LOG OF MEETING
DIRECTORATE FOR ENGINEERING SCIENCES

SUBJECT: Recreational Off-Highway Vehicle Association (ROHVA) ANSI ROHVA 1-2014 Public and Stakeholder Meeting

DATE OF MEETING: May 5, 2015

PLACE OF MEETING: Hilton Inn, Chicago O'Hare Airport

LOG ENTRY SOURCE: Mark Kumagai, ESME

COMMISSION ATTENDEES: See attached attendance list

NON-COMMISSION ATTENDEES: See attached attendance list

SUMMARY OF MEETING: The ANSI ROHVA standard committee met to discuss their recent testing and analysis of ROVs. Attached is the presentation made by Polaris describing their vehicle handling testing. Polaris measured the ROV's yaw rate while driving around a 100 ft. diameter circle at a constant steering wheel angle and increasing speed. All of the ROHVA members agreed that the yaw rate test was a valid method to determine if a ROVs exhibits divergent instability, however a pass/fail criteria needs to be developed. CPSC staff asked if ROHVA could share their yaw rate data by coding the vehicle. ROHVA members had some concerns but would consider staff's request.

The following issues of the standard were discussed:

- **Seat Belt Speed Limiter:** ROHVA members will consider requiring driver side seatbelt speed limiter for electronic fuel injected vehicles. ROHVA members stated that carburated and diesel vehicles should be exempt due to technical challenges for limiting speed. Members noted that most of their vehicles are fuel injected. They estimated that a manufacturer would need two years to implement a seat belt speed limiter system into production vehicles. Manufacturers that have this feature reported that the have not received many customer complaints about seat belt speed limiter.

- **Tilt Table:** ROHVA proposed using the ROV's tilt table angle for a hangtag. They believe that tilt table angle is meaningful to consumers, easier, and more consistent to measure than lateral acceleration, Ay. Manufactures reported that their tilt table measurements showed good correlation to Ay. CPSC staff reported that they did not get good correlation between tilt table angle and Ay.

- **Lateral Stability:** ROHVA members stated they believe that the standard's 30 mph, 110 degree J-turn is a good test of lateral stability. CPSC staff expressed concerns that the test is not a comparative measure of lateral stability since steering ratios are different between vehicles. ROHVA members believe that a larger steering ratio results in slower steering response, (similar to truck steering versus a sports car) contributes to a more lateral stabile vehicle. One member was open to increasing the tilt table requirement.

- **Occupant Protection:** ROHVA members believe that consumers want the option to use nets with one handed operation. ROHVA members stated that consumers using ROVs for work want the ease of egress provided by nets. In addition, larger users find doors and rigid structures uncomfortable. CPSC staff expressed concerns that nets will not be used. Staff asked if industry members had any data on net use. They did not. ROHVA member stated that most recreational ROVs use doors or have doors as an option.

Polaris presentation attached.

Attendees at the ANSI/ROHVA 1-2014 Standard Meeting, May 5, 2015 – Chicago, IL

COMMISSION ATTENDEES

NAME	ORGANIZATION
Caroleene Paul	CPSC
Mark Kumagai	CPSC
Tony Teems	CPSC

NON-COMMISSION ATTENDEES

NAME	ORGANIZATION
Erik Pritchard	ROHVA
Tom Yager	ROHVA
Gary Heydinger	SEA
Gary Higgins	Honda
Jack Alden	Honda
Mike Wiegard	Eckert Seamans
Tyler Furhman	Kawasaki
Ted Bettin	Arctic Cat
Annamarie Daley	Barnes & Thornburg LLP
Siva Sundaresan	John Deere
Kevin Lund	John Deere
Keith Steenladge	John Deere
Bob Loehr	John Deere
Brad Franklin	Yamaha
Brian Gabel	Yamaha
David Murray	Willkie Farr & Gallagher LLP
Paul Vitrano	Polaris
Louis Brady	Polaris
Damien Hartly	Polaris
Erika Jones	Mayer Brown
Marie-Claude Simard	BRP
Daniel Leclerc	BRP
Bonnie (didn’t get last name)	American Academy of Pediatrics

