ITVP2 RADAR – TECHNICAL REPORT
TRIAL RESULTS VS INDUCTIVE LOOPS &
VIDEO SENSOR

(ISSUE 1)

Stop line sensor

Author: ICOMS
For: traffic engineers, traffic maintenance companies, traffic controllers manufacturers etc.

Notice

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1 CONTENTS

2   INTRODUCTION

The purpose of the document is to show the results of ICOMS DETECTIONS R&D tests regarding the accuracy of the radar "**ITVP-2"**, especially designed to detect as well moving vehicles approaching a traffic light at 40 m, as vehicles stopped at the stop-line.

ICOMS can of course understand that for some of you this report can't be considered as a neutral report and therefore invites you to confirm those results through your own tests and build your own experience.

3   KEY-POINTS

ITVP-2
- is an above ground sensor (non intrusive);
- is based on the Doppler effect, combined with FSK and a tracking algorithm (microwave technology);
- is equipped with 2 relays : 1 for moving vehicles on a distance of 40 m from installation point, 1 for stopped and moving vehicles on an adjustable distance from the installation point (8, 10 or 15 m);
- is designed to replace inductive loops or other commonly used technology for traffic lights actuation;
- needs no setting software and is installed in minutes.

4   TRIAL SITES

4.1 LOCATION 1

4.1.1 Place
- Junction Waterloosesteenweg (N5)/Schilderachtige Dreef, 1180 Ukkel
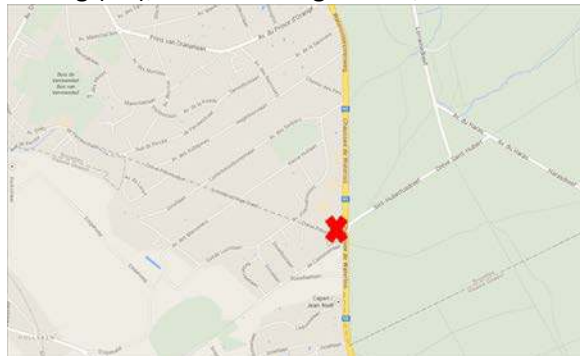
4.1.2 Test date
- From 12 June 2015 to 18 June 2015

4.1.3 Technologies involved in the trial
- ITVP2
- Trafficam
- Video recording

4.2 LOCATION 2

4.2.1 Place
- Junction Haachtsesteenweg/Metrologielaan, 1130 Haren
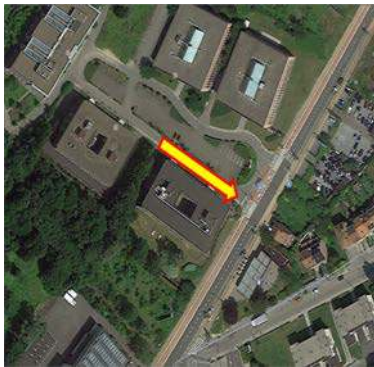
4.2.2 Test date
- From 19 Augustus 2015 to 28 June 2015

4.2.3 Technologies involved in the trial
- ITVP2
- Stop line inductive loop

4.3 LOCATION 3

4.3.1 Place
- Junction rue du Pont/Quai du Gravier, 6980 La Roche-en-Ardenne

4.3.2 Test date
• From 14 September 2015 to 15 September 2015

4.3.3 Technologies involved in the trial
• ITVP2
• Stop line inductive loop
• TM60

4.4 LOCATION 4

4.4.1 Place
• Junction N50/N368 Kortrijksestraat/Prodijsstraat, 8020 Ruddervoorde

4.4.2 Test dates
• From 24 September 2015 to 25 September 2016.

4.4.3 Technologies involved in the trial
• ITVP2
• Inductive loop at 16 m
• TM60

4.5 LOCATION 4B

4.5.1 Place

- Junction N50/N368 Kortrijksestraat/Prodijsstraat, 8020 Ruddervoorde
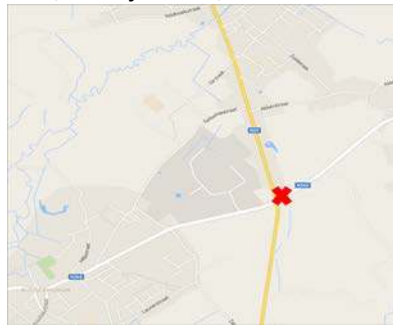- Settings slightly changed : increased side inclination

4.5.2 Technologies involved in the trial

- ITVP2
- Inductive loop at 16 m
- TM60
- Video recording

4.5.3 Test dates

- From 6 June 2016 to 8 June 2016.

