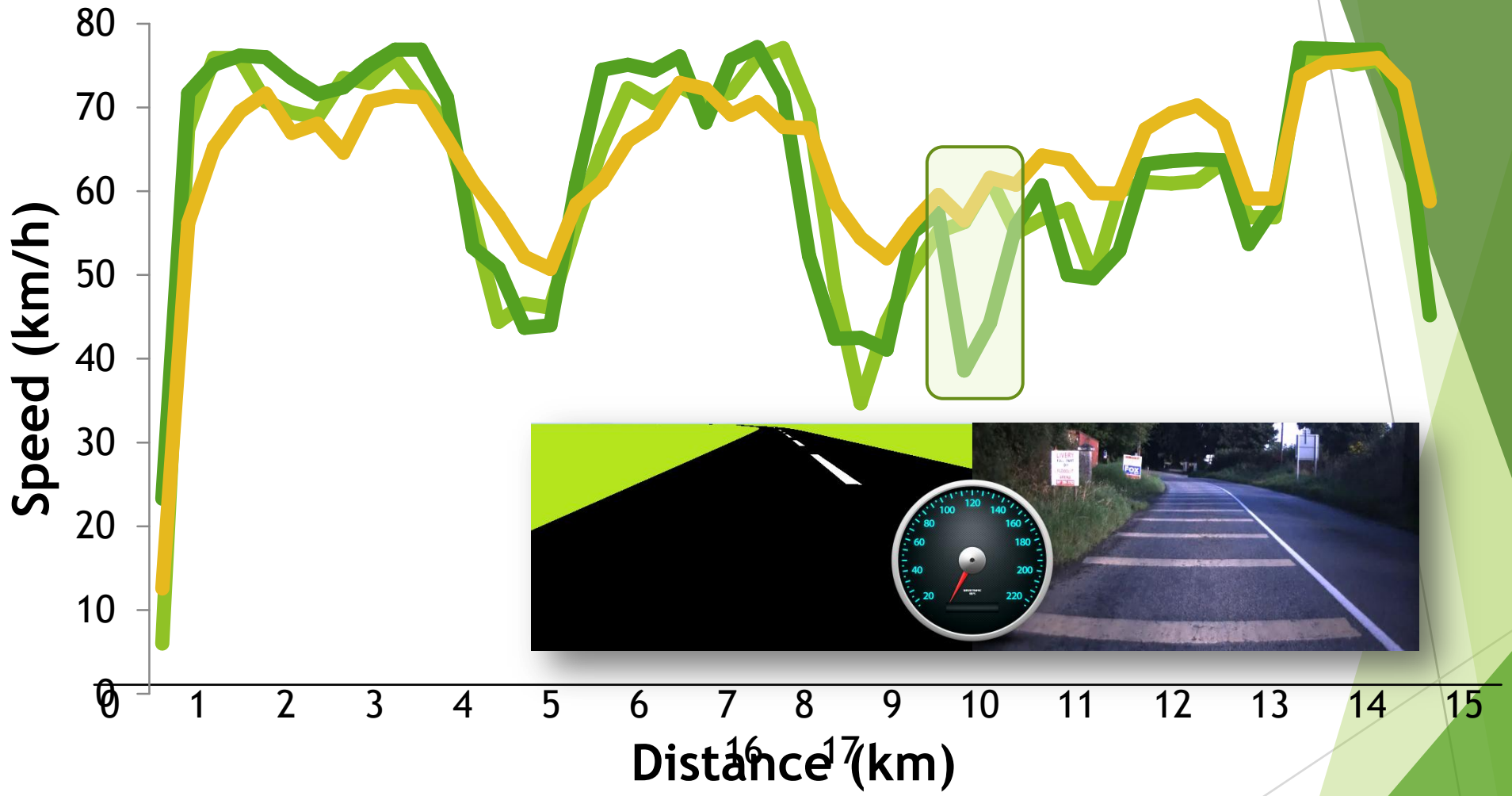
n = 1

n = 11

n = 11

Ground-truth and Model: 87.3% Correlation
Ground-truth and Video: 84.6% Correlation
Video and Model: 92.8% Correlation

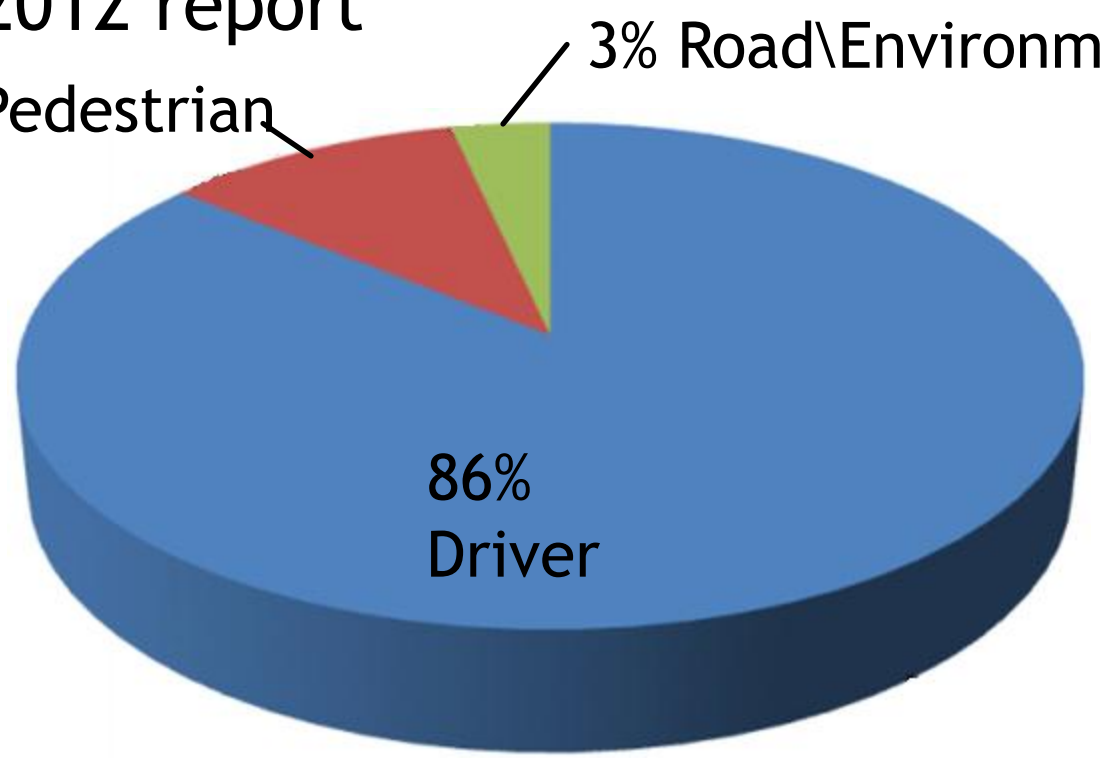
Results of GPS Model and Video Data



Correlation between model and video of 89%

Cognitive assessment of drivers

RSA 2012 report



86% of accidents on Irish roads are due to driver error and behaviour

Table 36 Two Vehicle Collisions: Contributory Action, where Specified

Driver Action	Fatal	Injury	Total	%
* Drove through Stop/Yield Sign	0	37	37	13.3*
Exceeded Safe Speed	0	12	12	4.3
* Went to Wrong Side of Road	7	94	101	36.2*
Improper Overtaking	0	6	6	2.2
* Drove Through Traffic Signal	0	30	30	10.8*
Failed to Signal	0	0	0	0.0
Other Action	0	93	93	33.3
TOTAL	7	272	279	100.0