A Handling Quality Metric

100 ft Testing Data

Detecting Divergence – Fixed Steer Results

No Spin Condition

Plotting yaw rate against vehicle speed will show its character

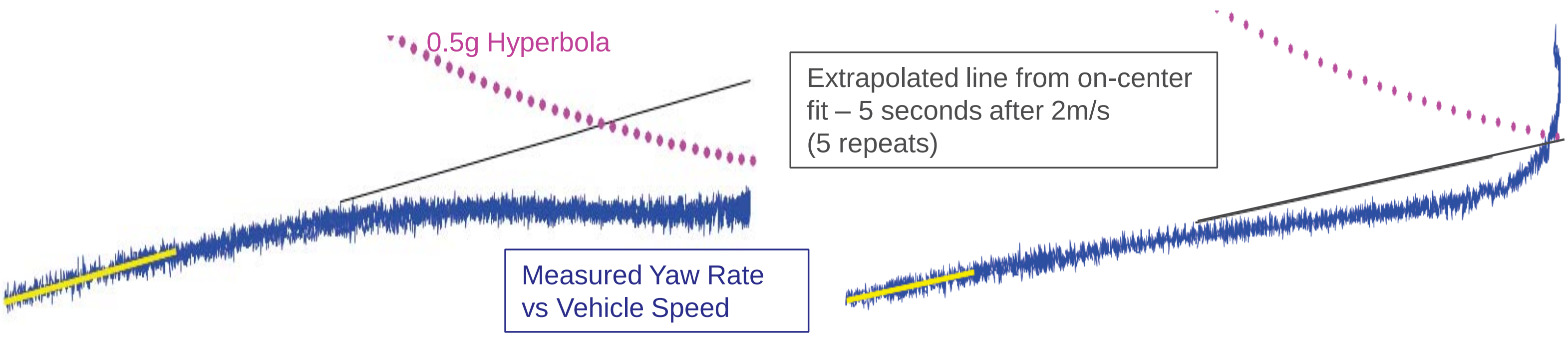
An imaginary, equivalent “geometric” vehicle can be extrapolated from **on-center** with a **straight line**

Plotting $0.5g*9.81ms^{-2}/\text{Vehicle Speed}(ms^{-1})$ gives a “0.5g Hyperbola” to determine test end

Divergent Spin Condition

Convergent vehicles typically keep a “substantially constant” slope of yaw rate with speed (bottom left)

Instability is shown by a large change in the character (slope) of the plot for a small speed change – it “goes vertical” (bottom right)



