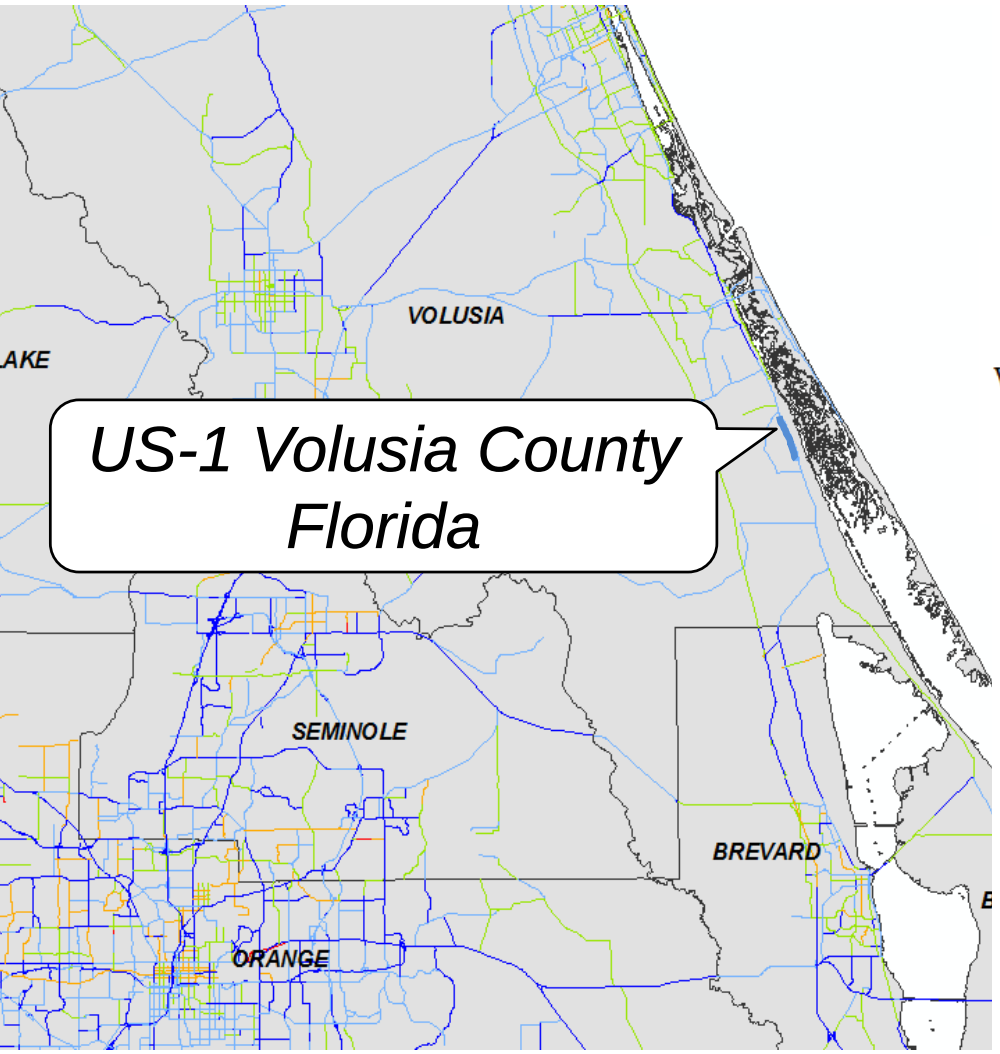
Florida Department of Transportation

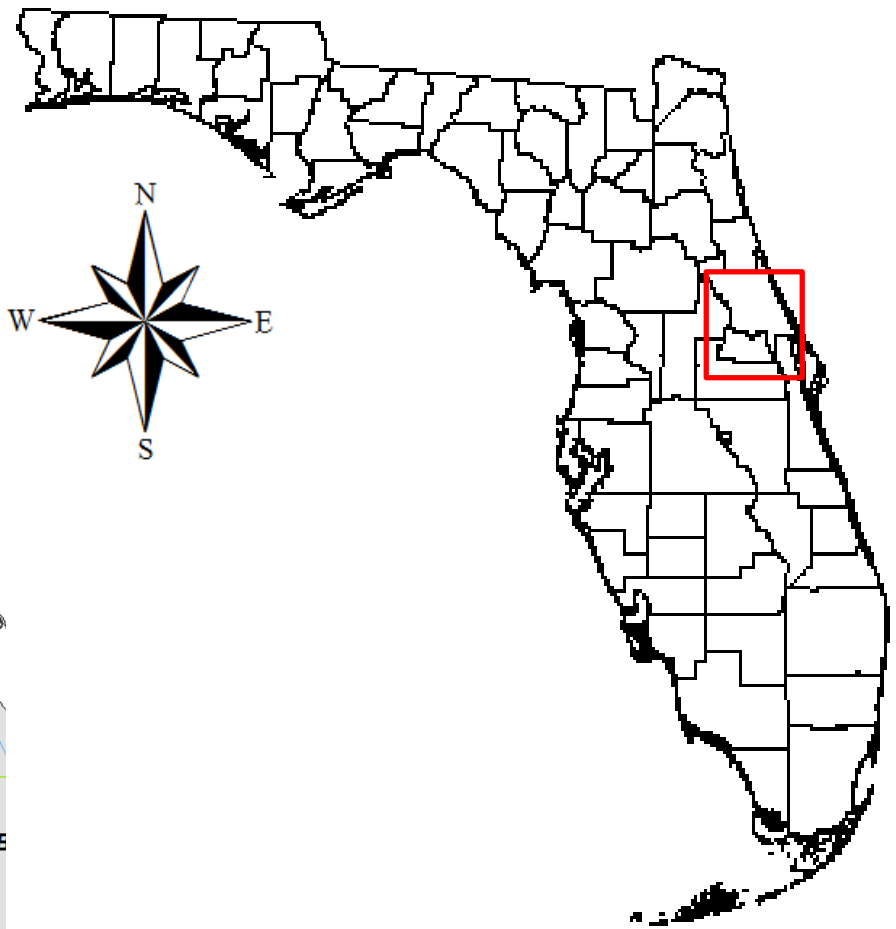
Long-Term Performance of Concrete Overlay US-1 Florida Case Study

Abdenour Nazef, P.E.

