Mobile Retroreflectivity: Florida's Perspective

Prepared for the 2006 South Eastern Pavement Management Conference

FDOT State Materials Office

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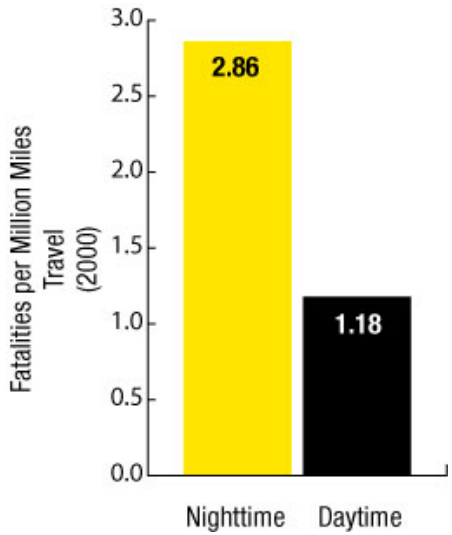
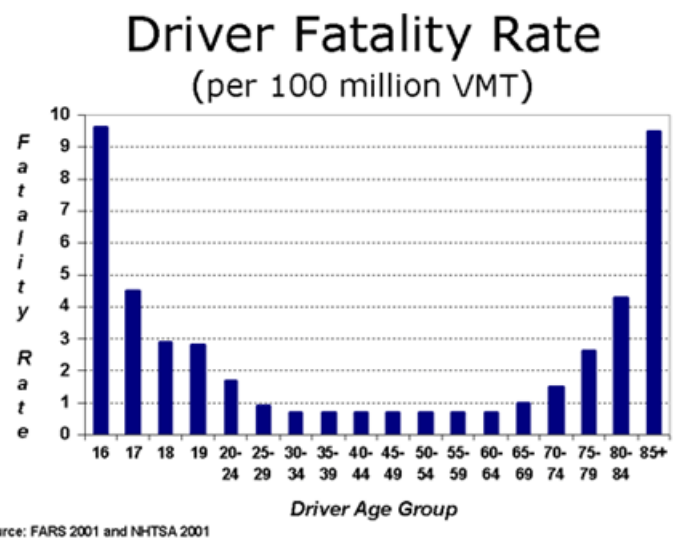
The Importance of Pavement Markings

- Provides traffic control
- As much as 85% of driving information given by visibility
- Rate of night driving fatalities nearly three times day rate
- On average, drivers need twice the amount of light to see every 13 years
- >12% of the country's drivers are over the age of 65 (>18% in Florida)



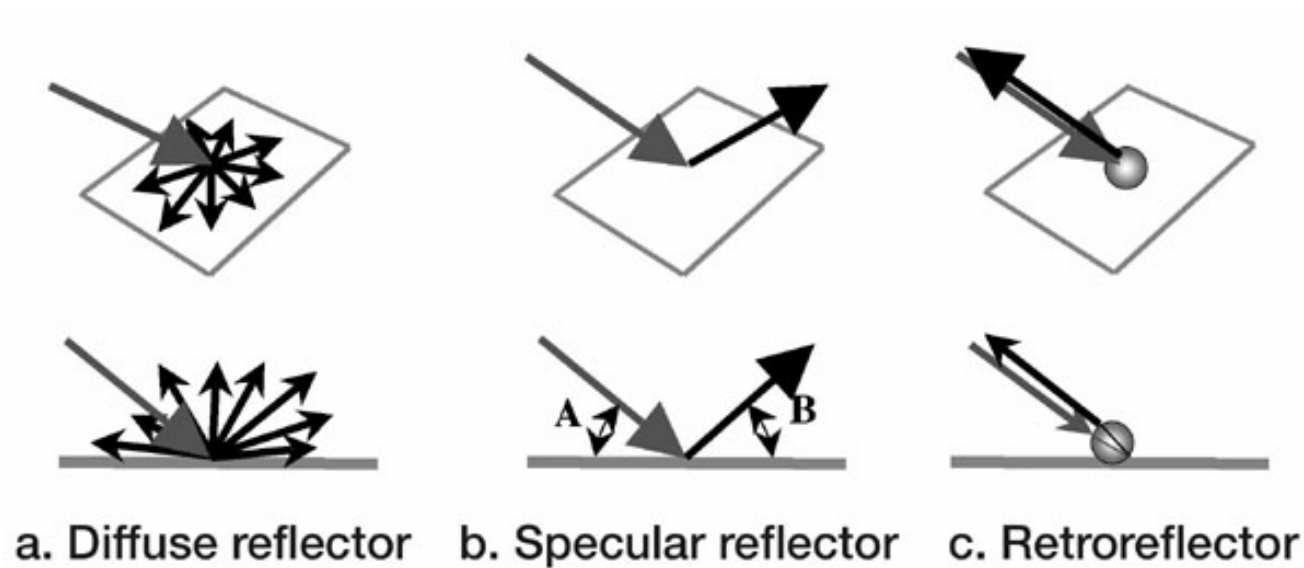


http://tti.tamu.edu/researcher/newsletter.asp?vol=40&issue=1&article=4

Can you tell the difference between the retroreflectivity of these signs?