Many of these may be due to ‘cognitive’ failings’, such as

Inattention,
Distraction,
Fatigue,
Poor decision making,
Impulsivity,
Risk-taking etc.

Driver Distraction/Inattention

In Australia, distraction accounts for between 14%-33% of serious crashes (McEvoy et al., 2007).

In Norway 22% of crashes were due to distraction and inattention (Dingus et al., 2006).

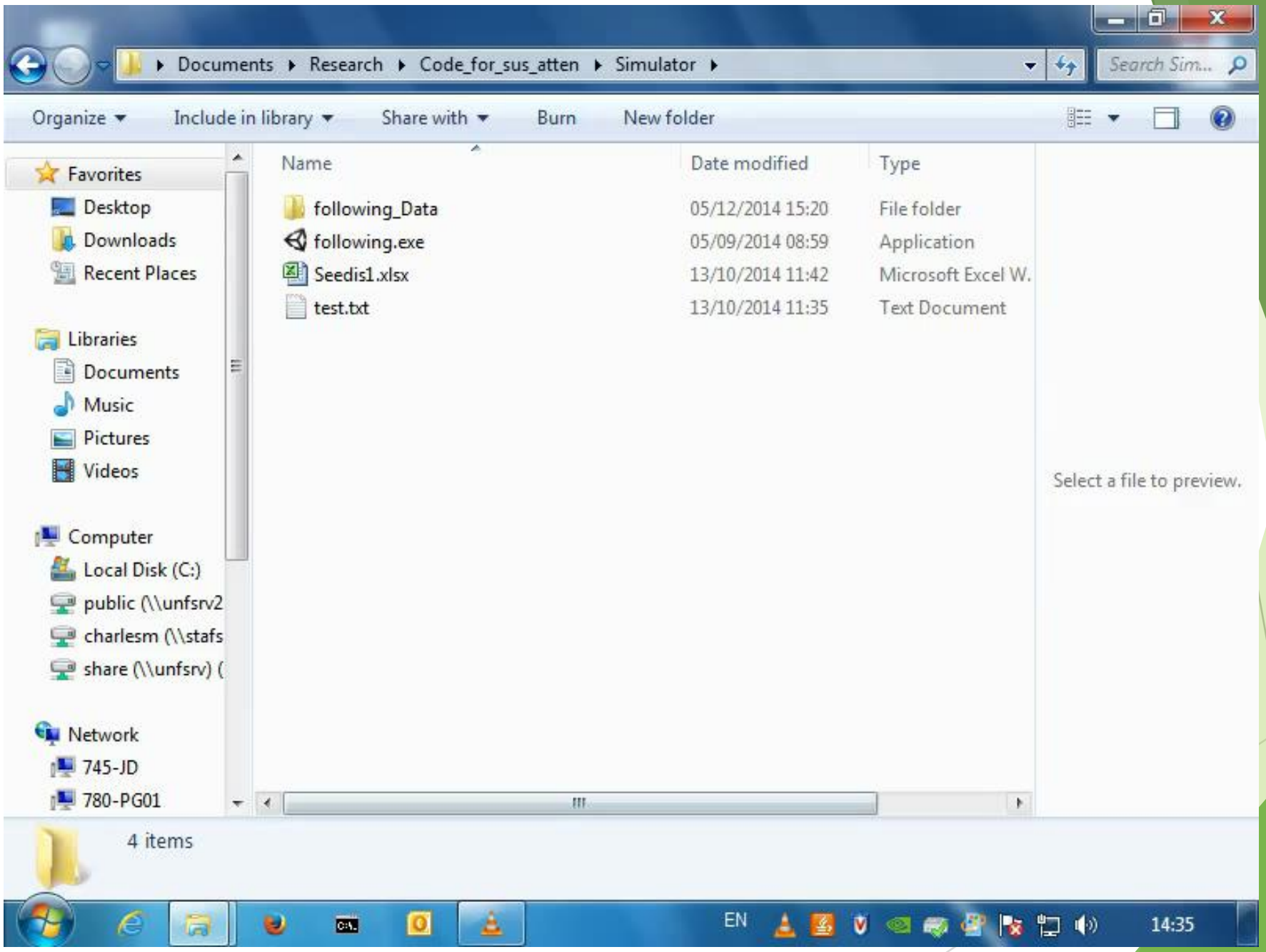
We have recently shown that attention levels can affect driving behaviour and where people look.

1st set of experiments:
To investigate the driving behaviour of high and low attention individuals