2015 RPUG Conference
Raleigh, NC

Project Overview





Project Objectives

1. Long-term Performance of Concrete Overlay

2. Performance Comparison of Three Different Laser Sensors

Project Overview

- Existing AC was milled 4 inches
- Milled surface overlaid with 1 inch type S AC
- Ready-mix concrete, fixed form paving
- Whitewashing to cool the AC
- Joints sealed with low modulus silicon
- Transverse tinning and diamond grinding
- Two southbound lanes

Project Overview

- 10 years, 1.2 million ESALs
- Test sections (19)
  - Section length: ~500 feet
  - Slab thickness: 6, 7, 8 inches
  - Slab length: 12, 14, 16, 18, 20 feet
  - Dowel-bar configuration: Standard (St), Special (Sp)*
    - 1” diameter (7 inch, 8 inch, and Control sections)
    - ¾” diameter (6 inch sections)

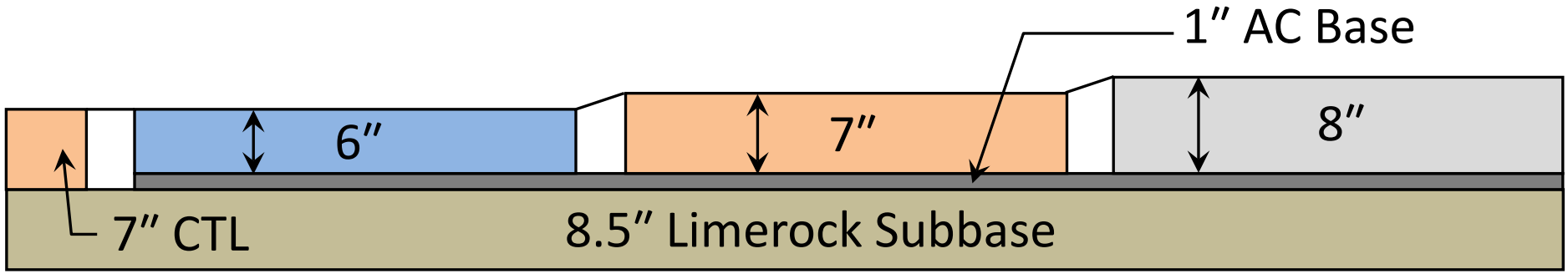
Project Overview

- *Dowel-bar configuration:*

Standard (ST)

Special (SP)

Project Overview



- *Section ID*

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

- *Slab thickness*

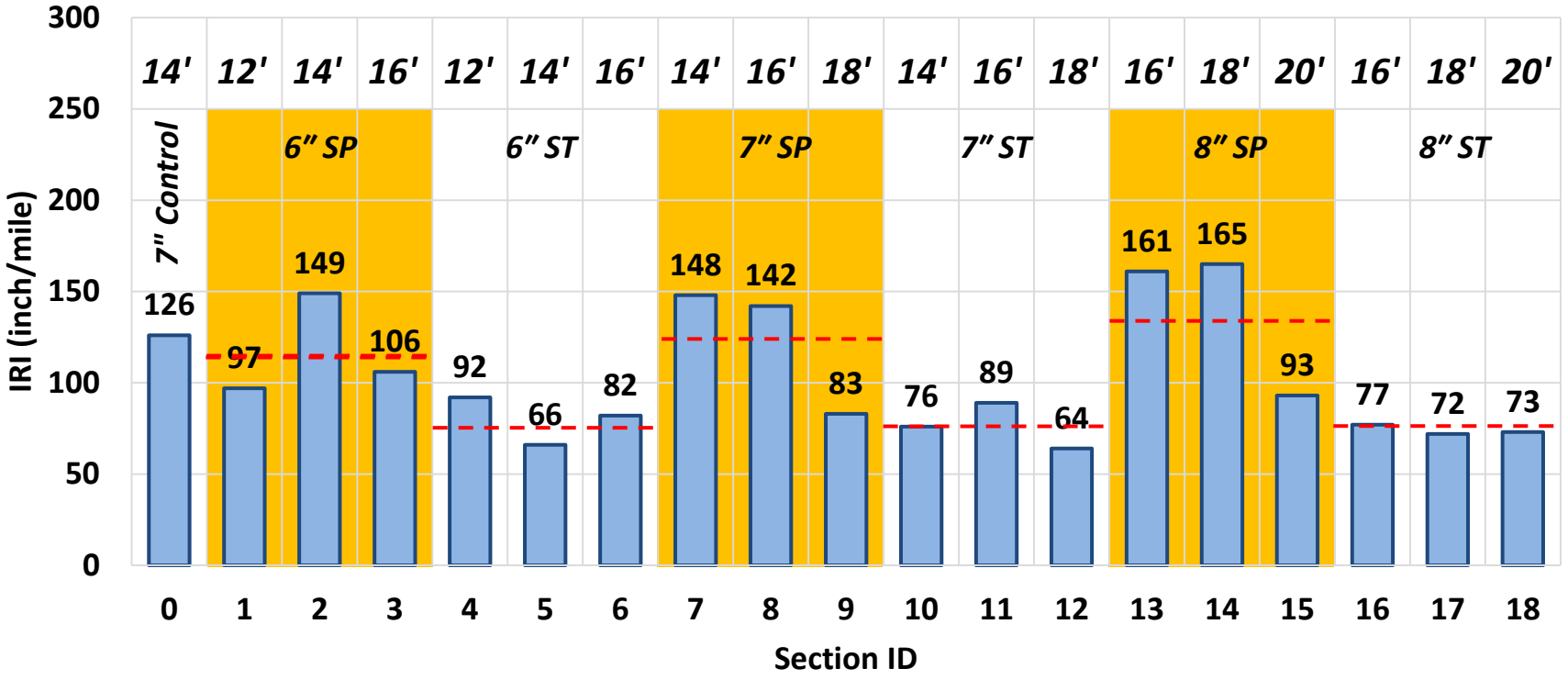
14	12	14	16	12	14	16	14	16	18	14	16	18	16	18	20	16	18	20