Visibility of Pavement Markings is Aided by Reflectivity

- Three types of reflection available from a marker
- Based on focus of the reflected light

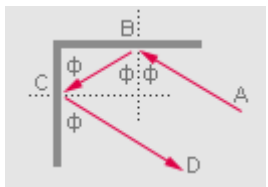


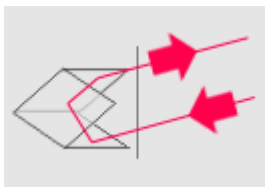
http://tti.tamu.edu/researcher/v40n1/images/surfaces.jpg

- Examples: Diffuse – Paper, Specular – Mirror, Retroreflective – Pavement marking

Retroreflection

- Prismatic Design: Used in RPM's and Signs
  - ❑ Provide good wet retroreflection, physical response to lane changes
  - ❑ Prismatic markers return a brighter more localized beam.
- Retroreflection in pavement markers to optimize visibility
  - ❑ Glass Beads: Flat pavement markings
  - ❑ More overall light reflected by beads than prismatic markers.





Cube-corner Retroreflection

http://www.e-kolight.com/technews/techinfo.asp

Factors that Wear Markings

- Ultraviolet light and solar heat
- Abrasion from traffic, wind and sand
- Chemical action
- Pavement deterioration

It is difficult to determine the best time to replace retroreflective pavement markings. Too soon increases maintenance costs. Too late compromises safety and driving.

!

Florida's Current Methods of Retroreflectivity Maintenance

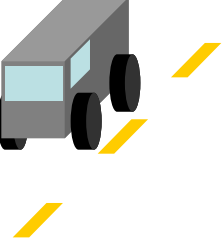
- New Construction (handheld measurements)
  - Prescriptive specification used
  - Florida Test Method FM 5-541 Standard used by contractors over the warranty period of the marking
- Inventory (visual inspection)
  - Included in the Maintenance Rating Program
    - Roadway, Roadside, Traffic Services, Drainage, Aesthetics
    - Rates random 1/10 mile sections of various types throughout state
    - Inspected day and night

Issues with the Current Practice

- Using a Handheld Reflectometer:
  - Puts workers into oncoming traffic
  - Slow operation for long stretches of roadway
  - Point measurements of a line rather than the whole line
  - Inclusion of bias due to the variance in marking retroreflectivity
- Visual Inspection:
  - How reflective is reflective enough?
    - Variable illumination types and focus of headlamps
    - Subjective ratings

Needs of the DOT

- Evaluate application methods and performance of various pavement marking materials
- Plan re-striping strategies
- Establish a pavement marking management database to make informed decisions



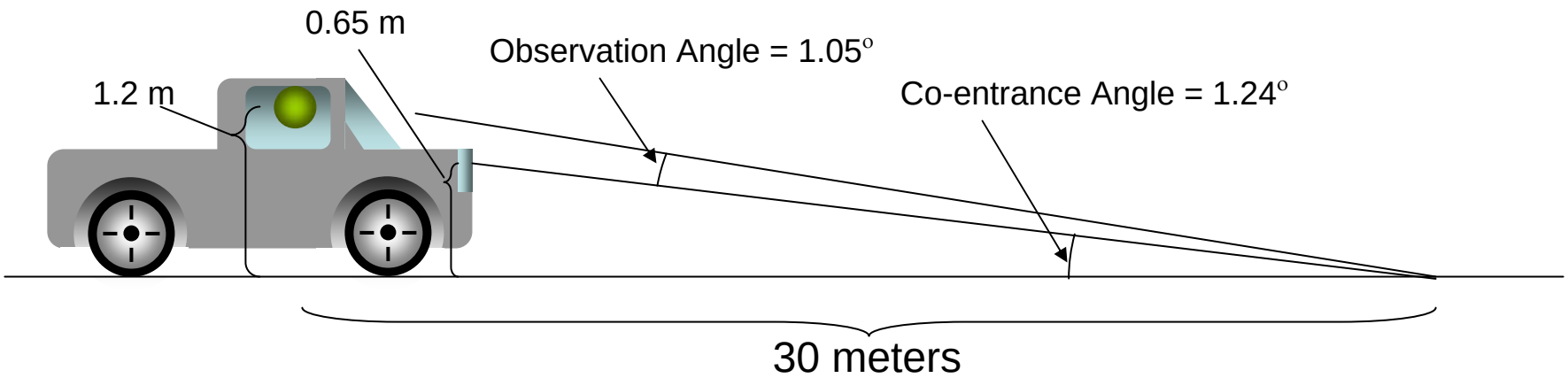
How do we plan to do this?