1. Car-following experiment (using modelled environment)

2. Driving a rural environment-measure eye gaze.

   - (1)Measured accelerator pedal, braking timing and distance from lead car.
   - (2)Measured driver eye gaze in a rural environment.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Desktop
Downloads
Recent Places
Libraries
Documents
Music
Pictures
Videos
Computer
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Text Document
Select a file to preview.
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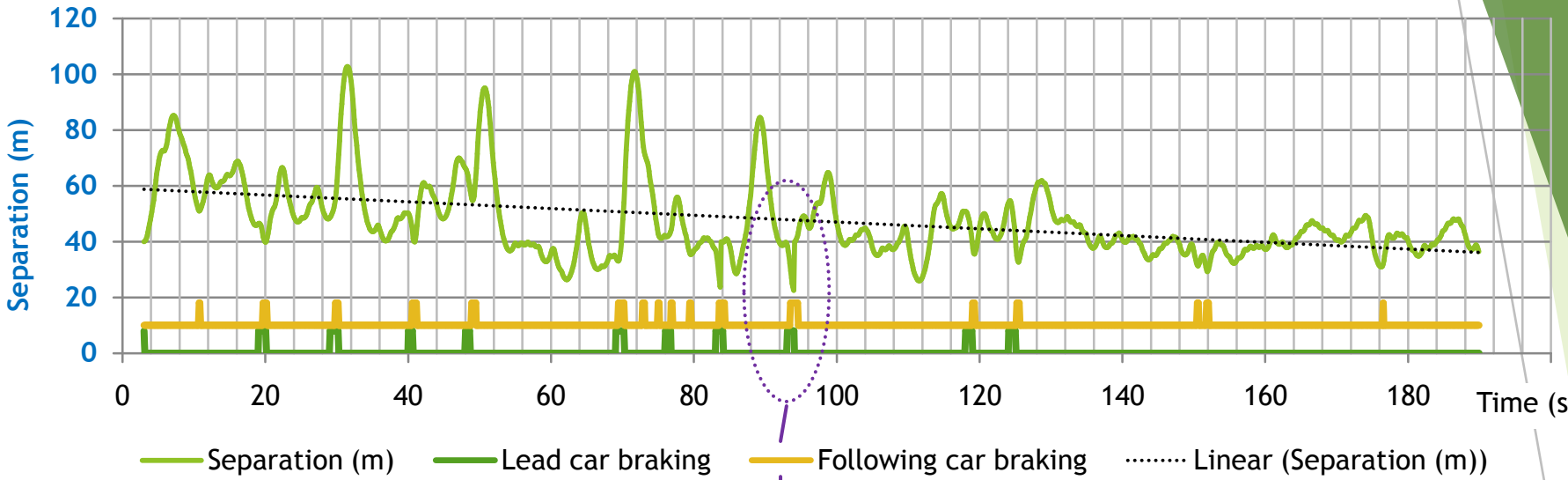
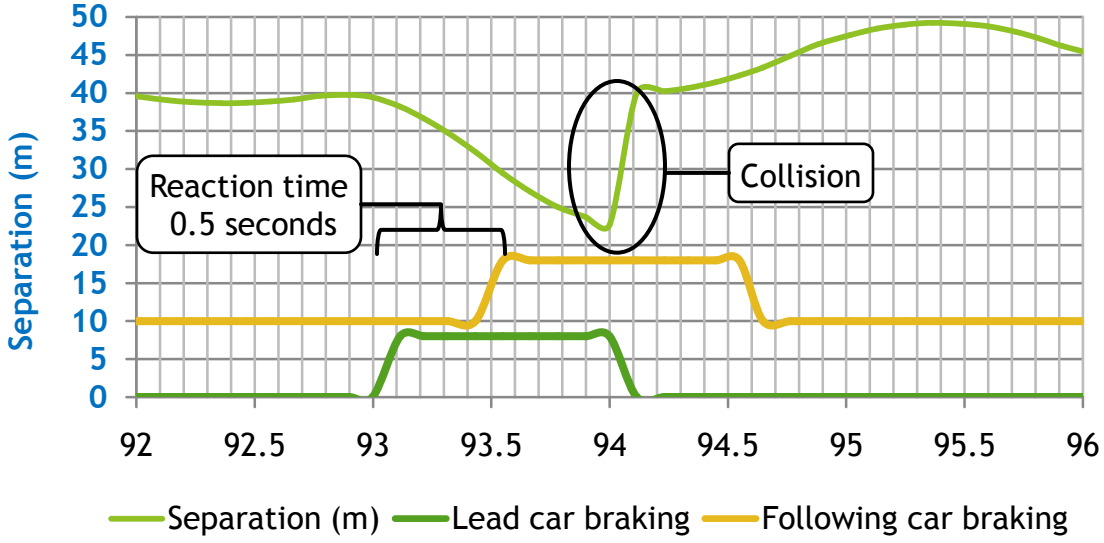
Typical sustained attention data