- *Dowel-bar configuration*

St	Sp		St				Sp			St			Sp			St		

1. Long Term Performance of Concrete Overlay

Smoothness

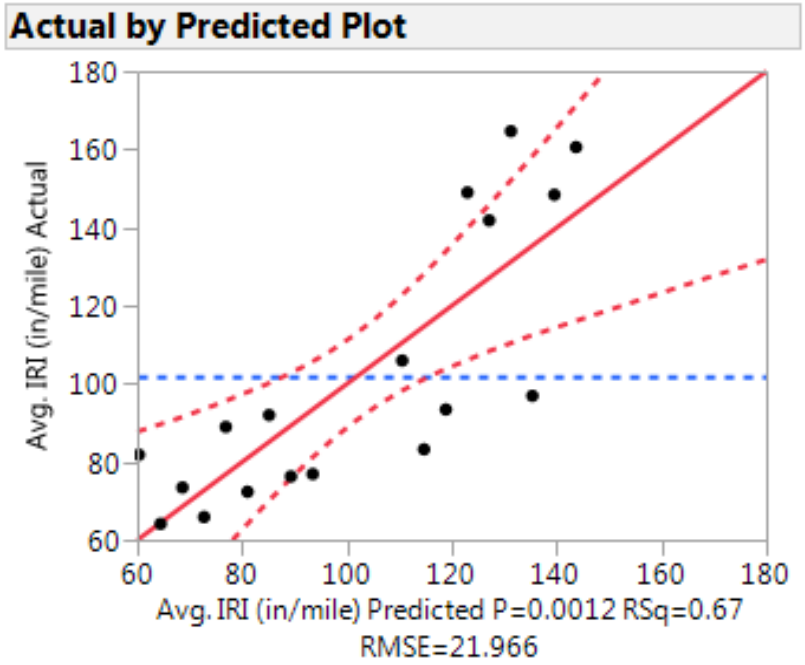

300
250
200
150
100
50
0
IRI (inch/mile)
14' 12' 14' 16' 12' 14' 16' 14' 16' 18' 14' 16' 18' 16' 18' 20' 16' 18' 20'
7" Control
6" SP
6" ST
7" SP
7" ST
8" SP
8" ST
126
97
149
106
92
66
82
148
142
83
76
89
64
161
165
93
77
72
73
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Section ID

Smoothness

Slab Thickness (in)	Dowel Config.	Joint Spacing (ft)	Average IRI (in/mile)	IRI Difference
6	SP	12 - 16	117	37
	ST		80	
7	SP	14 - 18	124	48
	ST		76	
8	SP	16 - 20	140	66
	ST		74	