Mobile Retroreflectivity Unit (MRU)

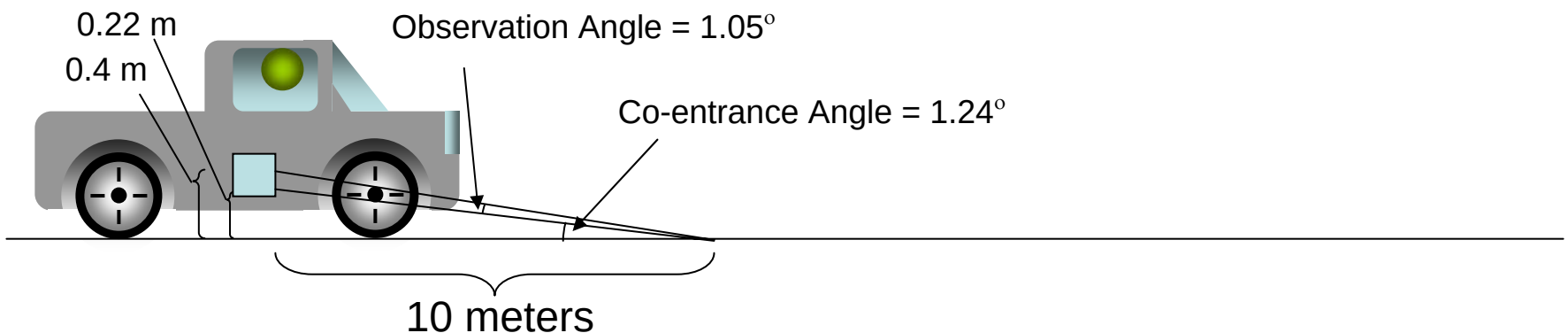
Method of Measurement

- For an average driver (Standard based on FHWA recommendation and recognized as an international standard)

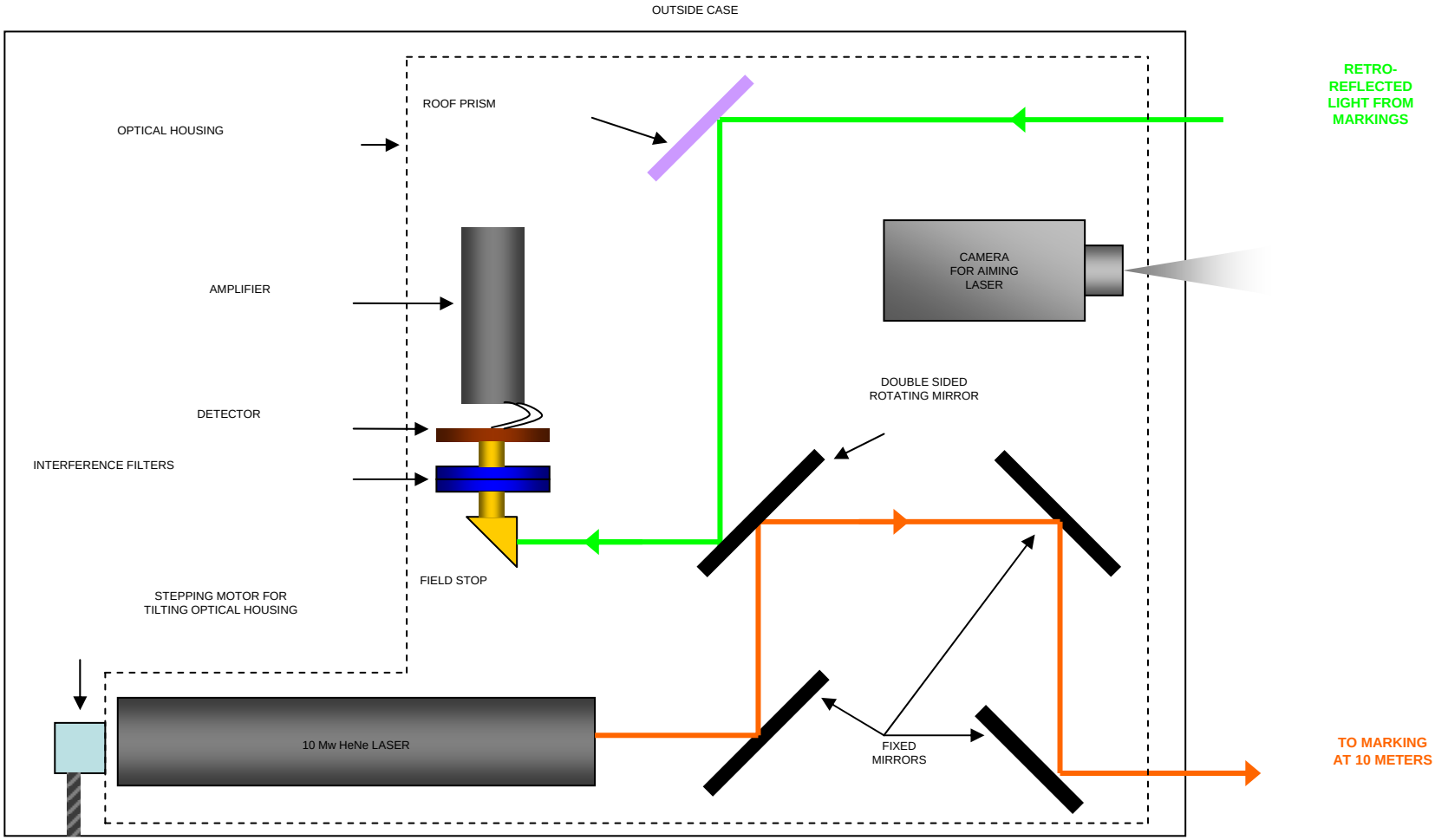
Standard 30 meter geometry



1/3rd scale of 30 meter geometry (Used in Laserlux)

