



Dwight David Eisenhower Transportation Fellowship Program



Multi-Sensor Vehicle Tracking

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Introduction

- ⦿ Global Positioning System (GPS) is a navigational system involving satellites and computers that can determine the latitude and longitude of a receiver.
- ⦿ GPS gave information about :
 - Where a person or vehicle is at a given time,
 - What route it takes,
 - How fast is going.
- ⦿ All these information is obtained with a level of accuracy of plus or minus a few meters for location, and to the nearest second or less in time.

Objectives

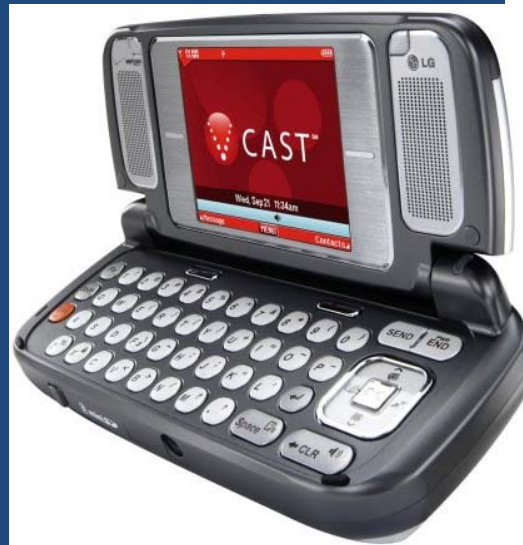
- To measure the lateral distance of a vehicle from the lane marking on the road.
- Observe the variation of the lateral distance at different situations using video camera.
- Compare the accuracy of a GPS of 5Hz vs. 1Hz.
- To try and compare the measurements in reality with the one obtained from GPS to verify its accuracy.

Problem

- ⦿ It is very difficult to obtain and analyze the data of the driver's behavior
- ⦿ Most of the data obtained of driver's skills and styles are based on self-reported scales, like ones obtained from driving simulation.
- ⦿ The majority of the drivers don't keep the vehicle in the middle of the lane, and deviate laterally depending on the vehicle movements.

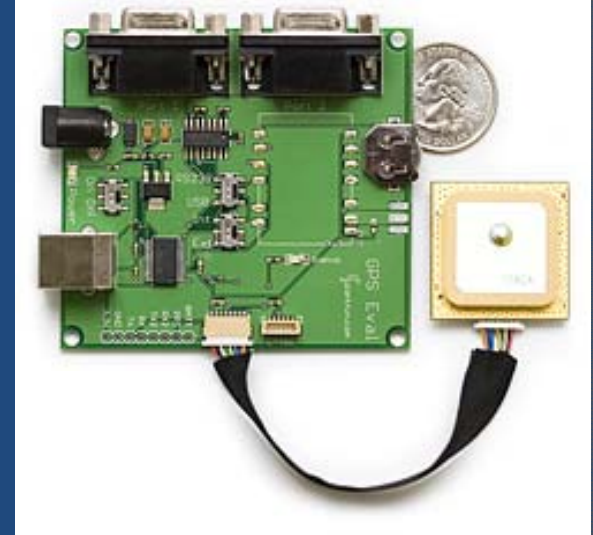
Causes of lateral moving

- It can be produce by distractions inside the vehicle like:
 - Cell phones
 - GPS
 - iPod / iPhone
 - Radio
 - Clock
- Traffic signs
- Avoid objects and potholes.



Project Description

- Operate a vehicle with a GPS and a recording camera, from URI to Wakefield and vice versa.
- The camera recorded the front-left tire of the vehicle
- GPS was at 1Hz and 5Hz