4.6 LOCATION 5

4.6.1 Place

- Junction N50/N370 Wingenesteenweg/Kortrijksestraat, 8750 Hille (Wingene)
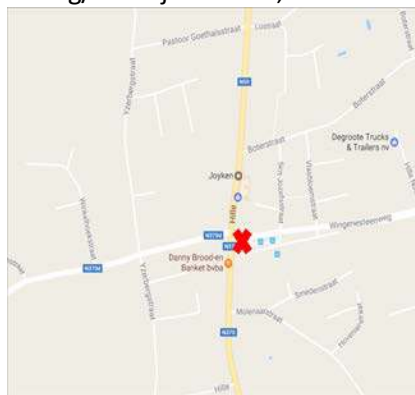
4.6.2 Test dates

- 7 July 2016 – radar is still working on site

4.6.3 Technologies involved in the trial

- ITVP2
- Stop line loop
- TM60

5 DATA COLLECTION PROCESS

For each test site, we analyzed a period of 24h, excepted for location 3, due to controller limitation. The data logger has a log for 10 000 events, which was full within 18h.

The data are recorded by the data logger of the controller and analyzed by time bins of 30 minutes.

Recorded information :
- radar relay state (stop line relay only)
- loop or Trafficam relay state
- traffic light phases
- for location 1 and 4b, video recording on hard drive

On location 3, we could make a comparison for relay 2 (movement detection at 40 m) with an approach radar (Icoms TM60). We roughly compared the detection curves of both technologies and could observe they were similar.

6   COMPARISON METHODOLOGY

6.1   COMPARISON TECHNOLOGIES

On location 1, we compared with a video system (FLIR Trafficam) and a video recording to understand where was the error when we observed a difference between the radar and the Trafficam.

On the other sites, we compared with a stop line loop. Our basic premise is that the loop is 100 % accurate (which is not 100 % true, please refer to chapter 8.2.2).

6.2   POTENTIAL ERRORS

Each traffic light cycle can be divided in 4 potential events :
- if there is no vehicle, no detection can occur
- when a vehicle arrives, it must be detected
- when it stops at the stop line, the detection must be hold up to the departure of the vehicle
- when the vehicle starts again at the green light, the contact must be released.

We analysed separately each type of potential error, for each traffic light cycle :
- Error 0: "unwished detection" - the radar detects something the comparison technology does not detect (pedestrian, bicycle ...)
- Error 1 : no detection of a vehicle arriving at the stop-line
- Error 2 : detection output lost when a vehicle is stopped
- Error 3 : no detection when a vehicle leaves

It means we computed the accuracy on the number of cycles basis (% of error related to the number of traffic lights cycles), but also on the number of events (potential errors) basis.