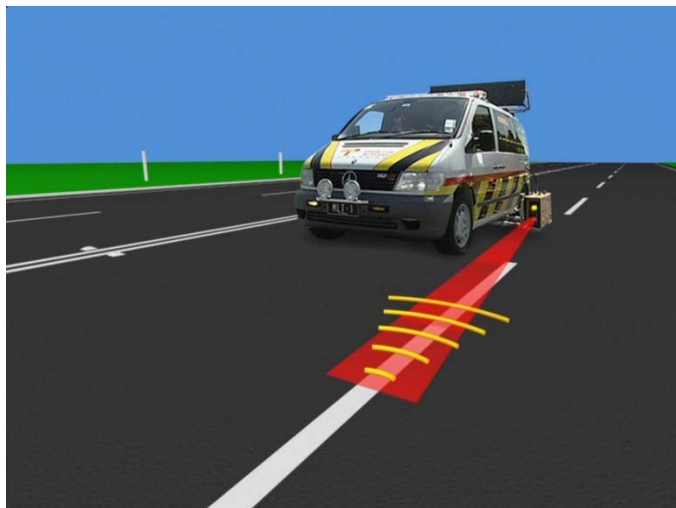


Mobile Retroreflectivity Device



Hardware Description

- Completes 18 scans per second of a 1.07 m. wide section
- Allows testing at highway speeds (55 mph)
- DMI, Linear Referencing
- Incorporates GPS for mapping route
- Capable of 490 miles of data less than 1Mb
- 1500 MCD max. and 20 – 30 MCD min.
- Has user defined validation thresholds
- 0 – 50 C Temperature range
- Measure day or night (frequency filters)
- Thermoelectric Cooling system

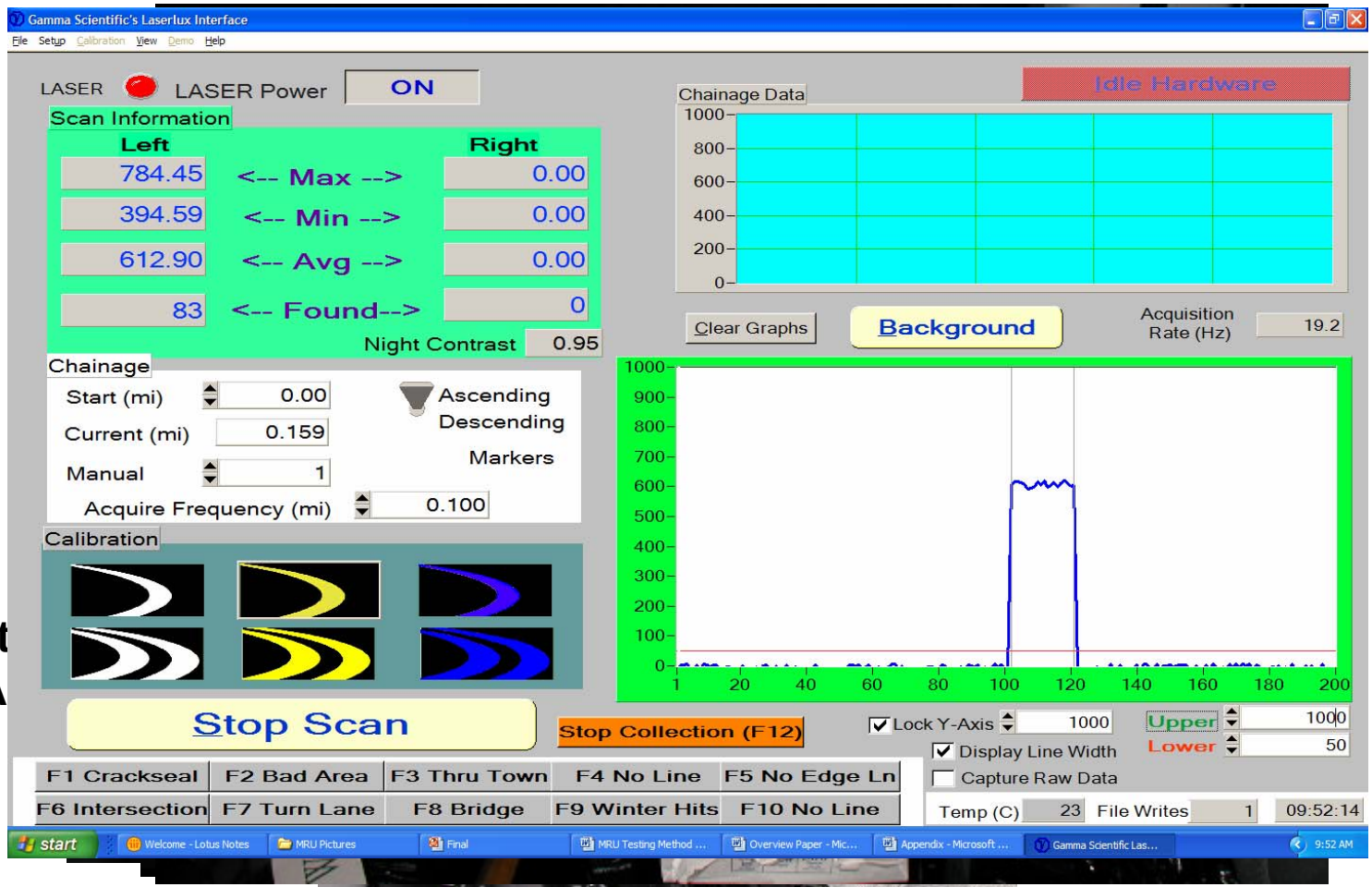


Hardware Description (cont.)