Regression Analysis

- *Smoothness*

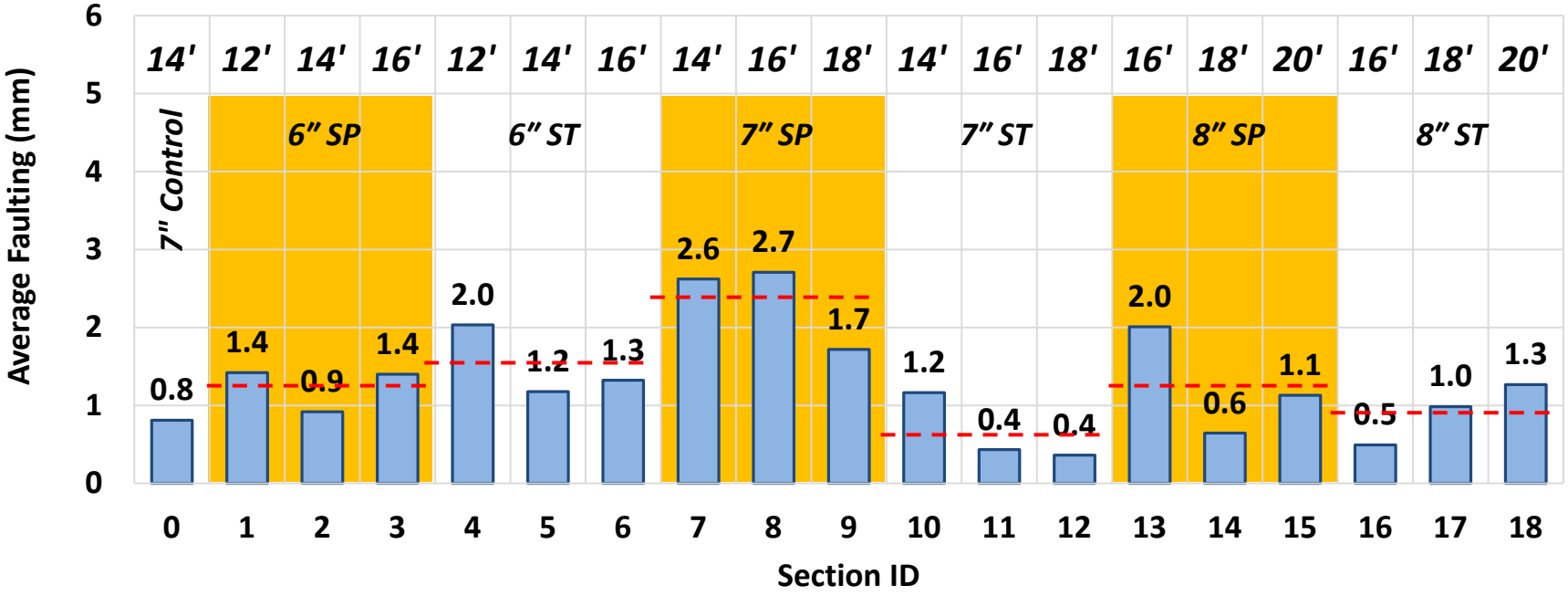


Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	85.346111	45.1354	1.89	0.0795
Length	-6.210833	3.170488	-1.96	0.0703
Dowel[Spe]	25.123333	5.177385	4.85	0.0003*
Thick	16.575	8.967494	1.85	0.0858

✓ **Dowel-bar configuration has the most significant effect on smoothness**

Faulting



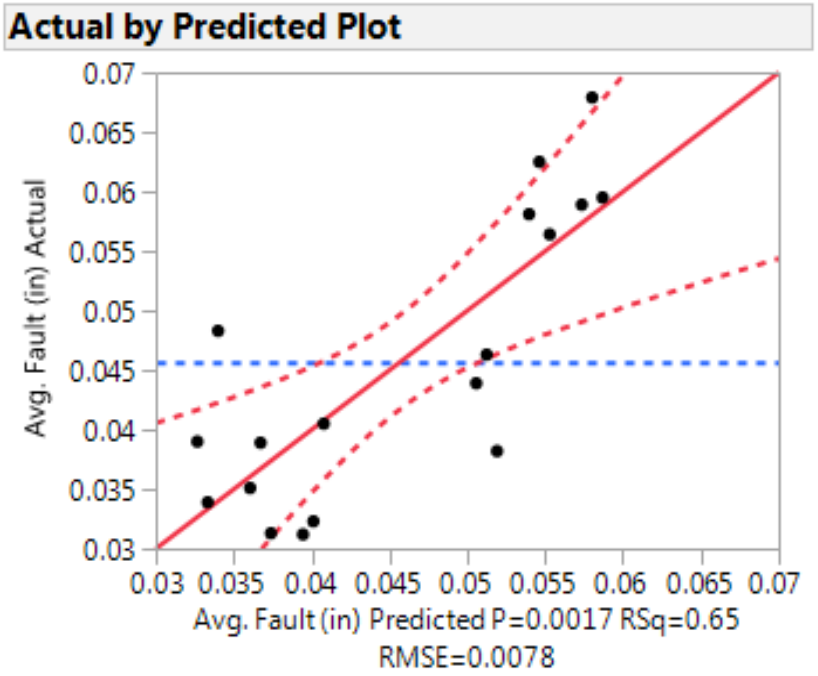
✓ **Slabs with special dowel bar configuration have relatively higher faulting**

Faulting

Slab Thickness (in)	Dowel Config.	Joint Spacing (ft)	Average Faulting (mm)	Faulting Difference
6	SP	12 - 16	1.3	0.3
	ST		1.0	
7	SP	14 - 18	1.5	0.6
	ST		0.9	
8	SP	16 - 20	1.4	0.5
	ST		0.9	

Regression Analysis

- *Faulting*



Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0.0537361	0.016054	3.35	0.0048*
Length	-0.001696	0.001128	-1.50	0.1548
Dowel[Spe]	0.0089556	0.001841	4.86	0.0003*
Thick	0.002725	0.00319	0.85	0.4073

✓ **Dowel-bar configuration has the most significant effect on faulting**

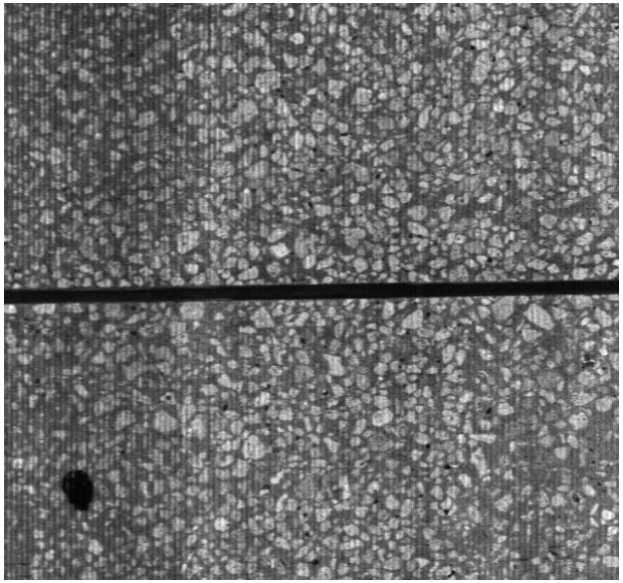
Summary

- *For faulting and smoothness, long-term performance results show …*
  - *Slabs with standard dowel-bar configuration provide smoother ride with lower faulting*
  - *Slab length and thickness have a relatively insignificant effect on smoothness and faulting*