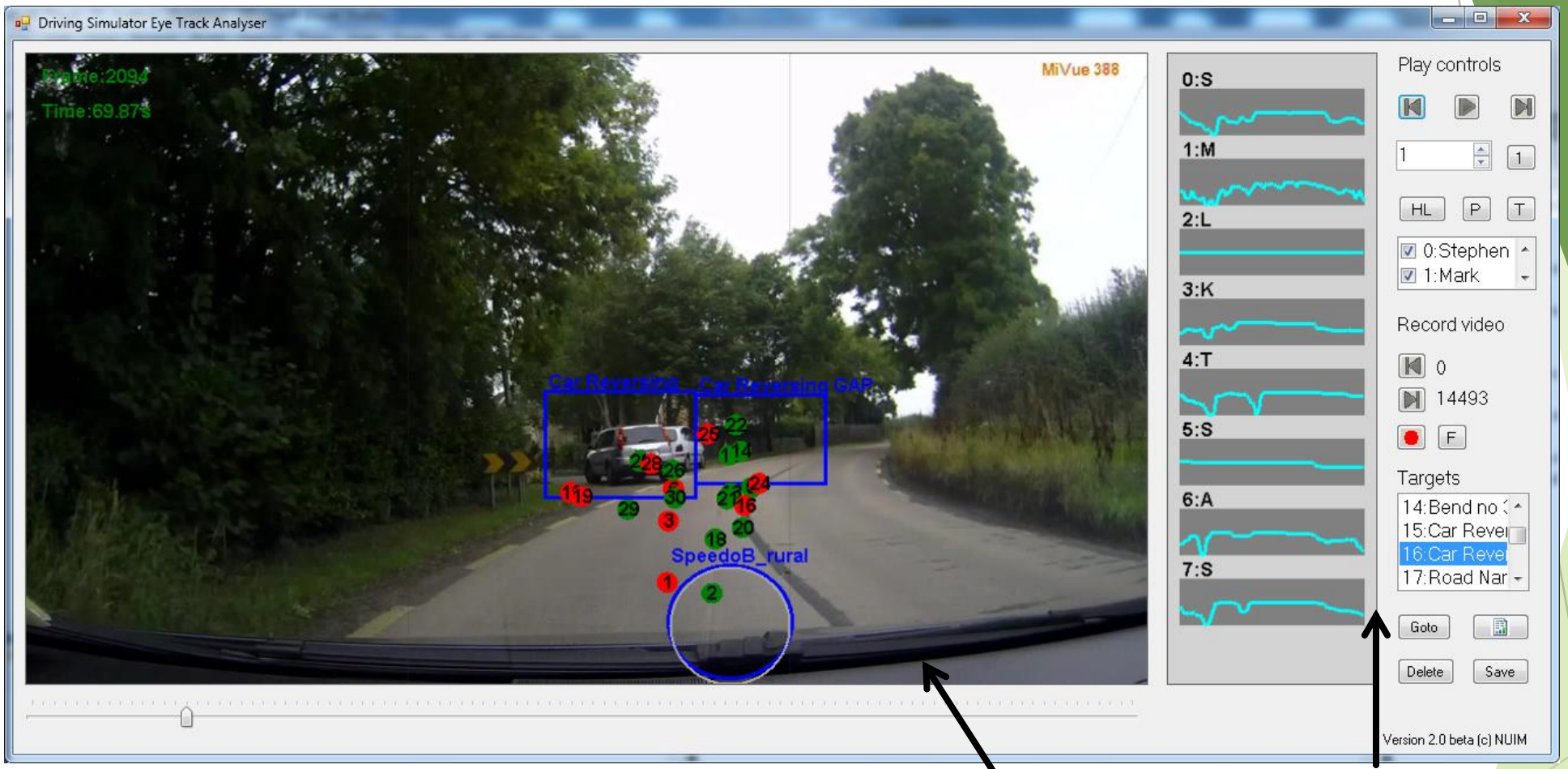


Average separation: 47.5m

Reaction time: 0.5s

Collisions: 2

Eye Tracking on a Rural Road-High and Low Attenders



Pedal position

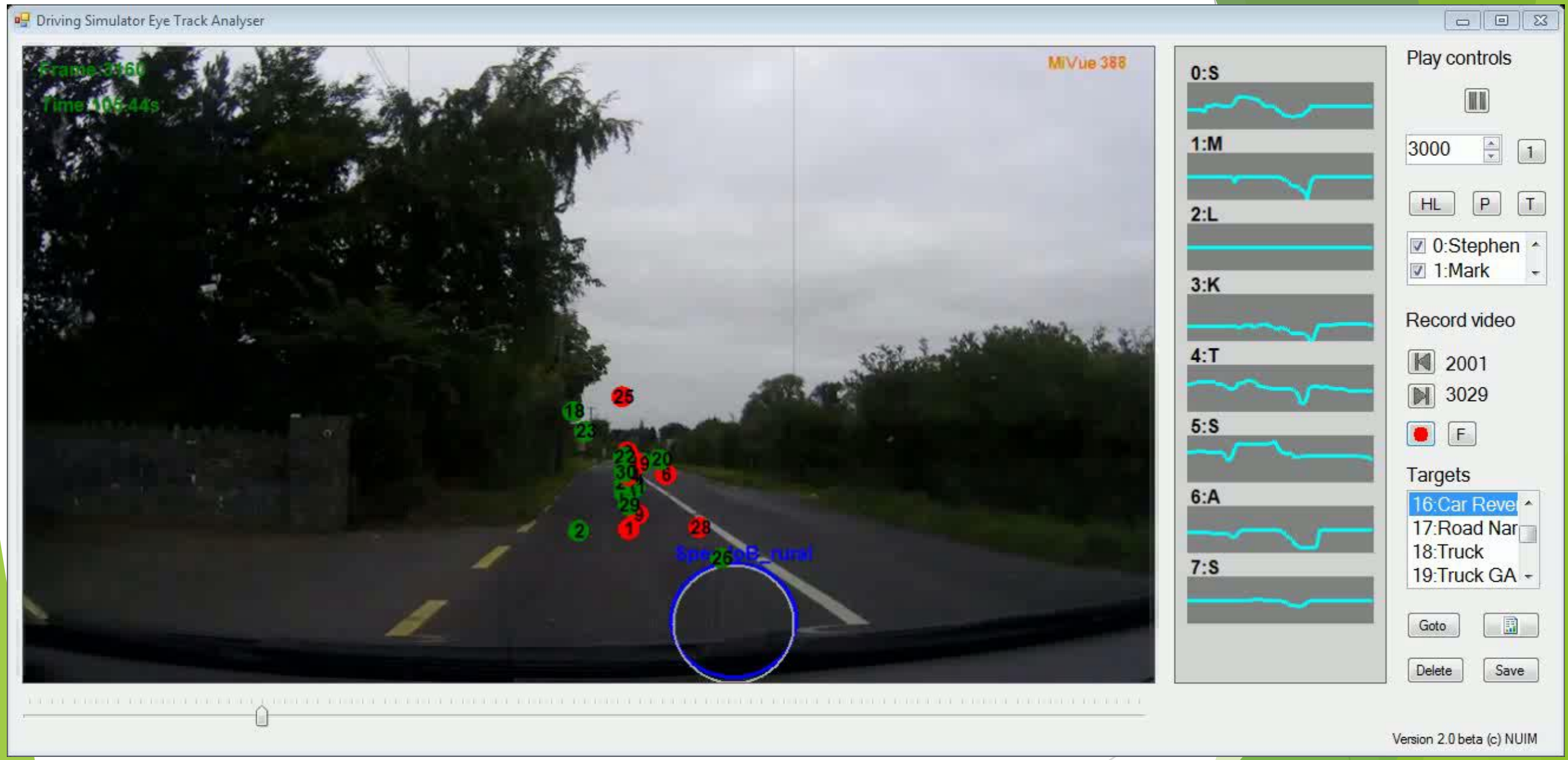
Target area

1 Low attention

2 High attention

Driver view and eye-gaze

31 Subjects, 11 High, 13 Low


Driving Simulator Eye Track Analyser
Frame 3160
Time 105.44s
MiVue 388
0:S
1:M
2:L
3:K
4:T
5:S
6:A
7:S
Play controls
3000
1
HL
P
T
0:Stephen
1:Mark
Record video
2001
3029
F
Targets
16:Car Reve
17:Road Nar
18:Truck
19:Truck GA
Goto
Delete
Save
Version 2.0 beta (c) NUIM

Targets: Motorway road sign

Pedal position

Driver view and eye-gaze

Target area

1 Low attention

2 High attention

31 Subjects, 11 High, 13 Low

Individual response to an individual event

Target view counted in terms of frames

Index	Name	Car Rev.	Gap	M3 Navan
0	St...	0	0	51
...	...	...	...	...
6	Ai...	10	0	17
7	Sh...	1	0	56
8	Da...	5	0	49
9	Al...	16	1	0
10	Do...	20	0	33
11	Ne...	10	6	82
...	...	...	...	...
27	Pa...	2	15	4
28	Pe...	7	2	10
29	Ra...	7	0	9
30	An...	0	0	0

Accelerator pedal position (Car Reversing)

Index	Name	Before	During	After
0	St...	0.25	0.32	0.7
...	...	...	...	...
6	Ai...	0.45	0.26	0.44
7	Sh...	0.39	0.24	0.45
8	Da...	0.21	0.07	0.38
9	Al...	0.21	0.09	0.23
10	Do...	0.31	0.21	0.35
11	Ne...	0.45	0.32	0.49
...	...	...	...	...
27	Pa...	0.42	0.44	0.49
28	Pe...	0.21	0.13	0.38
29	Ra...	0.31	0.24	0.39
30	An...	0.72	0.79	0.97