http://www.mobilelaser.com.au/contactus.asp

- Can be used on either side of the vehicle
- Analyzes yellow/white, skip/ continuous/ double lines on any pavement surface
- Calculates average retroreflectivity and outputs data to an Excel Spreadsheet

System Components

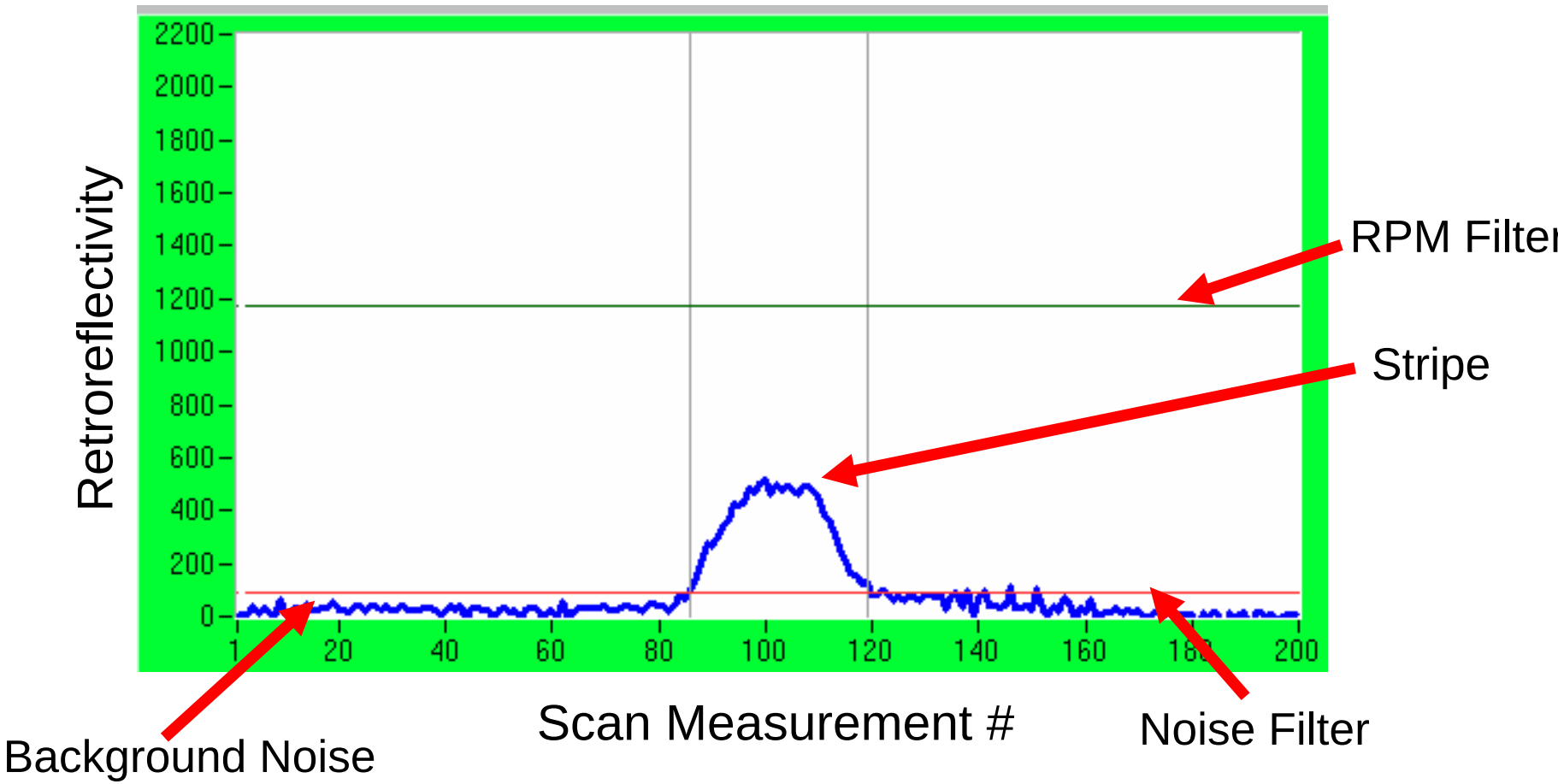


Lapt
A

Panel With Picture in Picture for Eye
Gamma Scientific Software
View Direction Video Recording