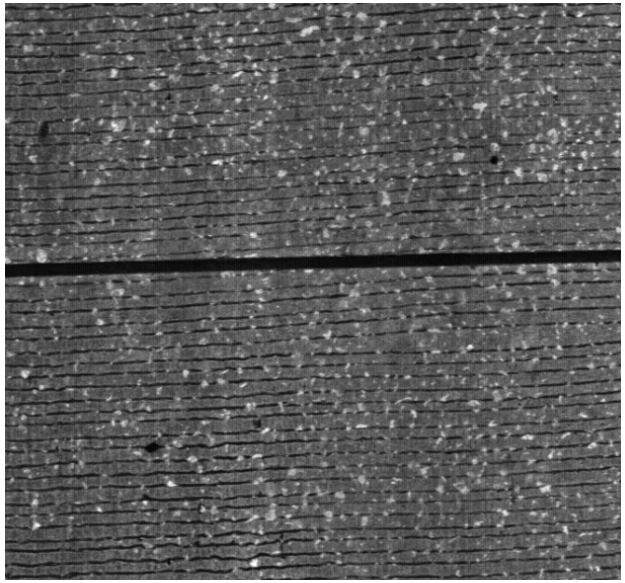
2. Performance Comparison of Three Different Laser Sensors

US1 Texture

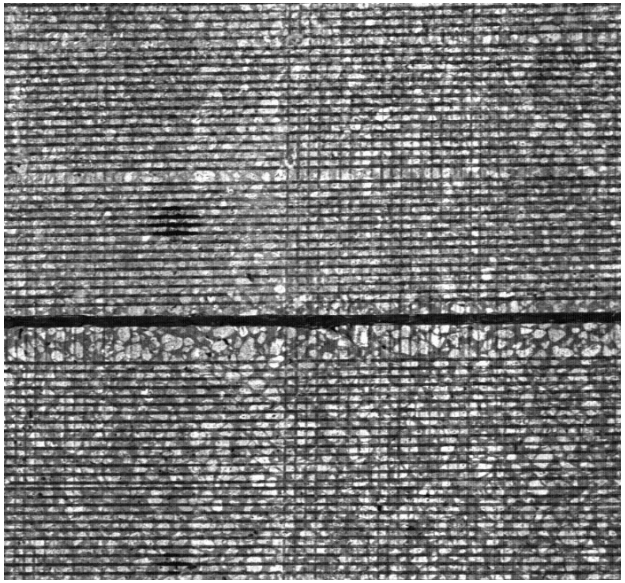
- *3 different textures*



Diamond Grinding (standard in FL)



Transverse Tining

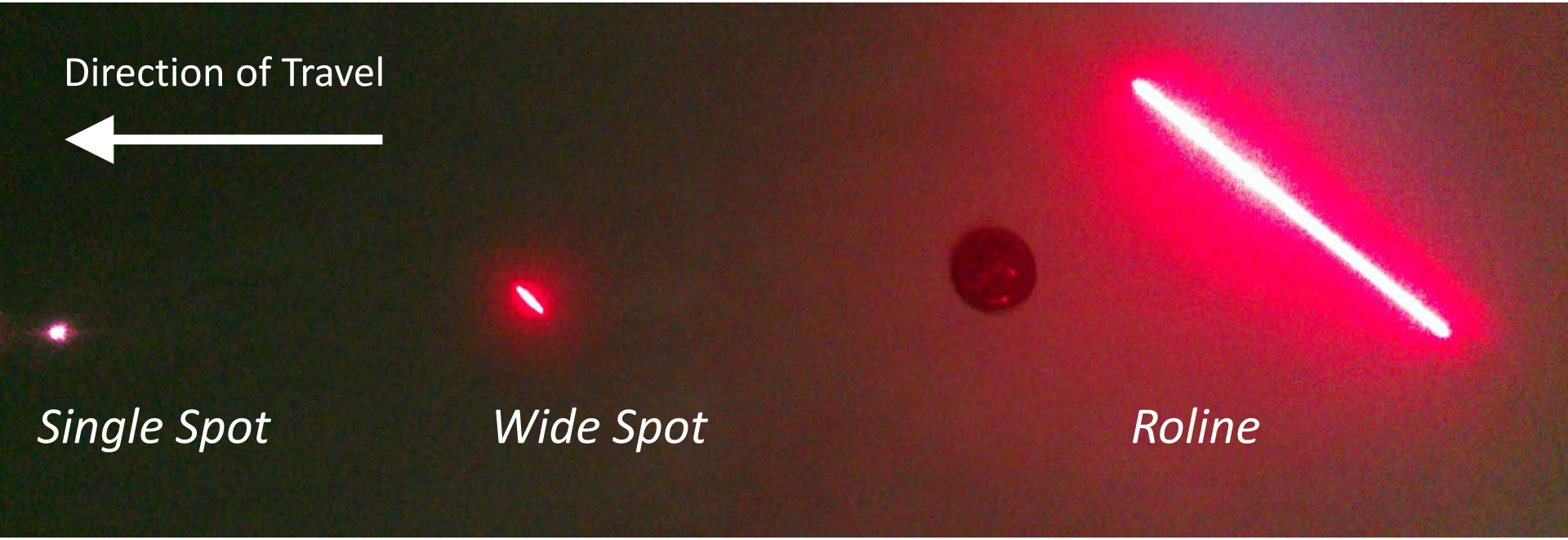


“Two-Way” Diamond Grinding (atypical)