Individual overall response to the route

Time to drive route

Index	Name	Rural (S)	Motorway (S)
0	St..	291.4	273.9
...	...	...	...
6	Ai..	276.5	275.4
7	Sh..	244.7	275.2
8	Da..	387.2	174.4
9	Al..	414.9	586.4
10	Do..	305.6	495.9
11	Ne..	272.5	428.7
...	...	...	...
27	Pa..	329	278.5
28	Pe..	345.3	433.4
29	Ra..	365.3	555.9
30	An..	139	269

Count of speedo. “looks”

Index	Name	Rural	Motorway
0	St..	39	44
...	...	...	...
6	Ai..	65	42
7	Sh..	51	21
8	Da..	31	63
9	Al..	65	27
10	Do..	94	79
11	Ne..	46	49
...	...	...	...
27	Pa..	11	91
28	Pe..	95	149
29	Ra..	76	39
30	An..	6	10

Group response to an event or target

Mean view per driver (frames)

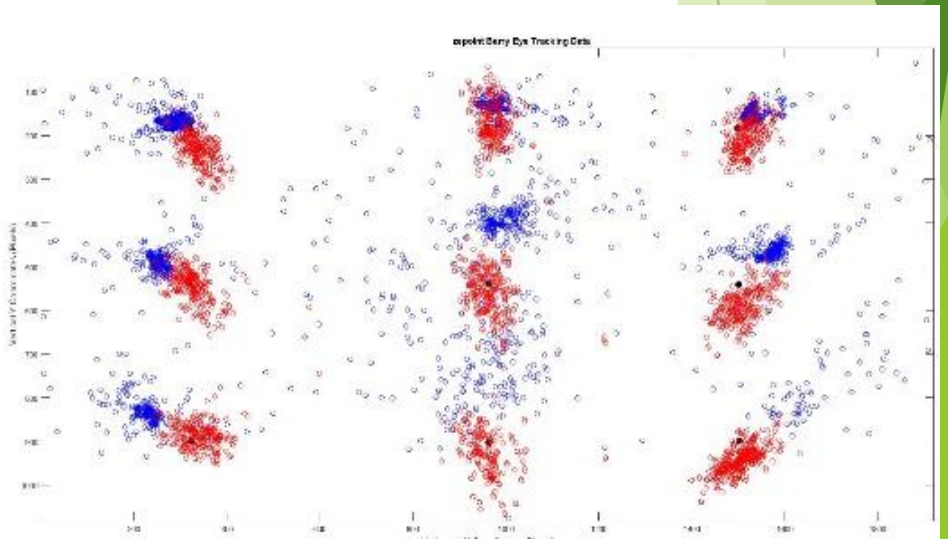
Name	Mean frame count
HorseNCart A	29.8
HorseNCart B (GAP)	9.6
Car Reversing	7.3
Car Reversing GAP	2.8
Road Narrowing Sign A	0.2
Dog Walkers	5.1
Dog Walkers- GAP	9.2
Big Bend RIGHT	4.3
Brown Sign (Services) vs M3 Staight Line Target Box 2	1.2
M3 Navan Exit Left Kells & Cavan Straight	29.6
NAVAN Exit Immediate Left	11.5
Exit 8 Left	0.0
Caution Signs M3	0.2
Speed Sign M3 120 KM	0.0
Speedo_Rural	271.8
Speedo_Motorway	375.7