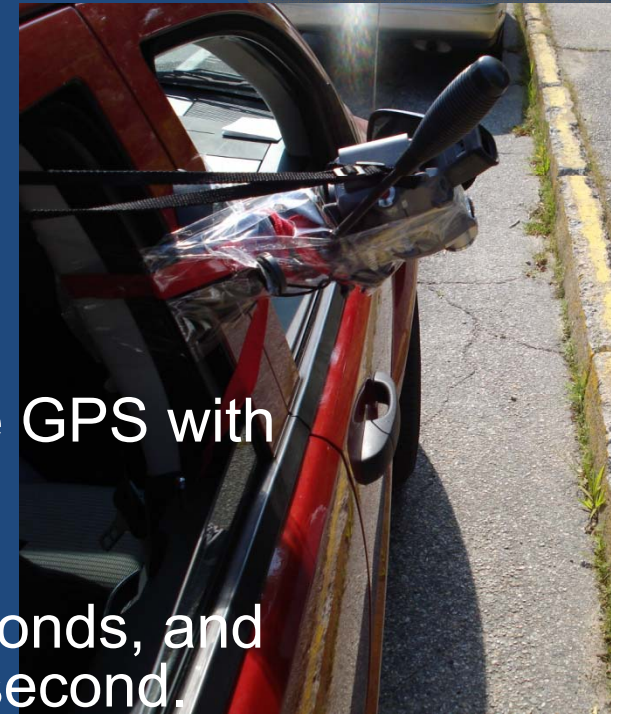


GPS Evaluation Board

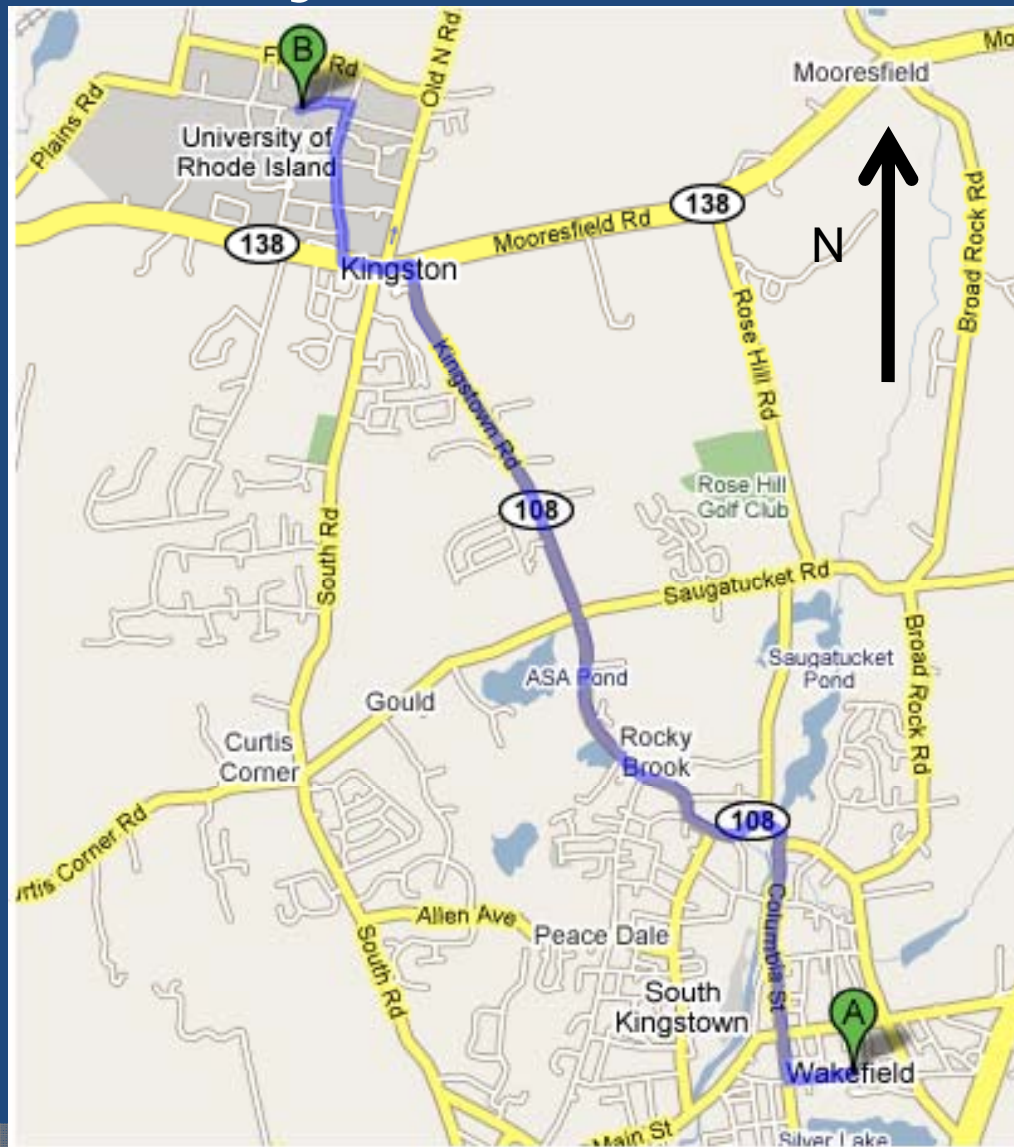


Project Description

- Synchronized the data collected from the GPS with the video recording, and time.
- The camera recorded 30 images per seconds, and the GPS collected 1 and 5 samples per second.
- Measure with a scale on the video the lateral distance and compare it with the GPS data.
- Compare the accuracy of the trace using GPS with 1Hz vs. 5Hz