Visually a Strong Difference – No Filtering/Processing Required

Suggested Detail

Plot 5 repeats in each direction

For each repeat

Fit on-center slope

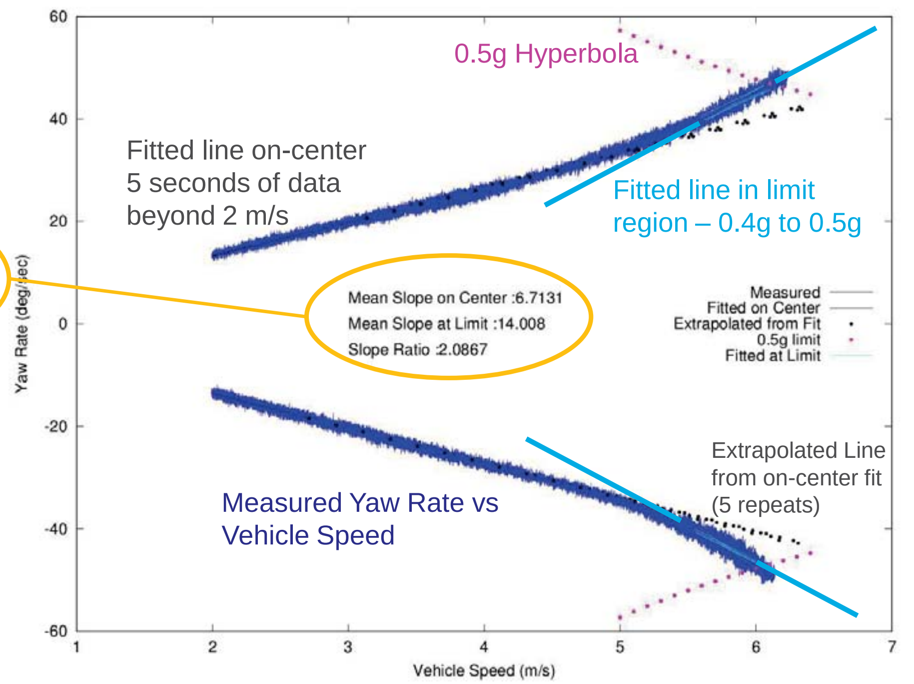
Fit limit slope

Average on-center slopes between repeats

Average limit slopes between repeats

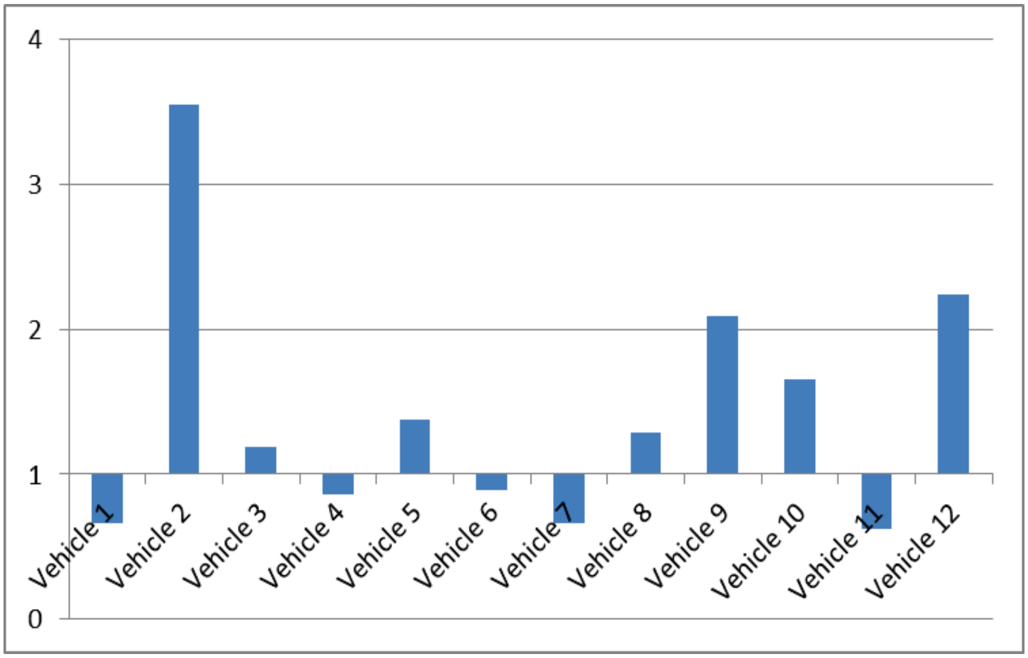
Evaluate relationship of averaged limit slope to averaged on-center slope

Pass-fail criterion tied to slope ratio



Numerically Robust With Typical Data (24 Vehicle Sample)

Sample Metric – Fleet Review (50ft)



- 200ft circle data shows an even stronger response - ratio of *13.8:1* (Vehicle 2)
- 100ft circle expected to be somewhere between the two
- 100ft probably reflects a good compromise between space required and quality of results
- All vehicles converge except Vehicle 2 (spins)
- Not all vehicles are understeer