6.3 COMPARISON BASIS

Example of a 30 min. period without error (location 1) :
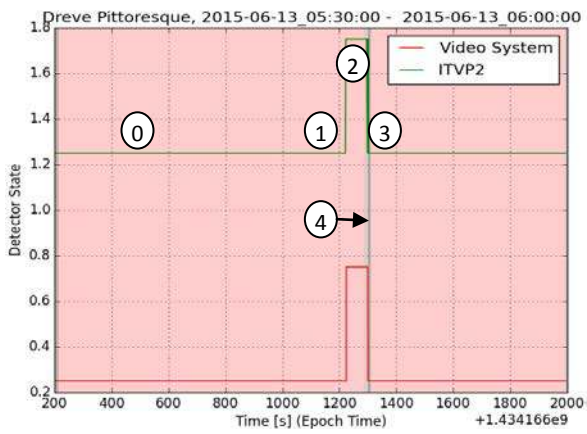
0 : no unwished detection
1 : arrival detection, relay on
2 : relay on while vehicle is waiting at the red light
3 : departure of the vehicle
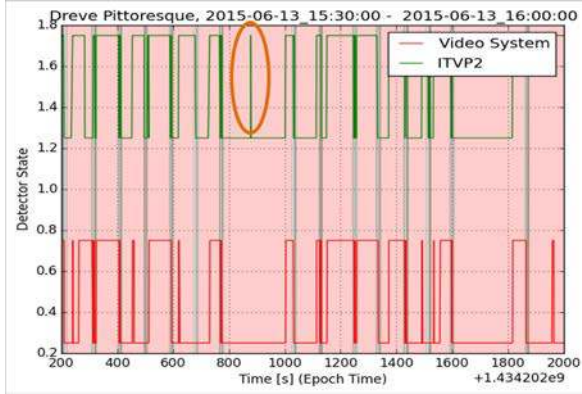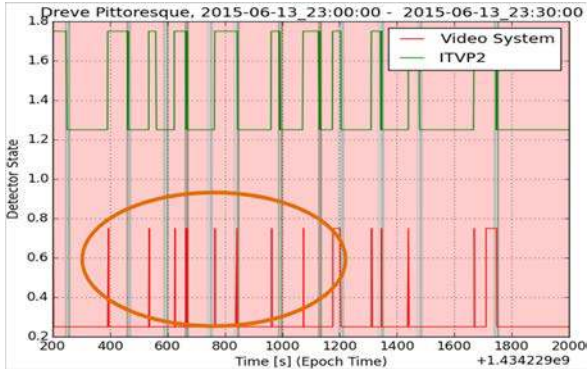4 : green phase

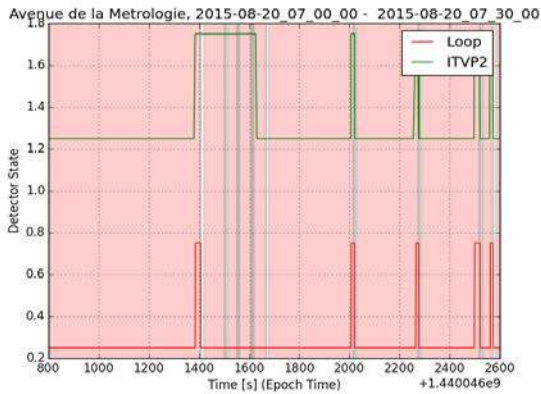Example of an error 0 (in this case, detection of a bicycle, location 1) :

Example of an error 2 from the video system (proven by video recording, location 1) :

Example of an error 3 from the radar (location 2) :

7 RESULTS

	# error 0	# error 1	# error 2	# error 3	Total # errors	# cycles	Accuracy per cycle	# potential errors *	Accuracy per event
Location 1	2	0	5	14	21	524	96%	2096	99%
Location 2	5	0	0	25	30	336	91%	1344	98%
Location 3	12	23	3	13	51	861	94%	3444	99%
Location 4	4	0	0	93	97	1125	91%	4500	98%
Location 4b	12	0	3	39	54	1101	95%	4404	99%
Location 5	75	75	20	2	172	885	81%	3540	95%
Total	110	98	31	186	425	4832	91%	19328	98%
Accuracy per error type	98%	98%	99%	96%					

* : number of cycles x number of events per cycle (4)

8 OBSERVATIONS AND NOTES ABOUT THE METHODOLOGY

8.1 IMPACT OF EACH ERROR TYPE

Each error type has not the same impact on the intersection regulation.
• Error 0 : generates an unwished call (see hereunder, 8.2.1)
• Error 1 : no call for a given vehicle (see hereunder, 8.2.2)
• Error 2 : in the event the vehicle does not start at the green, it is "forgotten" until a new vehicle approaches.
• Error 3 : generates unwished calls.
  • The impact of this type of error can be decreased by reducing the maximum relay hold time;
  • The arrival of new vehicle will generate a new call on relay 2 and generate a new cycle.