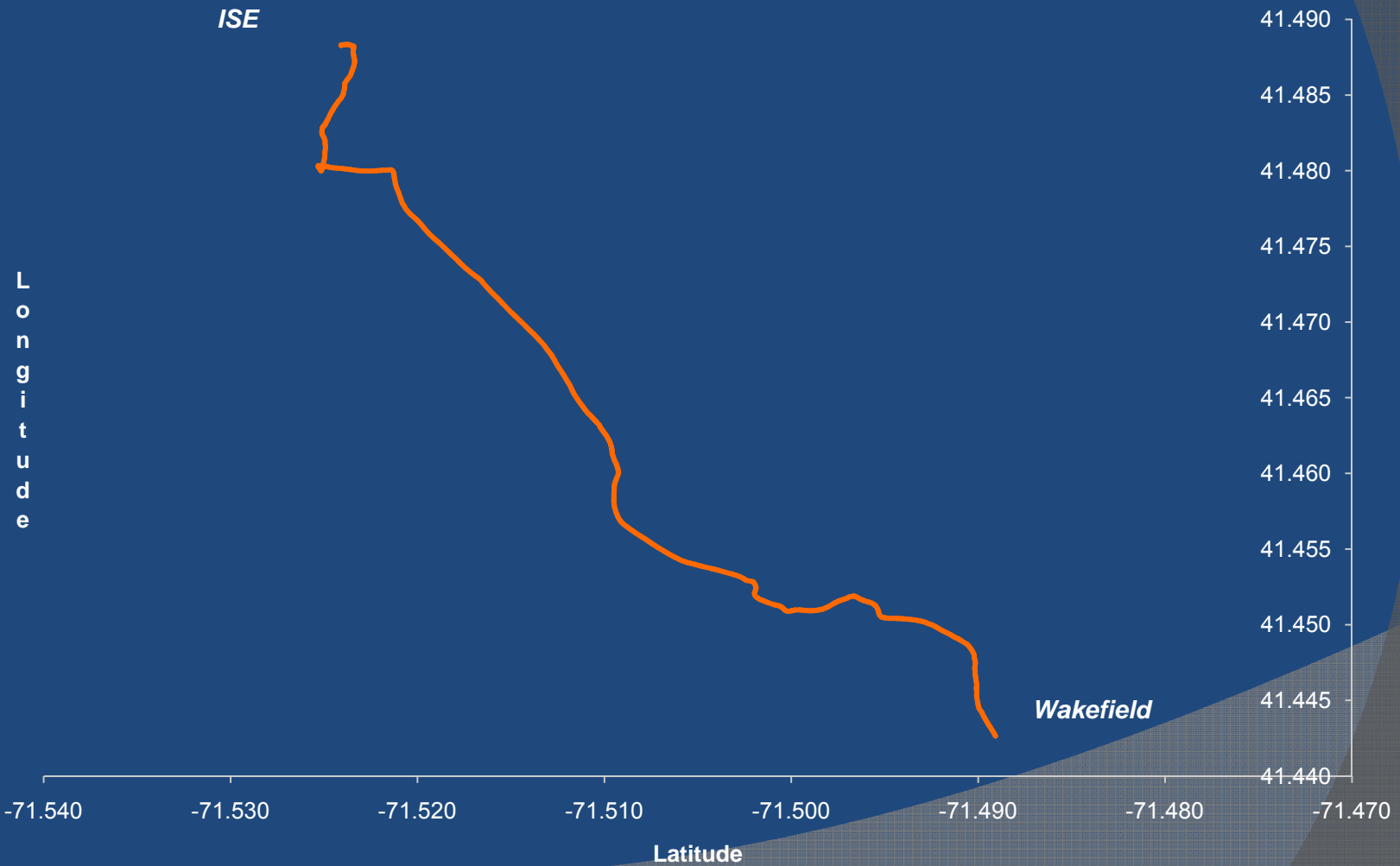
Area of study



4.5 miles

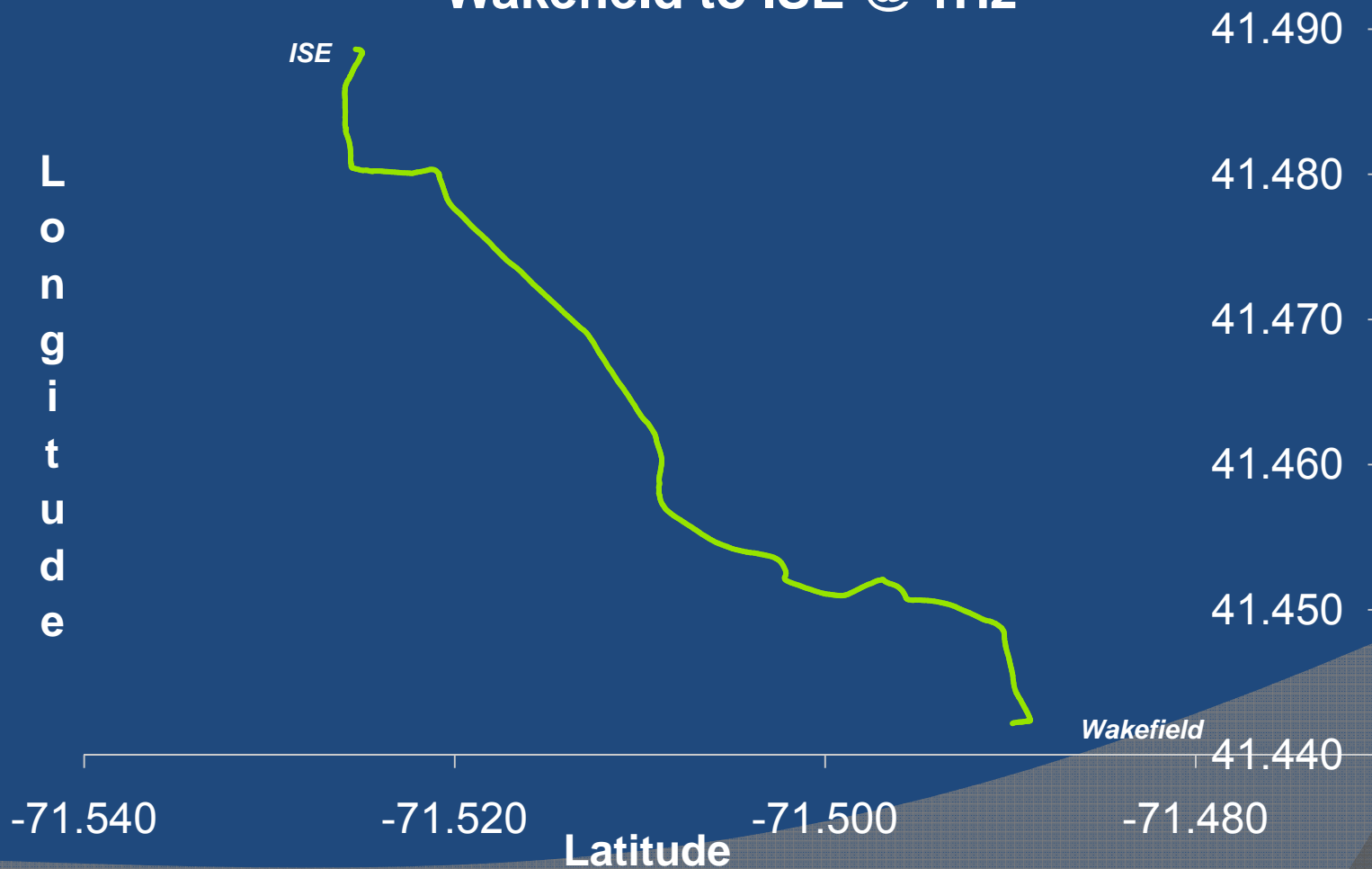
Project's Results

ISE to Wakefield @1Hz



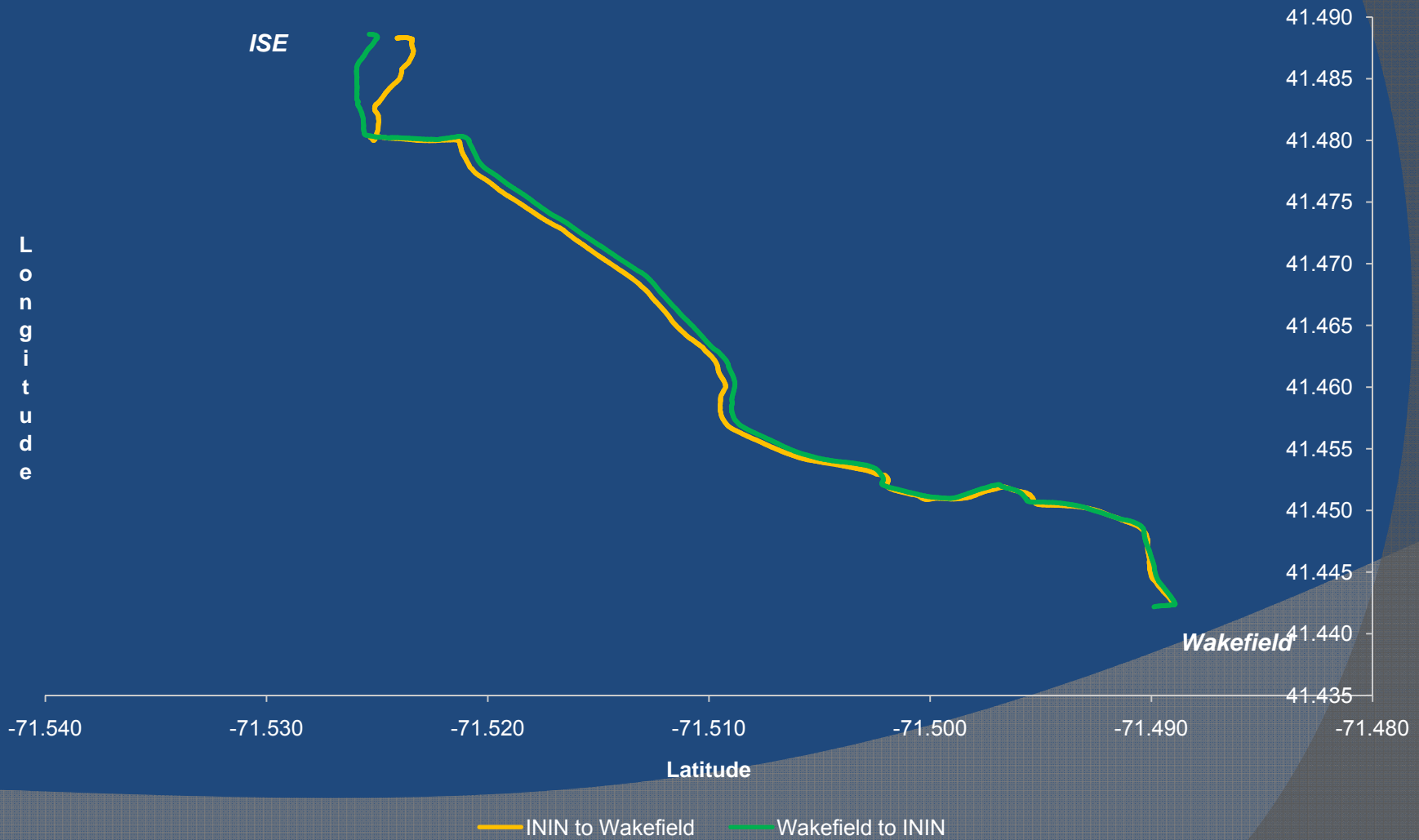
Project's Results

Wakefield to ISE @ 1Hz



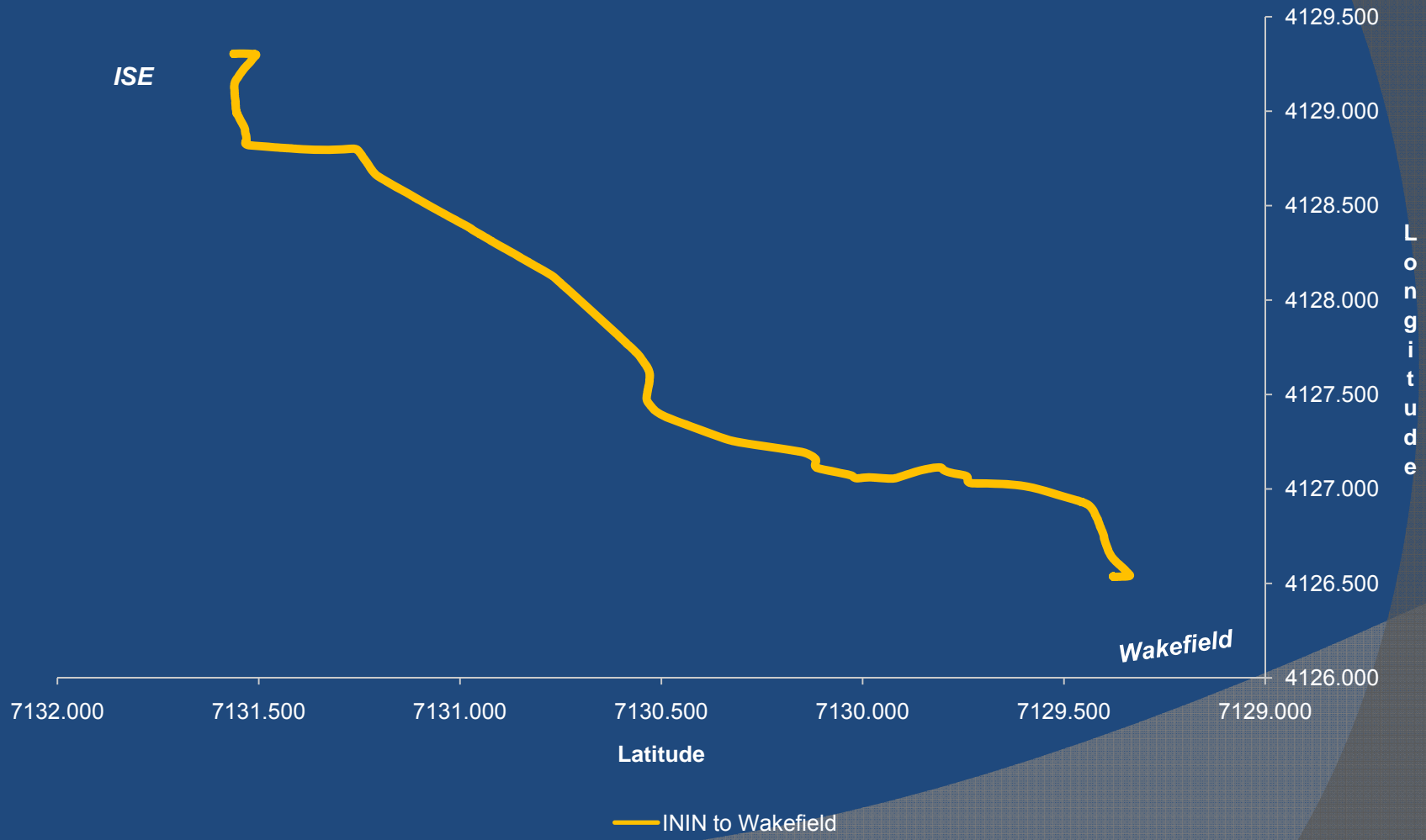
Project's Results

Both Traces @ 1Hz



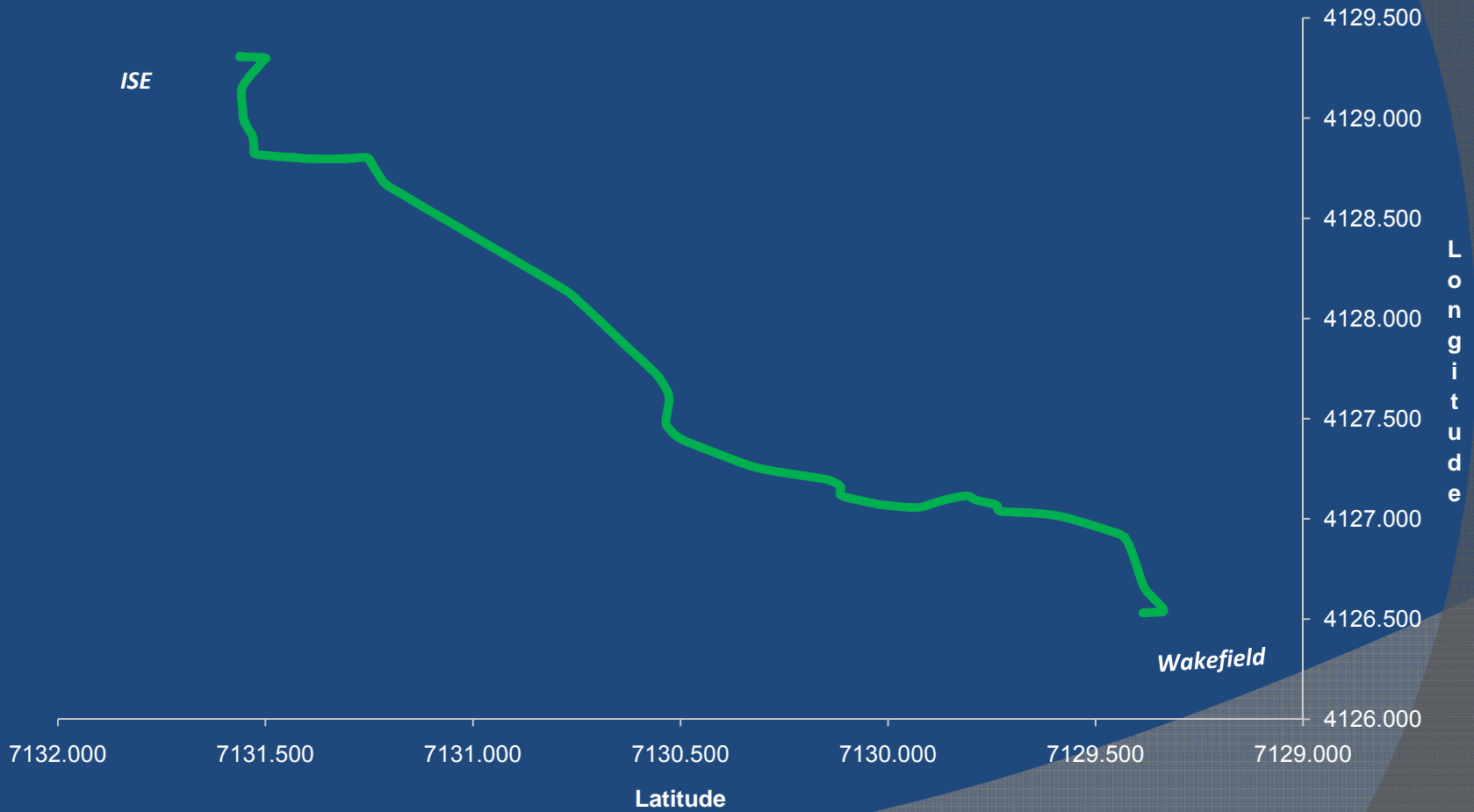
Project's Results

ISE to Wakefield @ 5Hz