Data Collection

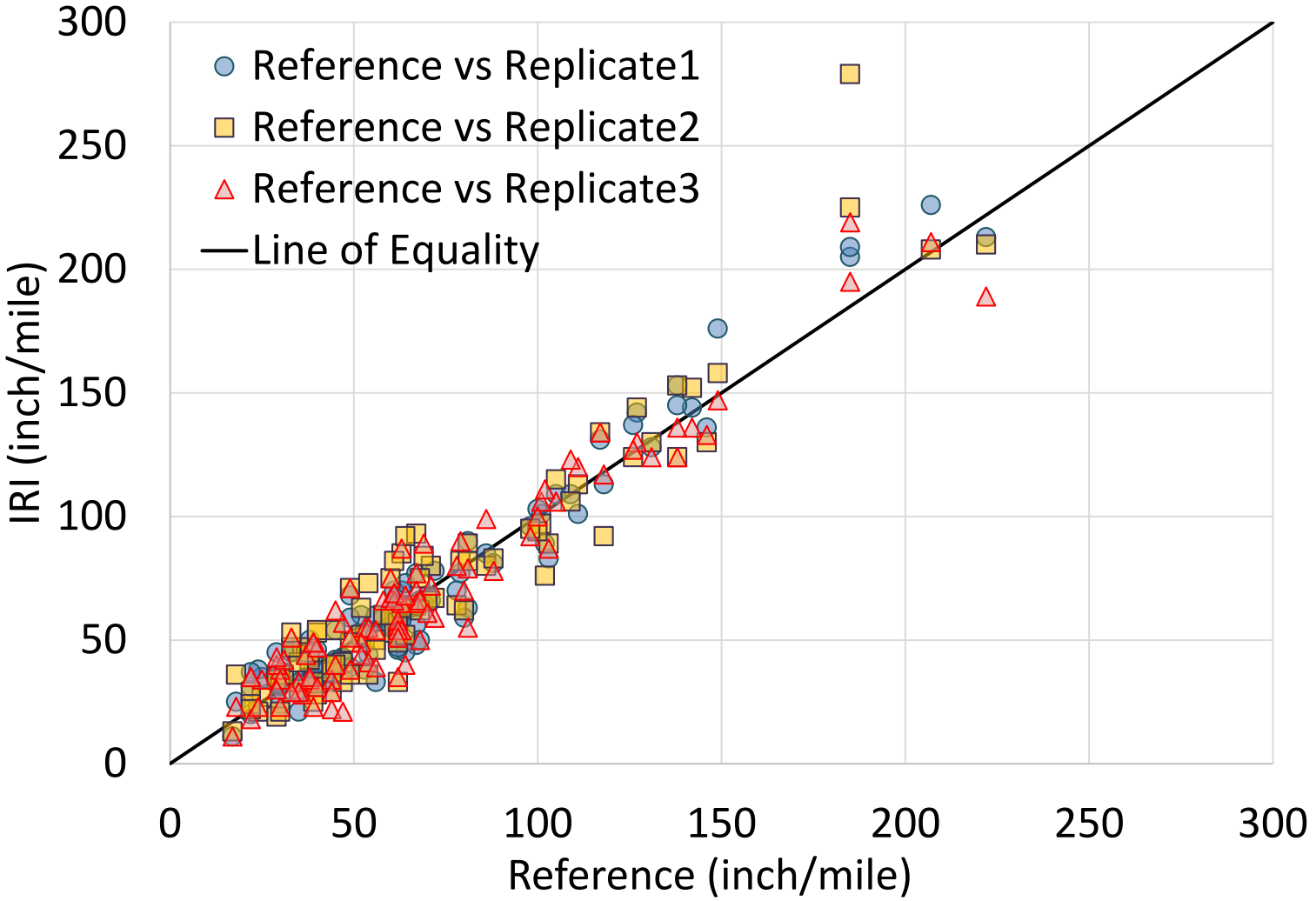
- Device
  - High speed profiler
  - 5 passes
  - 40 mph
- Test Parameters
  - Single Spot, Widespot and Roline
  - All mounted in LWP
  - 0.78 inch sampling
  - 0.001 mile reporting