Eye Gaze Measurements

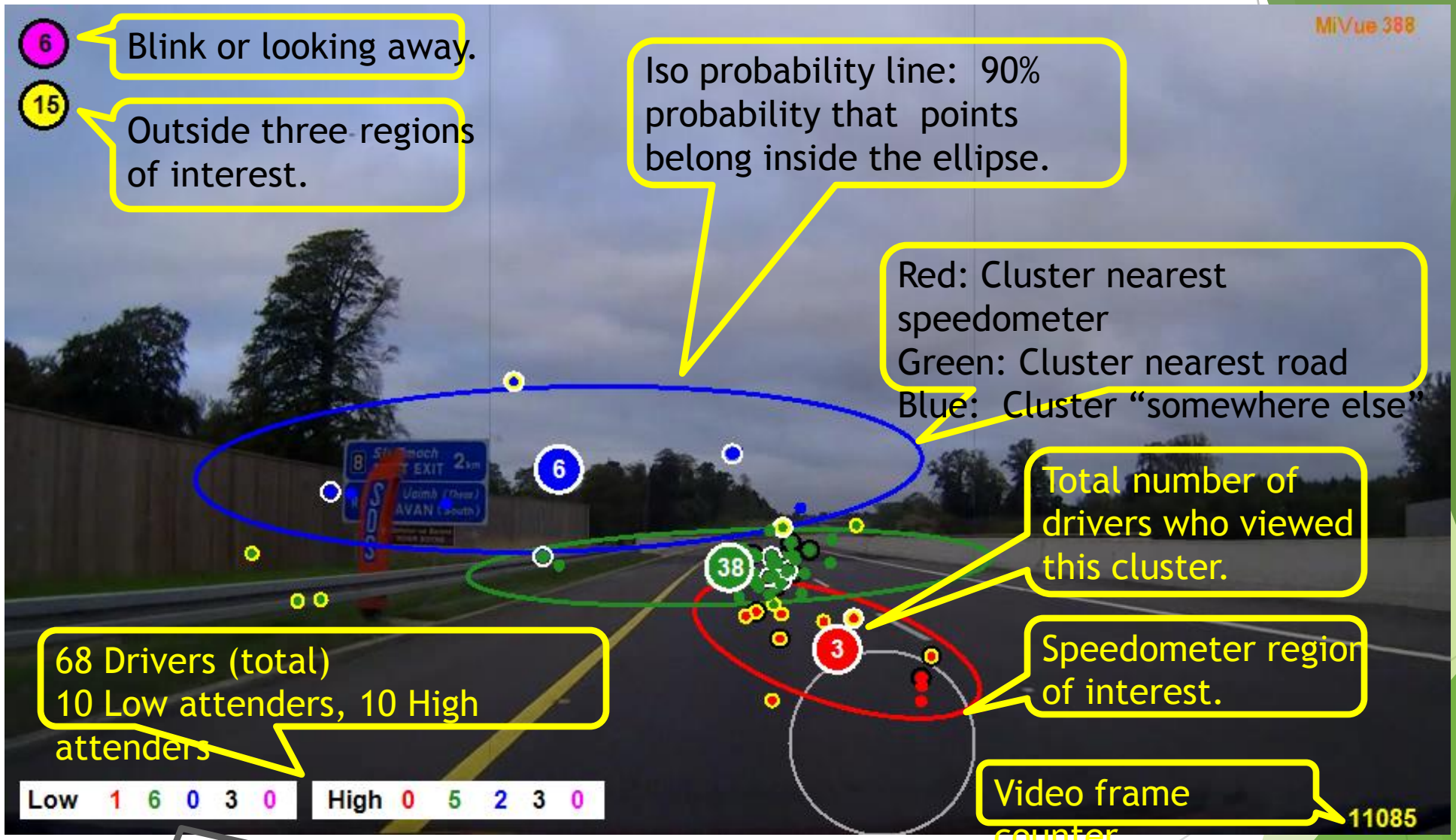
Low-Cost Eye Trackers

Eyetribe

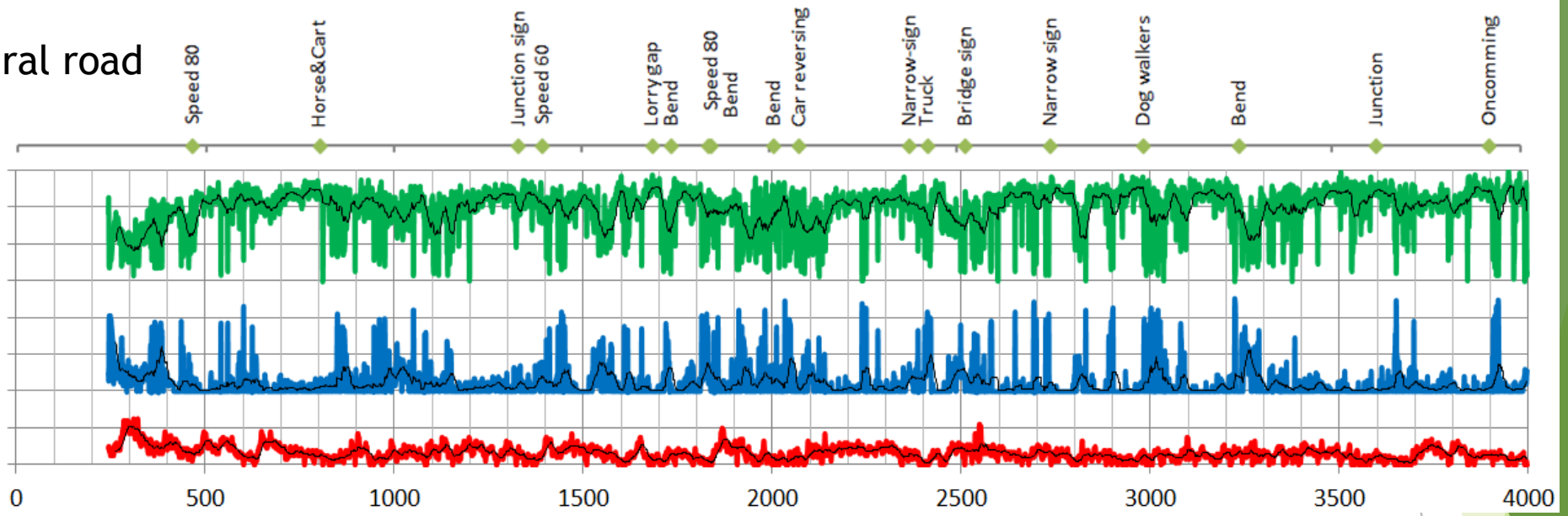
Gazepoint GP3



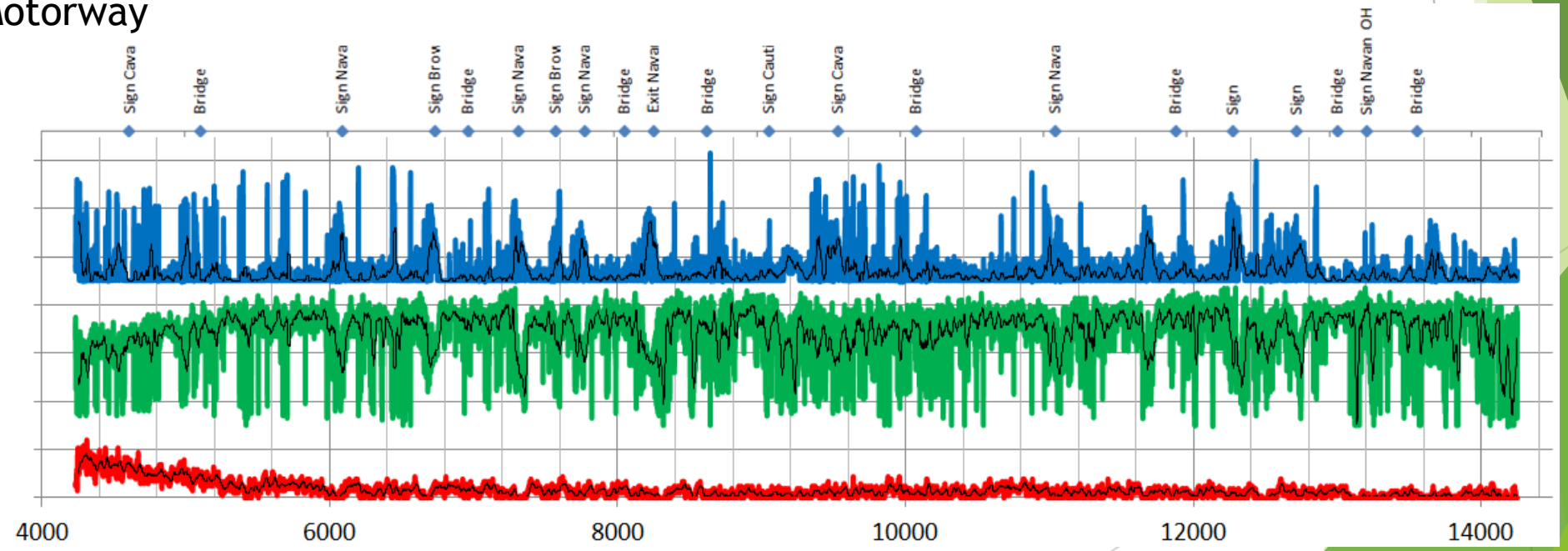
Advanced analysis – Where did they look?