Project's Results

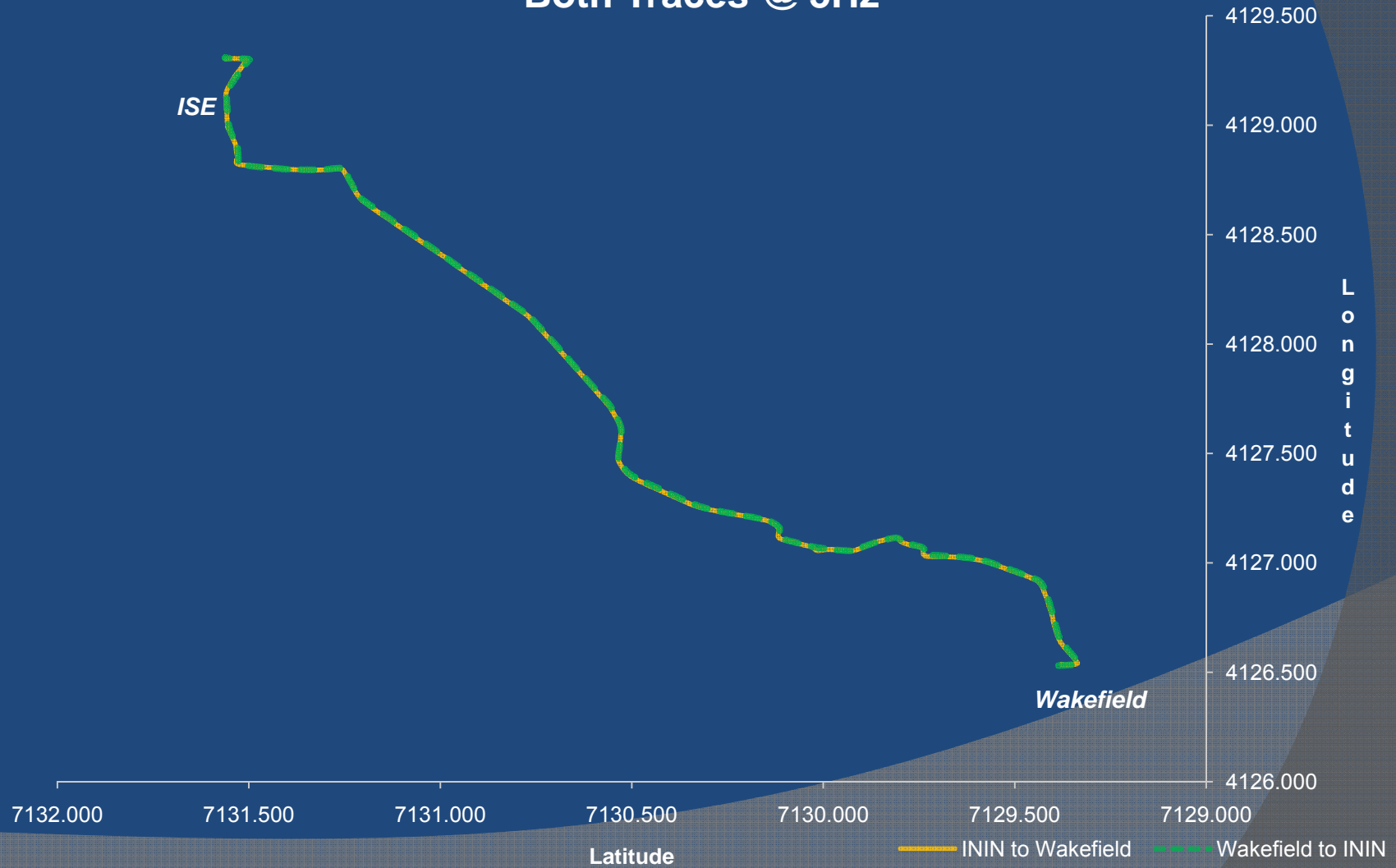
Wakefield to ISE @ 5Hz



Wakefield to ININ

Project's Results

Both Traces @ 5Hz



Project's Results

Points on ISE to Wakefield @ 5Hz					
	Longitude	Latitude	Distance (in)	Real Frame	Current Frame
1	4128.381	7130.974	28.00	4798	7698
2	4128.222	7130.848	12.00	5458	8358
3	4127.687	7130.549	30.67	6814	9714
4	4127.462	7130.534	22.67	7678	10578