Divergent Response Stands Out in Blind, Automated Processing

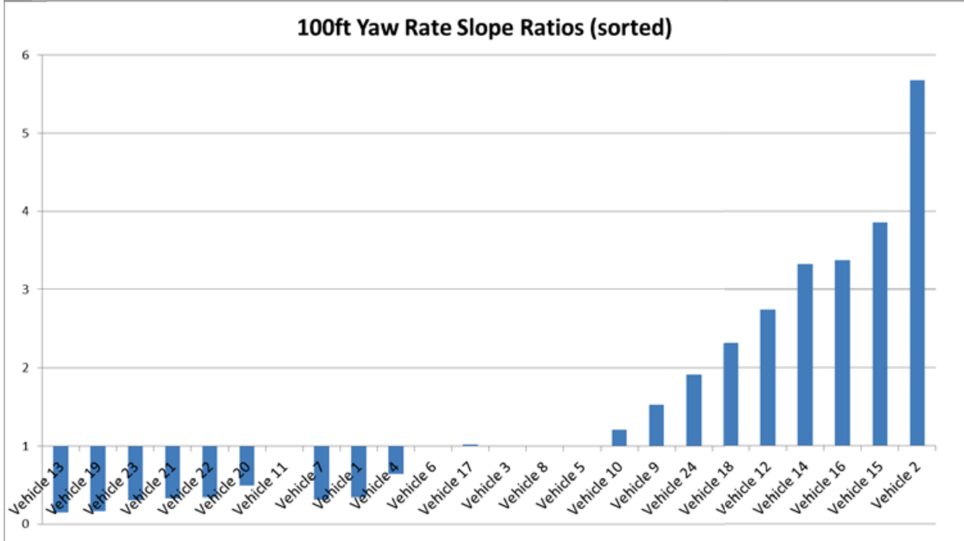
Further Results (100ft)

100ft Results

Vehicle 2 shows a stronger response on 100ft as expected

Vehicle 2 behavior still observed as diverging

Some of higher scoring vehicles begin to diverge in one direction but not other

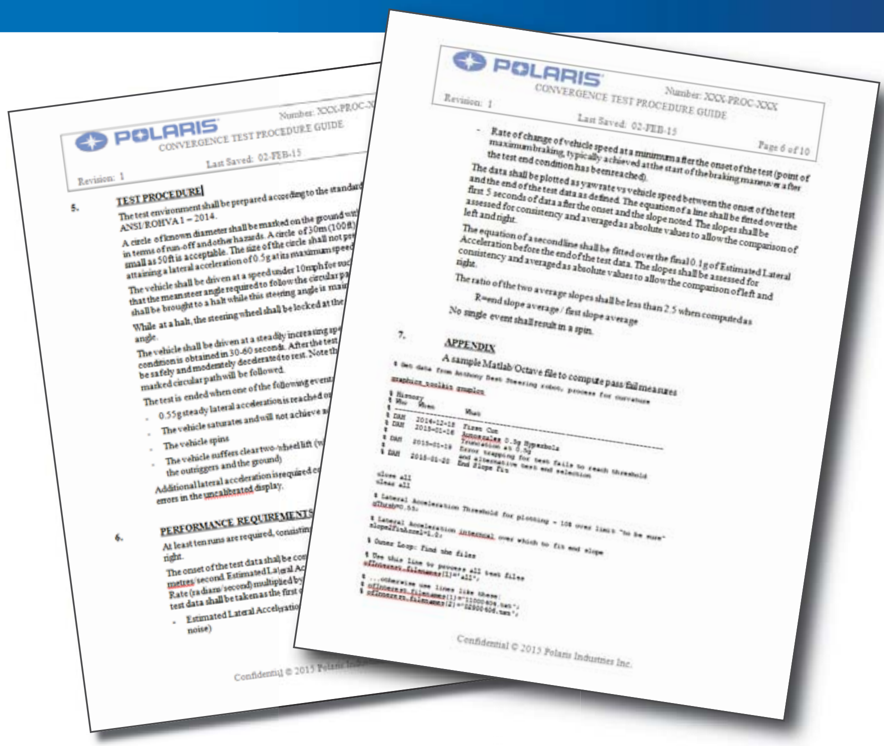


See Appendix for Data Plots

100ft Data Broadly As Expected; Pass/Fail Idea Still Holds; Where to Draw It?