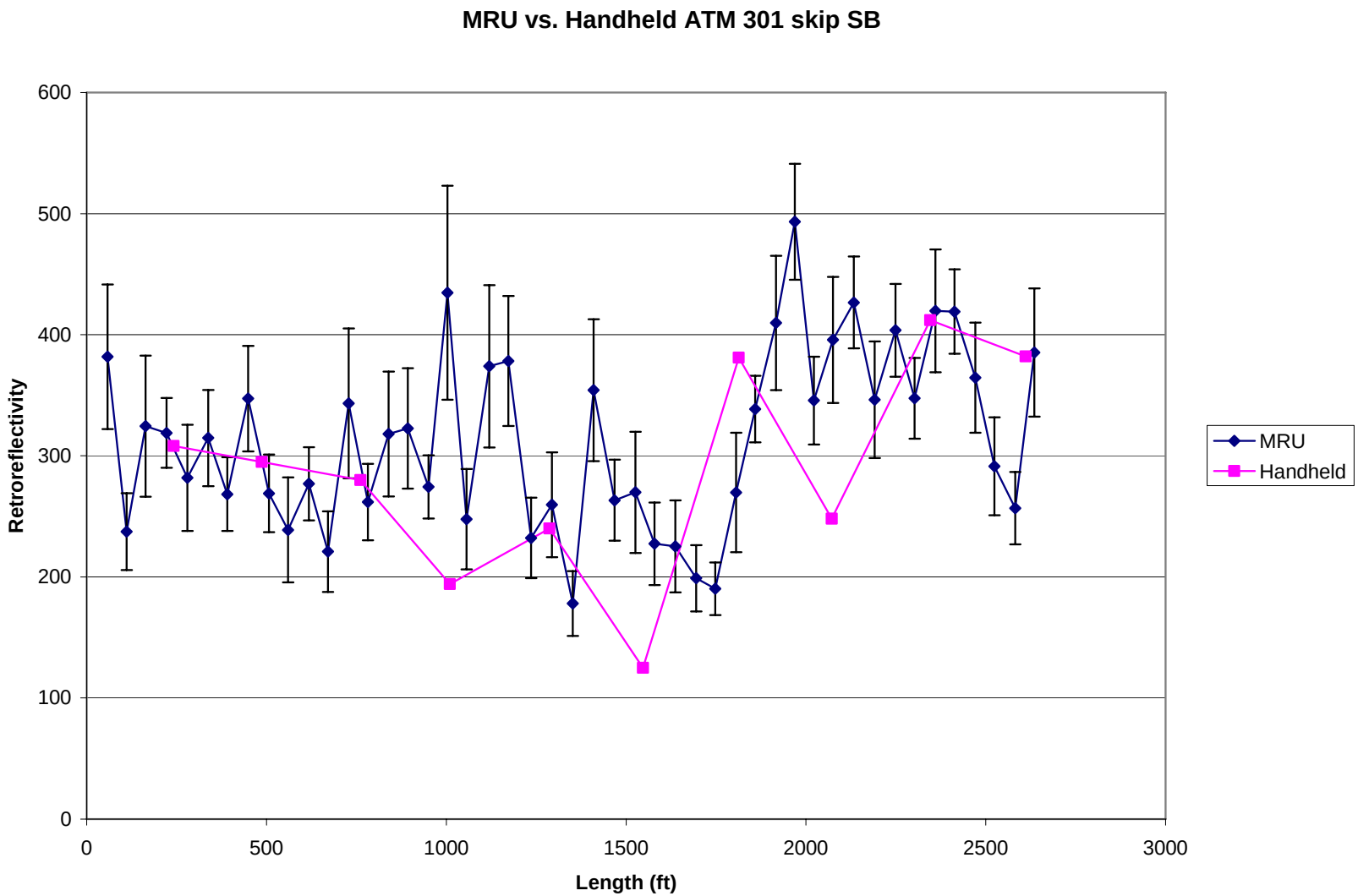
Typical Stripe Scan

A single scan is comprised of 200 discrete data points, of which about 30 is the actual stripe. This scan took less than 0.05 seconds to measure.