5	4127.407	7130.511	17.33	7888	10788
6	4127.395	7130.502	13.33	7942	10842
7	4127.263	7130.339	24.00	8638	11538
8	4127.247	7130.307	33.33	8764	11664
9	4127.203	7130.172	21.33	9232	12132
10	4127.090	7129.789	26.67	11530	14430
11	4127.078	7129.762	29.33	11644	14544
12	4127.029	7129.701	21.33	12160	15060
13	4126.991	7129.550	32.00	12628	15528
14	4126.851	7129.419	14.67	13708	16608
15	4126.613	7129.370	25.33	14794	17694

Project's Results

Wakefield to ISE @ 5Hz					
	<u>Longitude</u>	<u>Latitude</u>	<u>Distance (in)</u>	<u>Real Frame</u>	<u>Current Frame</u>
<u>1</u>	4126.893	7129.425	30.67	3072	25616
<u>2</u>	4126.907	7129.431	13.33	3222	25766
<u>3</u>	4126.983	7129.532	33.33	4098	26642
<u>4</u>	4127.163	7130.115	9.33	6996	29540
<u>5</u>	4127.304	7130.384	5.33	8010	30554
<u>6</u>	4127.727	7130.560	26.67	9660	32204
<u>7</u>	4128.024	7130.713	29.33	10973	33517
<u>8</u>	4128.204	7130.827	30.67	11725	34269
<u>9</u>	4128.565	7131.126	28.00	13194	35738
<u>10</u>	4128.586	7131.143	24.00	13307	35851
<u>11</u>	4128.681	7131.216	13.33	13771	36315
<u>12</u>	4128.802	7131.281	29.33	15591	38135
<u>13</u>	4128.799	7131.305	21.33	15936	38480
<u>14</u>	4128.797	7131.316	16.00	16467	39011
<u>15</u>	4128.810	7131.478	14.67	18499	41043