8.2 ERROR 0 & 1 DILEMMA

8.2.1 Error 0 – "unwished" detections

The test on location 1 and location 4b where we could compare with a video recording showed that unwished detections are mostly due to :
• Bicycles, scooters, bikes and motorbikes : these are, in fact, no unwished detections.

- Tractors, which are too high for the loops
- Pedestrians : this is the only really unwished detection category.

We considered each detection of the radar without detection of the comparison technology as an error, because it is impossible to determine what the radar detects without a video recording (locations 2, 3, 4 and 5). On 4 of the 6 test locations, we could not know how many errors 0 were really due to pedestrians.

8.2.2 Error 1 – "missed" detections

We could observe this type of error only on 2 locations (3 and 5), where we could not rely on a video recording to objectivize the phenomenon.

On location 3, for these 23 "errors", only the inductive loop was activated (no detection from the standard movement detector TM60 or from any of the 2 relays of the ITVP-2). A visual observation, after a discussion with the local authority (SPW), could show that big trucks (raw logs transport) activated the stop line loop when turning from the embankment to the bridge. This is a typical "wrong direction fault" of the loop.

On location 5, we suspect the same kind of phenomenon, with a maybe too sensitive loop.

8.3 ERROR 3

This error (the radar does not release the relay when the vehicle leaves) is mainly due to the installation conditions :
- - distance between the installation pole and the stop line < 2 m
- - curve
- - …

Please observe the decrease of this error between test 4 and test 4b, after we changed the orientation of the radar.

9   ICOMS CONCLUSIONS

- The accuracy level of the *ITVP-2* is high compared to the Trafficam and loops reference, ranging from 96 to 98 % depending on the type of analyzed error**.**
- Significant radar advantages :
    - Constant accuracy, whatever the weather or environmental perturbations (no accuracy difference between day and night, or due to rain or temperature)
    - Direction sensitive
    - Installed in minutes, without digging the ground nor stopping the traffic
    - No software, no difficult installation

10 VARIOUS

- We delivered until now about 450 units of this model, among which 250 for the Brussels region and Wallonia. Other units were delivered in France, Great-Britain, Poland, Switzerland …

- These tests allowed us to check the accuracy of the product, but also to improve the user's guide, in order to answer most of the installation questions.

- Different video presentations are available, to better understand the functionalities of the product on one hand and our methodology on the other hand.

- ICOMS Detections is working on an evolution of this product, including a counting ability and self monitoring.

11 FAQ'S

- Can the ITVP-2 monitor more than 1 lane?
  - ⇒ It is intended to monitor 1 lane. The detection area is wide, but it is not possible to make separate detections for direction lanes, by example.
- Does the ITVP-2 detect the bicycles?
  - ⇒ YES
- Is the ITVP-2 sensitive to light?
  - ⇒ NO. It is insensitive to light and temperature. The working is exactly the same 24h/day.
- Power supply?
  - ⇒ 10-42 VAC/12-60 VDC
  - ⇒ 110-220 V
- How far can be the pole from the traffic?
  - ⇒ Max. advised distance is 2 meters.
  - ⇒ Min. distance with stopline : 2 m
- Height of installation?
  - ⇒ Between 3.5 and 4,5 m

12 ADDITIONAL INFORMATION

Issue Record

Issue	Author	Comment
Issue n°1	*C. Bauvin*	*May 2017*

12.1 ABOUT ICOMS

Icoms Detections SA develops, manufactures, and supplies microwave sensors for traffic applications: Intersections, Warnings, Data collection.

Thanks to 20 years experience and thousands of radars supplied worldwide, Icoms Detections is considered as a reliable partner and supplier in the ITS industry.

Quality, long term business relationship, flexibility, continuous communication between its suppliers, partners and customers, allow the company to supply market-minded products and therefore allow your company to propose a very flexible and adapted solution to your customers.

12.2 DETAILS

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