Next Steps

- ~~100ft Data Comparison~~
- Receive Inputs from others
- ~~Expand Vehicle set~~
- ~~Test robustness further~~
- Refine Pass/Fail criteria
- ~~Formalize Process~~



Working Toward a Specific Proposal

Summary

Method developed on first principles/best-practices

Better than Oversteer as Surrogate for Tripped Rollover Risk

Repeatable methods with minimal test errors

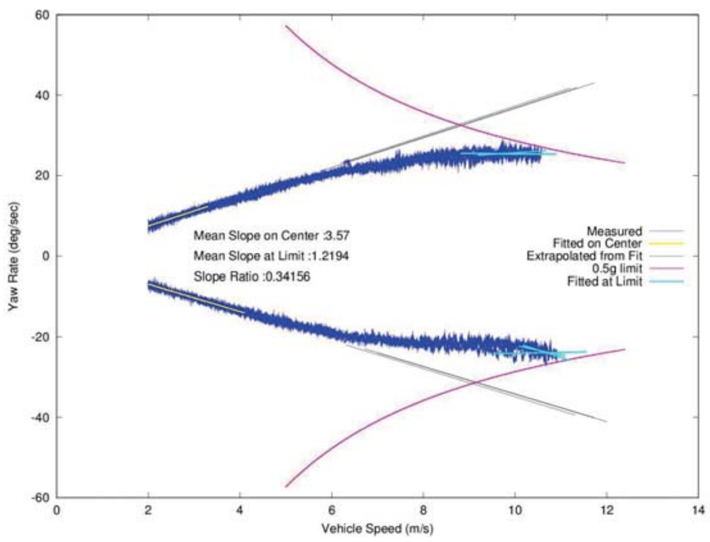
Drives predictable vehicle handling designs