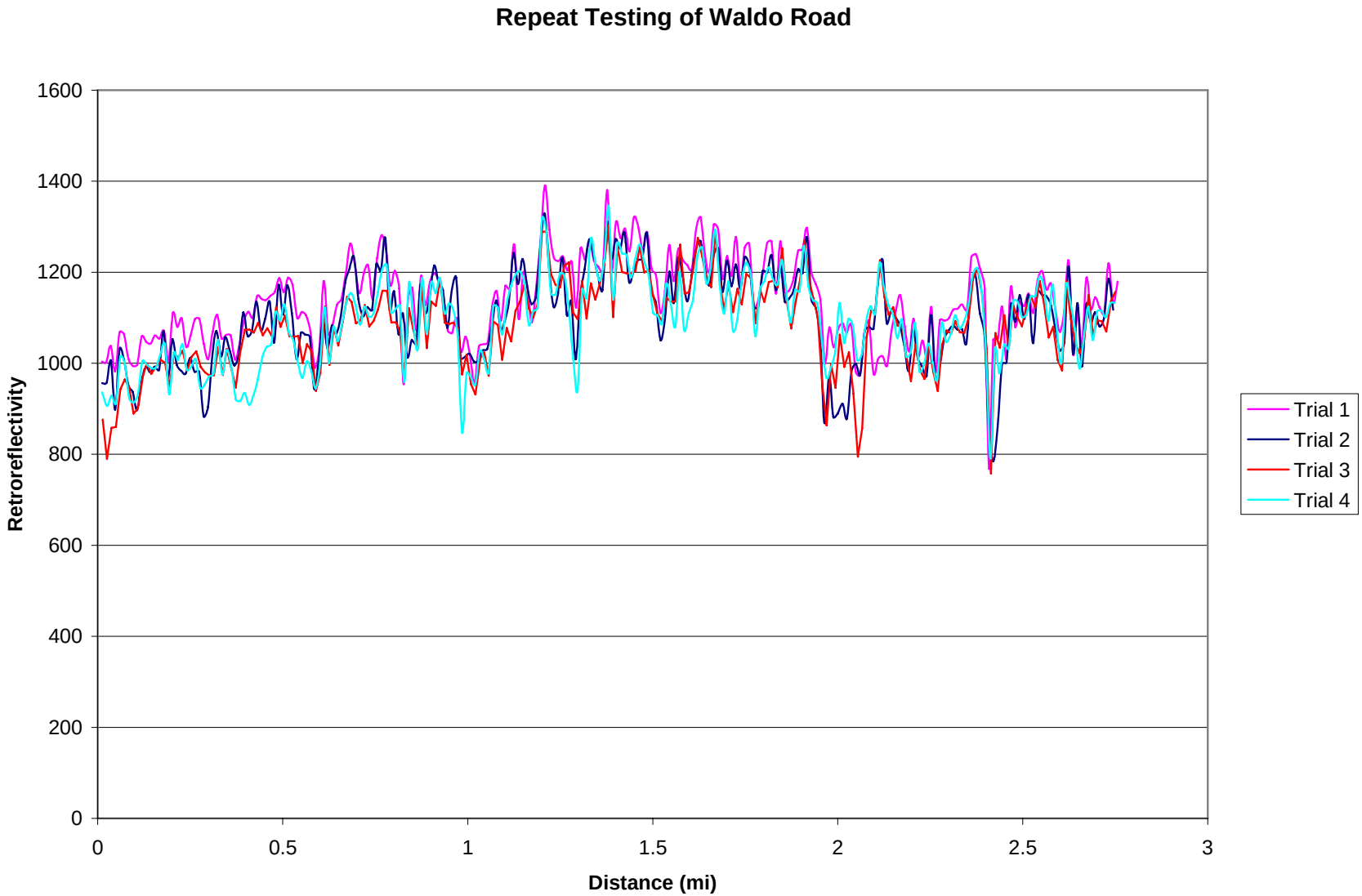


Examples of Data

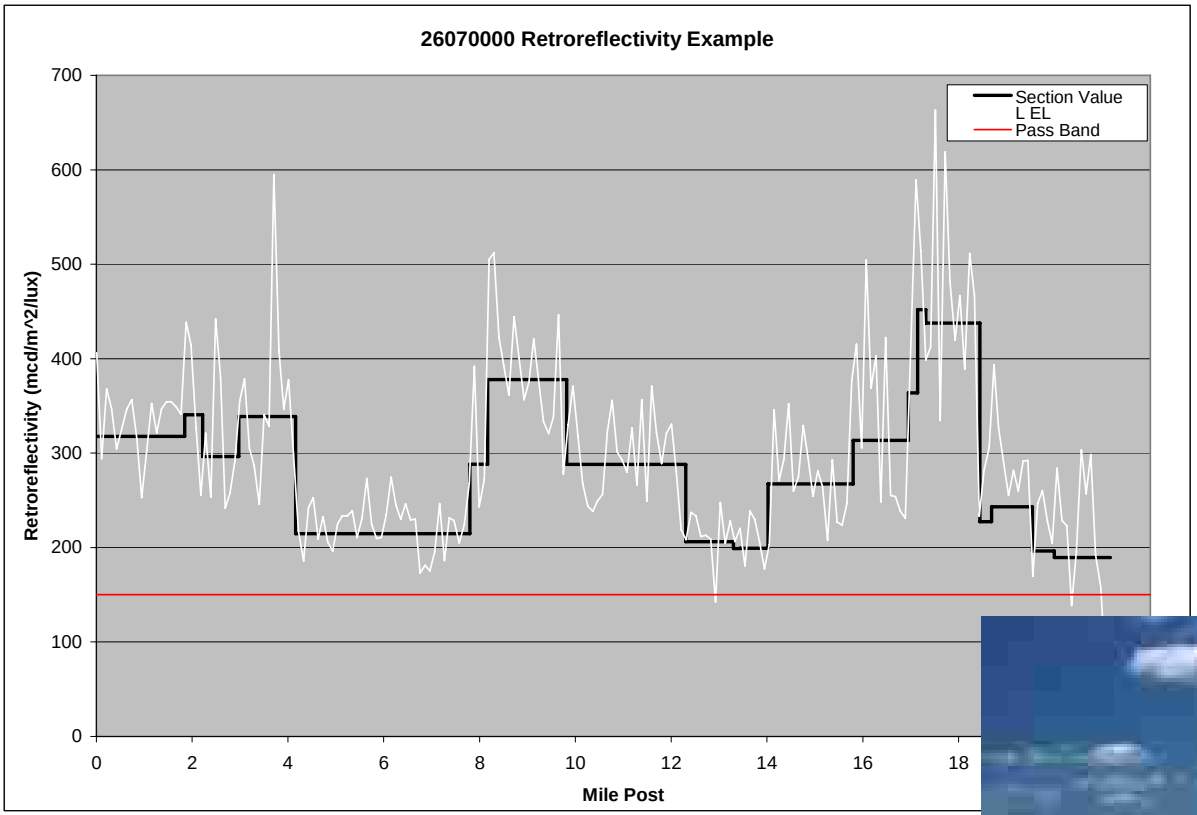
MRU vs Handheld (preliminary)