Height Lasers



Marked LWP

Single Spot Repeatability

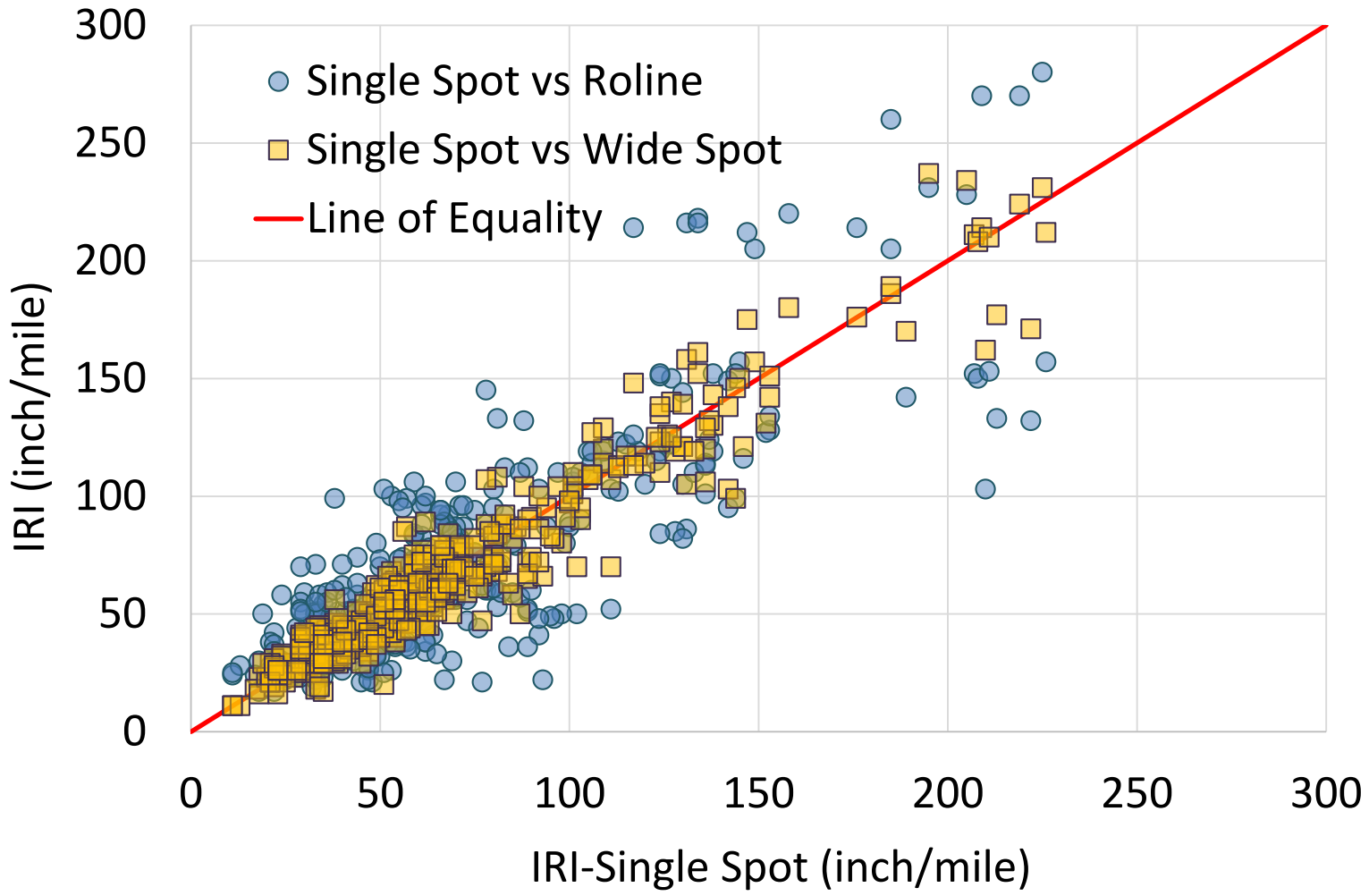


Sensor Repeatability

Sensor	IRI (in/mile)				
	Run 2	Run 3	Run 4	Run 5	Average
Single Spot	95.1	95.8	95.7	95.2	95.5
Wide Spot	95.9	96.3	96.4	96.1	96.2
Roline	94.0	94.1	94.6	94.2	94.2

Sensor	Repeatability Cross Correlation (%)		
	Min.	Max.	Average
Single Spot	93.0	95.9	95.0
Wide Spot	96.6	97.9	96.6
Roline	94.9	97.4	95.8

Sensor “Reproducibility”



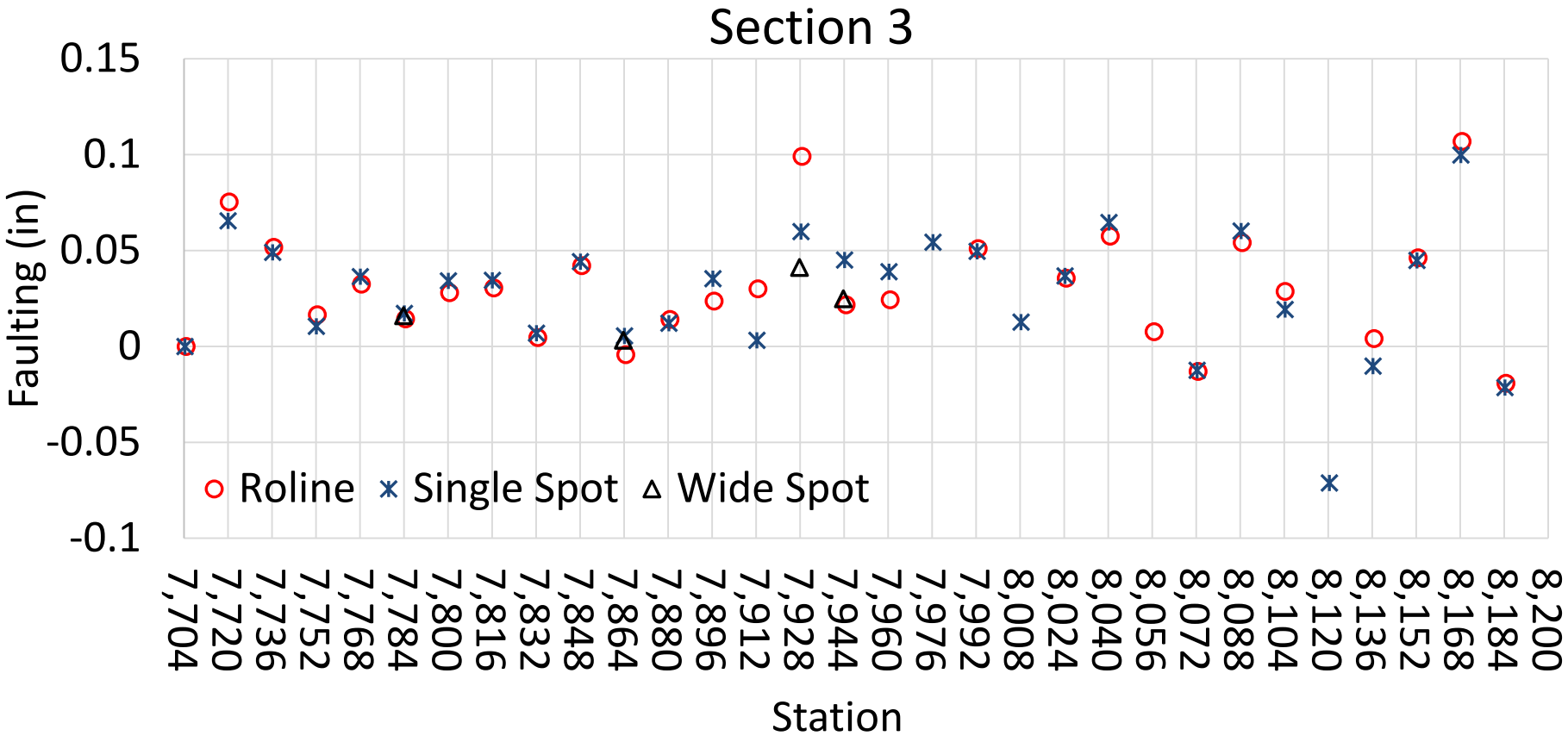
Sensor Reproducibility

Correlated Sensors	*Reproducibility Cross Correlation (%)*
Single Spot vs Wide Spot	93.3
Single Spot vs Roline	94.9
Wide Spot vs Roline	93.8