Average = 22.58 inches

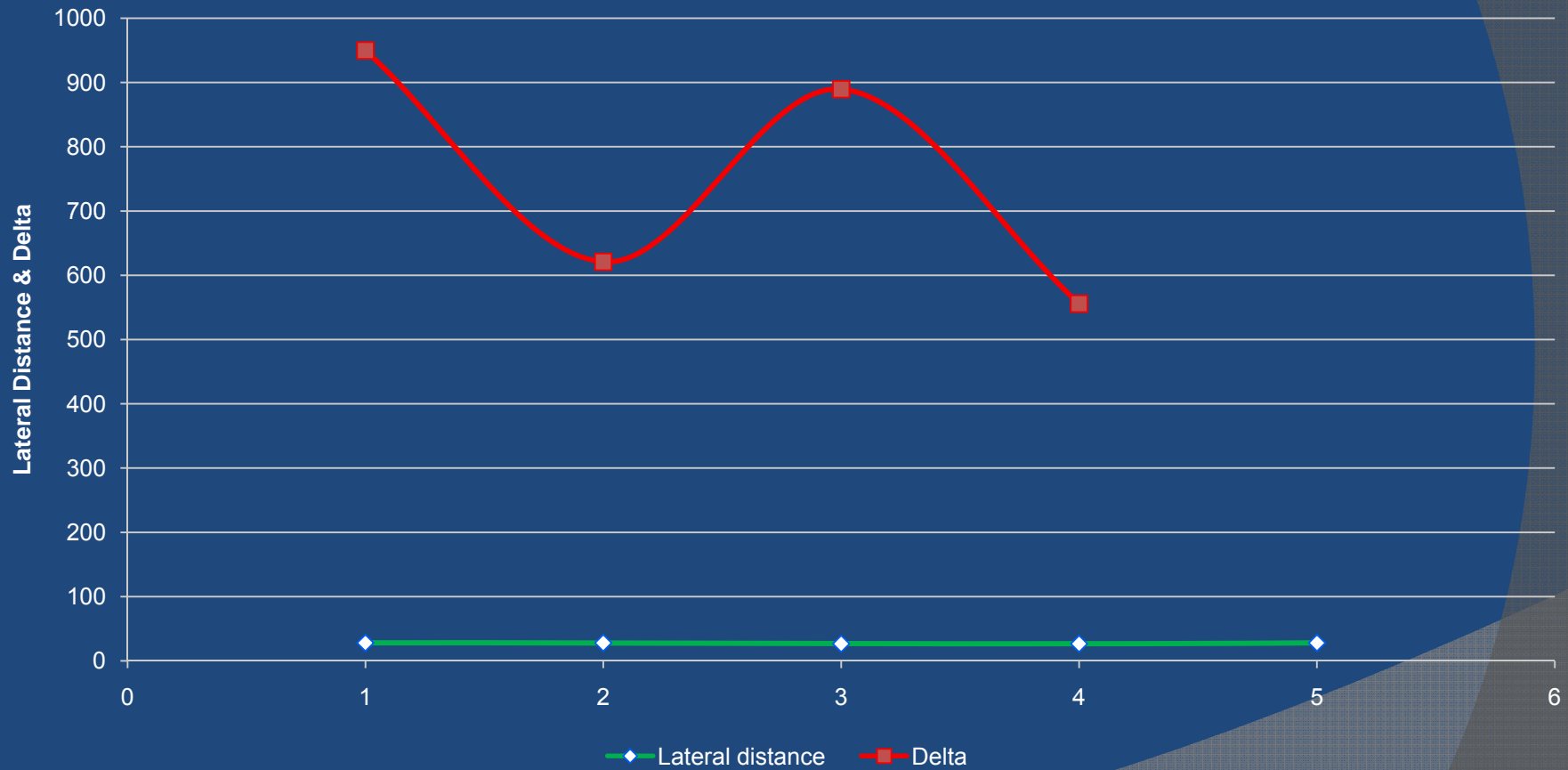
Standard Deviation = ± 7.88

Sample Video

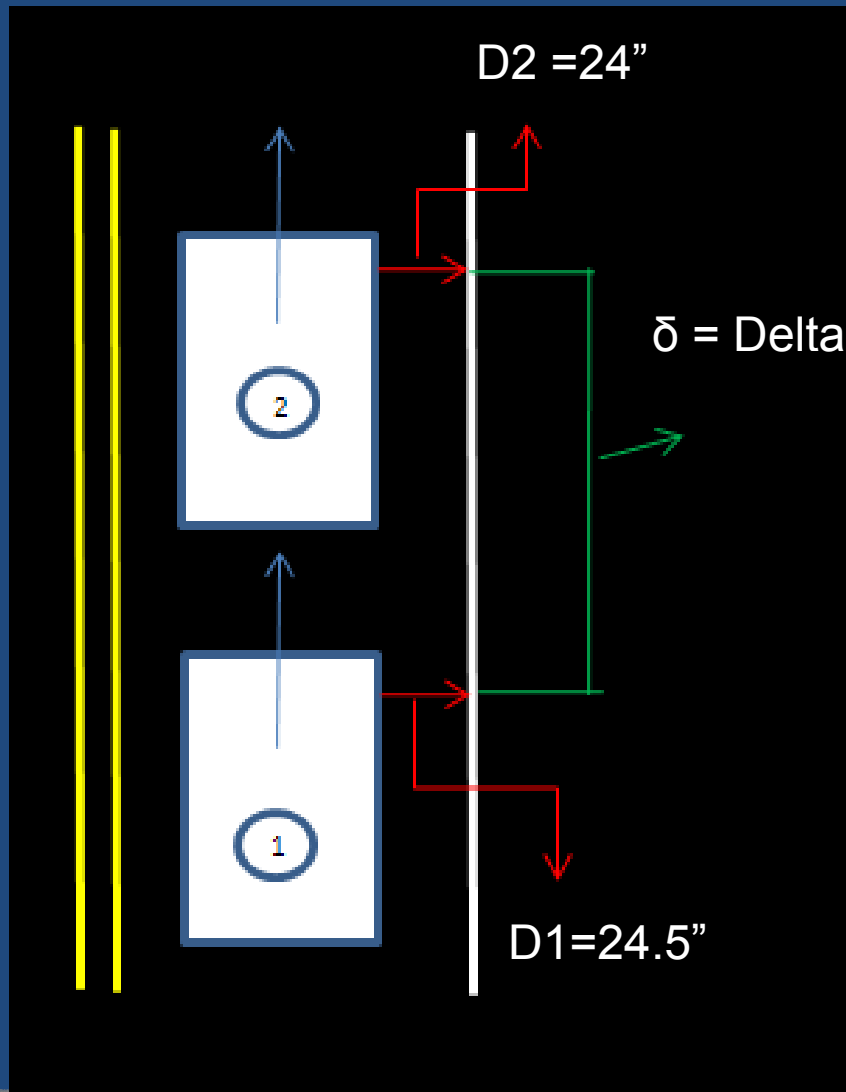


Project's Results

Consistency of Lateral Distance and Delta



Project's Results



- The difference between $D1$ and $D2$ is minimum.
- $D1$ & $D2$ is the lateral distance.
- The δ is the longitudinal length.

Conclusion

- ① The lateral distance to the lane marking was measured using the video camera, and making a scale that fit the video.
- ② These distances shows a big variation on the data, as discussed by the standard deviation.
- ③ The data obtained from the 5Hz GPS was more accurate than the 1Hz.
- ④ The data obtained from the GPS was not sufficient to measure the lateral distance, and compared it with the real one.

References

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QUESTIONS?