Repeatability Testing (preliminary)



Gainesville, Florida



Advantages of Mobile Unit

- Rapid data collection. Can collect a mile of striping data in just over a minute.
- Improved safety
- No more MOT and very little traffic disruption
- Can collect network level data and use to implement pavement marking management system
- Improved safety while cost minimized

Who Else Uses MRU's?

- University of Missouri-Rolla / MoDOT
- Iowa State University / Iowa DOT
- City College New York / NJ DOT
- Texas A&M University
- University of Alabama
- Minnesota DOT
- Michigan DOT
- South Carolina DOT
- Private consulting firms

Case Study: Minnesota DOT

- Minnesota DOT:
  - Measures ~20% of their roadway
  - 10 year history of MRU
  - Data used to produce predictive models for deterioration of pavement markings
  - ~$150,000 to operate and staff 2 vans
  - Saves approximately $5 million a year in pavement marking costs
  - Reduces handheld measurement bias

Current FDOT Plan for MRU

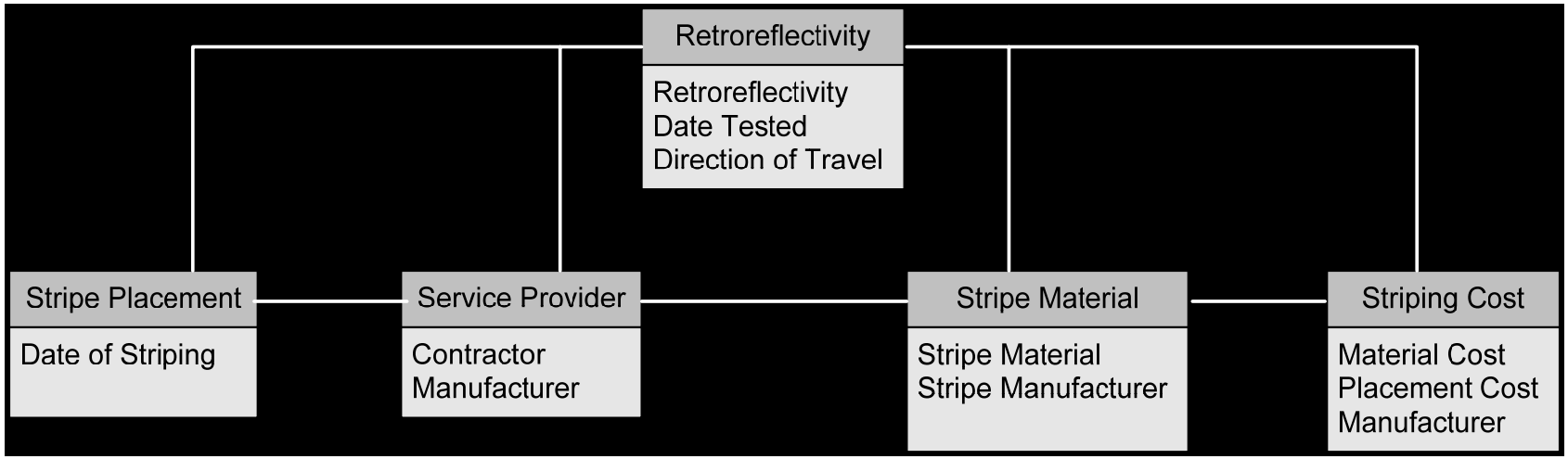
- Analyze the precision and bias of the unit
  - Characterize the significant factors that may cause measurement error
  - Study the effectiveness of improving the unit if necessary
  - Develop procedures to ensure accurate measurement

- Depending on the results of the study, there are a variety of possible uses
  - Inventory assessment to support a pavement marking management system
  - Project level warranty inspection assistance
  - Monitoring of test products

FDOT MRU Program

- Research is a joint effort between FDOT and the University of North Florida (UNF).
- Research team includes a UNF Mechanical Engineering Professor and 1 full time Mechanical Engineer on site supplied by UNF.
- Team working with manufacturer to characterize and resolve system sensitivities and implement into pavement management program.
- Interested in putting together MRU Users Group to exchange ideas and information.

Example of How To Implement Into Pavement Marking Management System



Relate all striping information together in a database to analyze results:

- Use information to effectively determine re-striping dates
- Determine best value based on performance and cost
- Does one contractor's work continually outperform another's?
- Does one material type tend to perform better on one pavement type?

Questions???