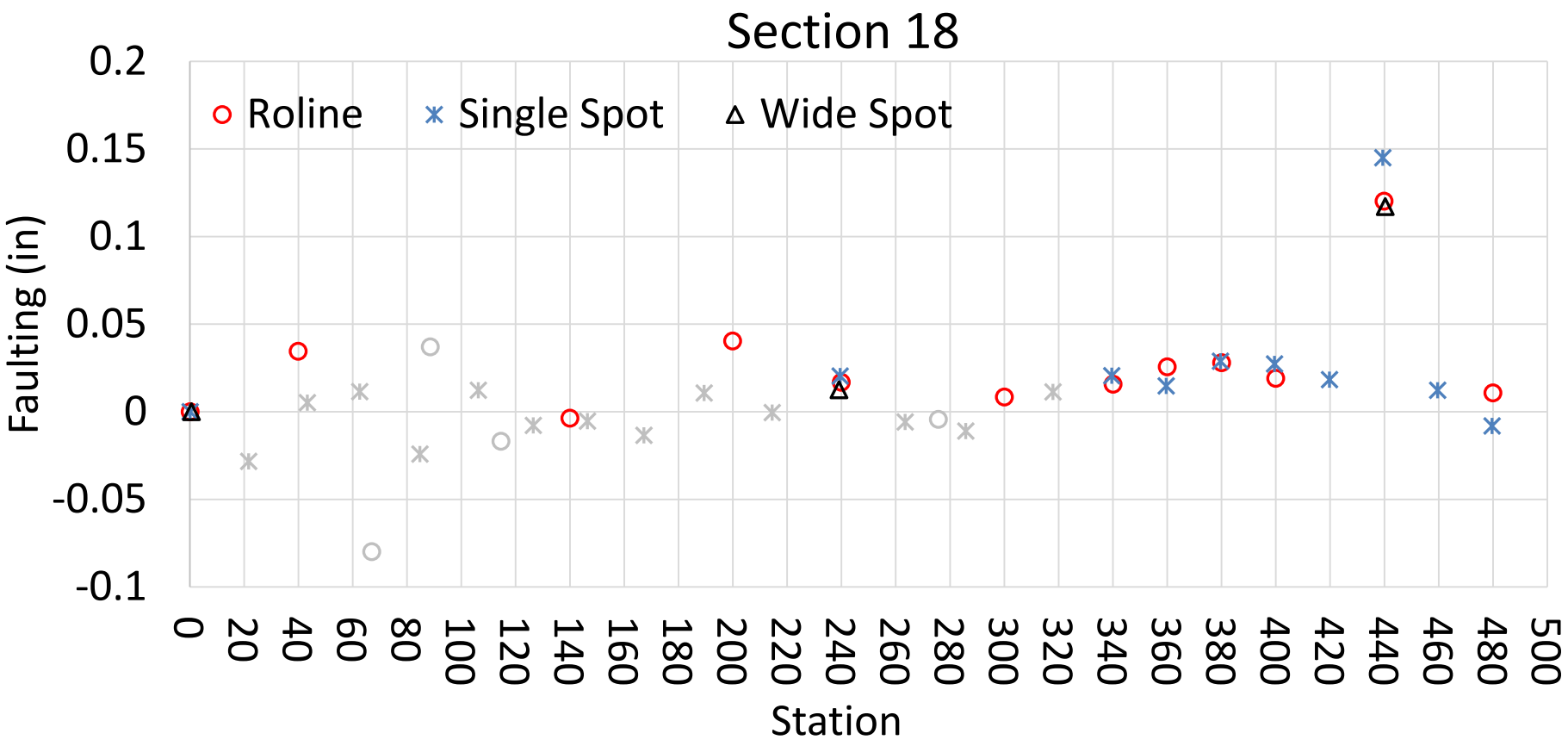
Joint Detection

Section	Number of Joints	Number of True Detected Joints			Joint Detection (%)			Reliability (No. of True detected joints/No. of true and false detected joints)		
		Roline	Single Spot	Wide Spot	Roline	Single Spot	Wide Spot	Roline	Single Spot	Wide Spot
0	36	18	26	1	50	72	3	78	81	50
1	42	32	37	6	76	88	14	100	95	86
2	36	23	22	1	64	61	3	88	71	100
3	31	28	30	4	90	97	13	100	100	100
4	42	36	39	4	86	93	10	92	91	80
5	36	27	32	6	75	89	17	93	100	86
6	31	27	27	5	87	87	16	100	96	100
7	36	25	29	5	69	81	14	89	91	100
8	31	26	28	4	84	90	13	100	100	100
9	28	25	24	3	89	86	11	100	92	100
10	36	22	19	3	61	53	8	81	66	100
11	31	16	21	1	52	68	3	84	84	100
12	28	15	16	1	54	57	4	75	64	100
13	31	11	15	4	35	48	13	58	60	100
14	28	16	19	3	57	68	11	84	76	100
15	25	13	14	2	52	56	8	72	67	67
16	31	16	12	1	52	39	3	84	48	50
17	28	8	12	1	29	43	4	40	50	100
18	25	12	10	3	48	40	12	75	43	100
Average					64	69	9	84	77	90

Faulting (Good agreement)



Joint Faulting (bad agreement)



Summary

- *For smoothness …*
  - ✓ *All three lasers correlate strongly*
- *For faulting …*
  - ✓ *Single spot and Roline lasers had the best combination of joint detection and reliability*
  - ✓ *Wide spot did not detect enough joints to be useful*

Questions?