Rural road

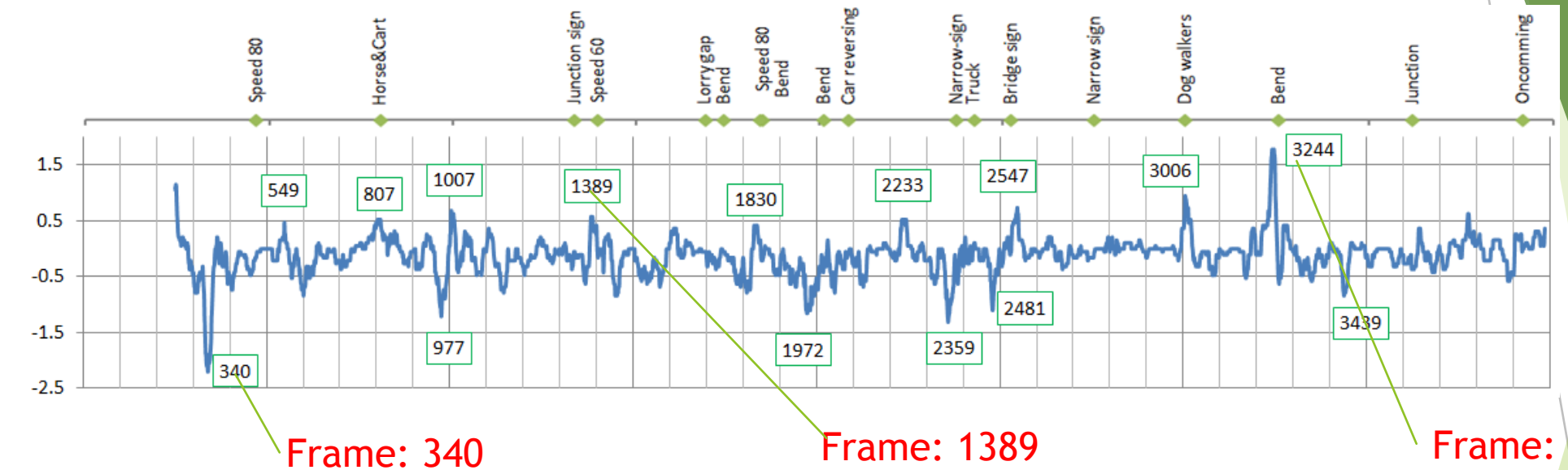


Motorway

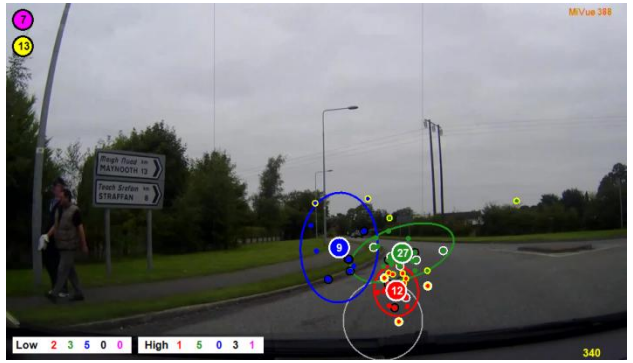


68 drivers, Red “speedo”, Green “road”, Blue “something else”

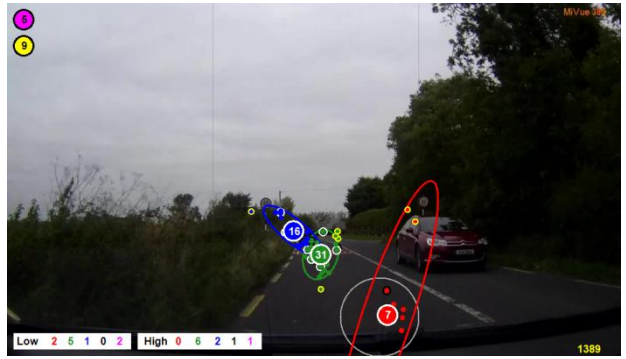
Rural– difference between high and low attenders (20pt moving average)



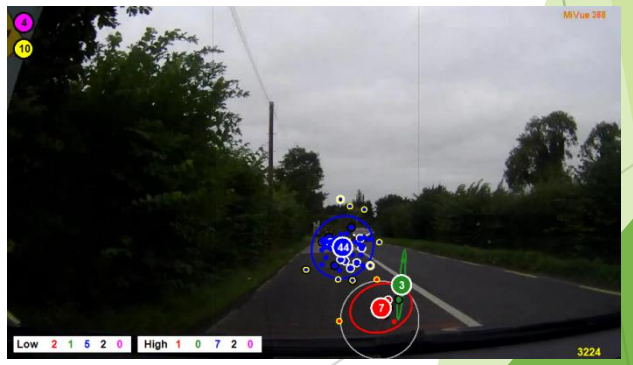
Frame: 340



Frame: 1389



Frame: 3244



Rural road summary

High attenders check speedometer 10% more

Both look at road equally

Low attenders look around 18% more

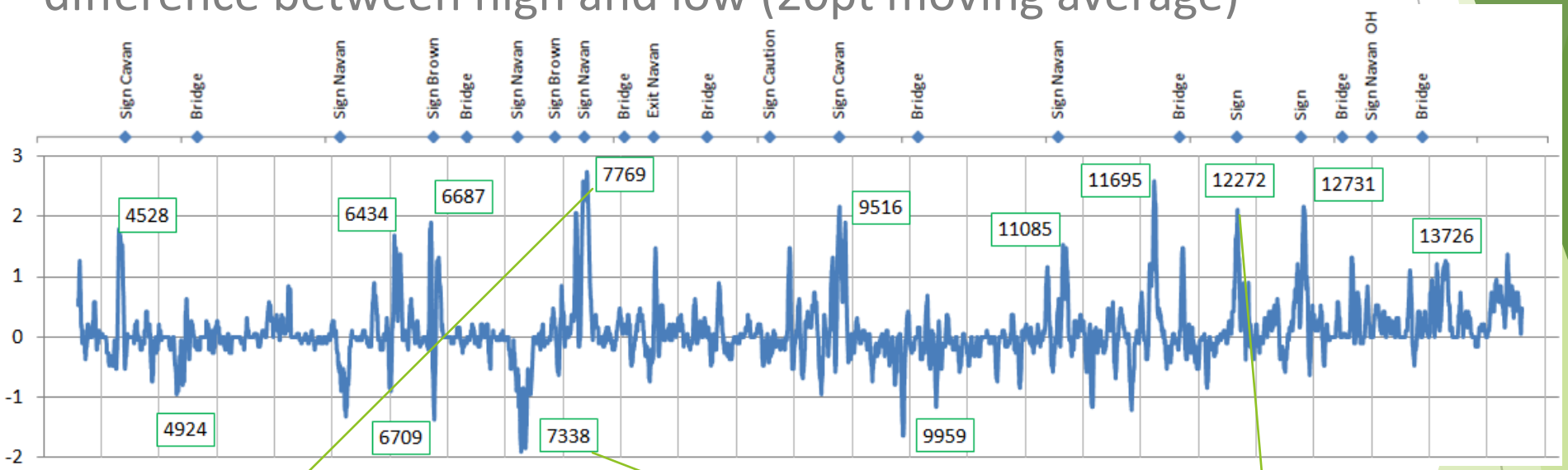
Motorway summary

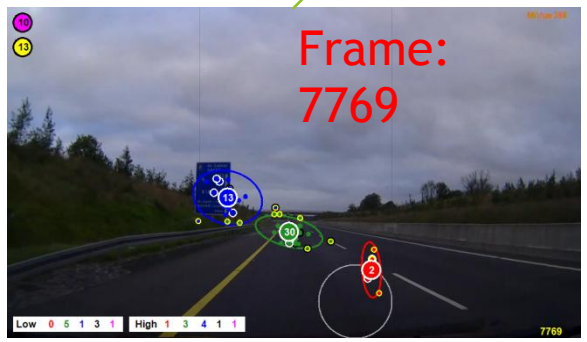
High attenders check speedometer 6% more

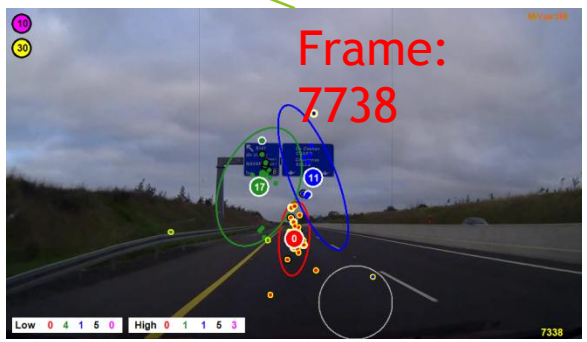
Both look at road equally

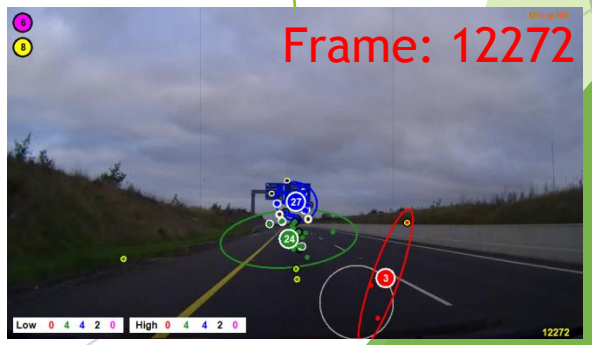
Low attenders look around 20% more

Motorway – difference between high and low (20pt moving average)









Previous Findings

- 30-60% accidents due to distraction factors
- Much of the simulator based research has been concentrating on in-vehicle distraction factor(i.e.mobile phones, in-vehicle information systems)
- Experienced, as well as novice drivers, are likely to be distracted and involved in accidents

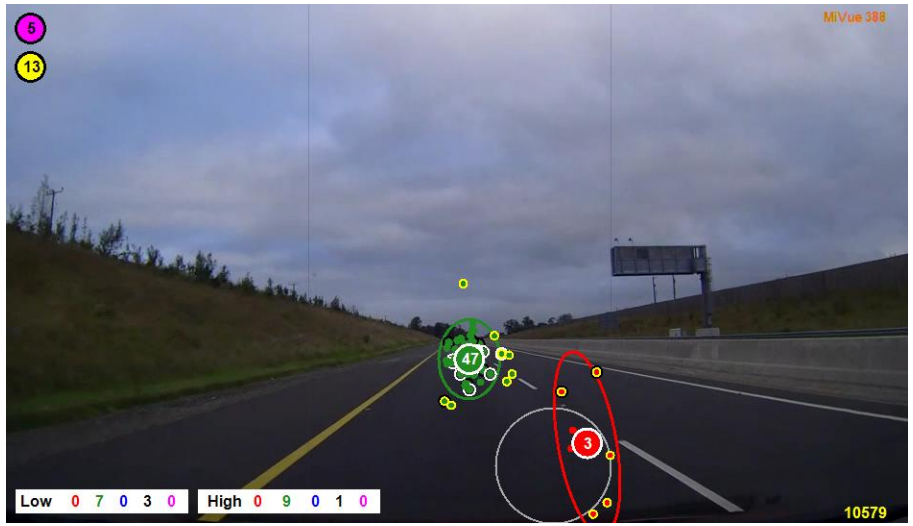
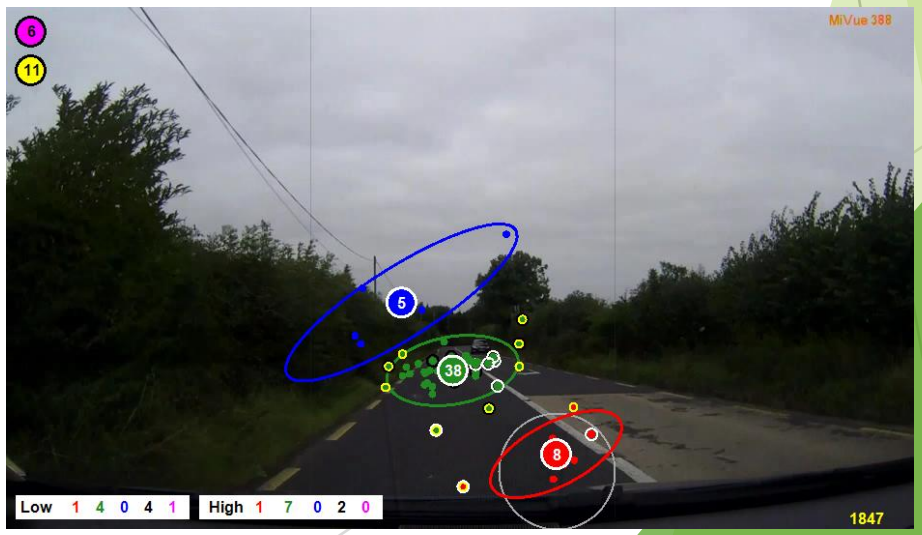
General Research Aims

- Investigate the complex relationship between the driver and road environment.
- Using-simple driving simulators,synchronised bio-feedback devices ~(eye tracking, EEG).

Proposed Study

- To investigate the potential for distraction of additional structures on selected parts of the Irish road network
- Focus on distraction sources outside the vehicle
  - Eg- advertising hoardings, artworks, signage

    To what extent will these structures cause a distraction?

    Rural vs urban locations-will driver response vary ?

    Will driver response settle over time?