Discriminates and identifies unpredictable behaviors

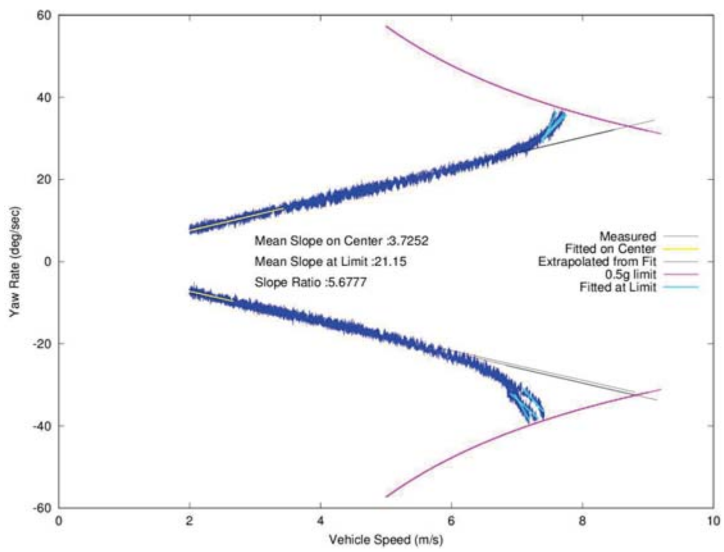
Superior Alternative to Understeer Bias

Appendix – Real Vehicle Data – 100ft

- **Vehicle 1**

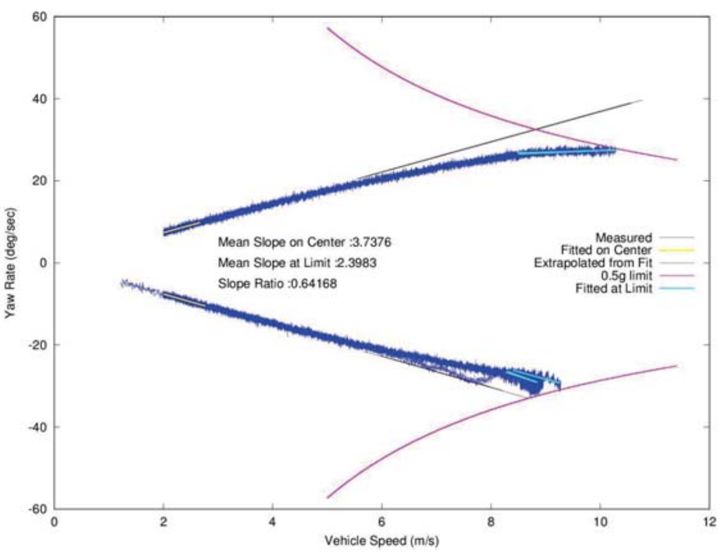


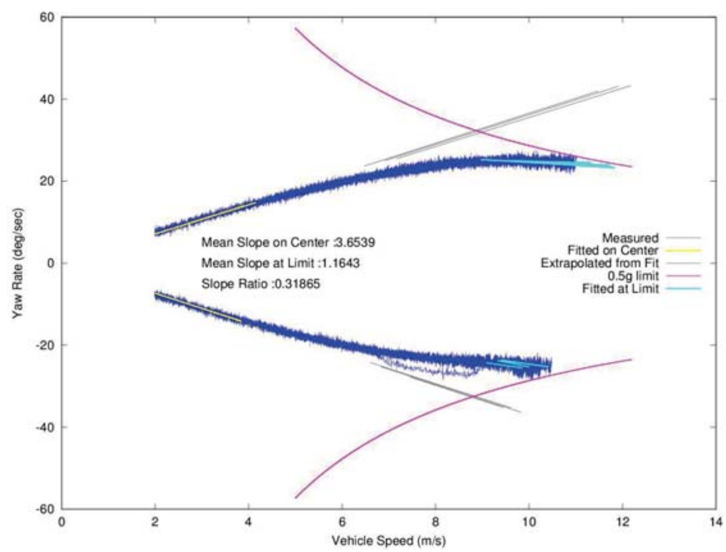
- **Vehicle 2**



Appendix – Real Vehicle Data – 100ft

- **Vehicle 4**
- **Vehicle 7**





Appendix – Real Vehicle Data – 100ft

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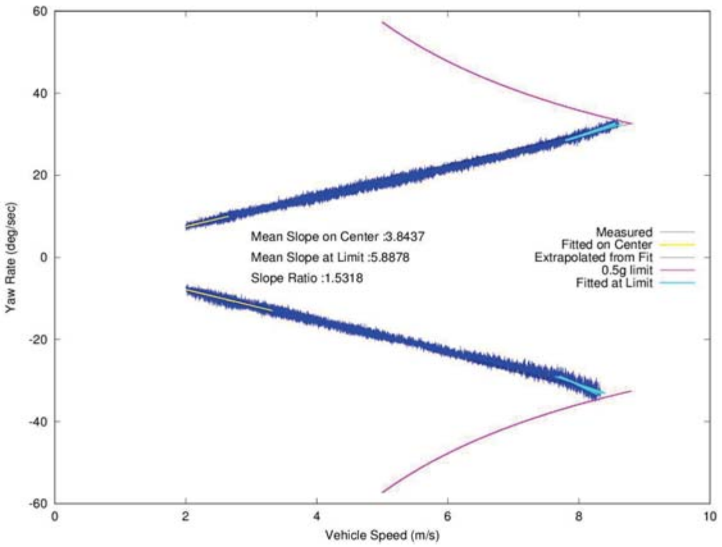
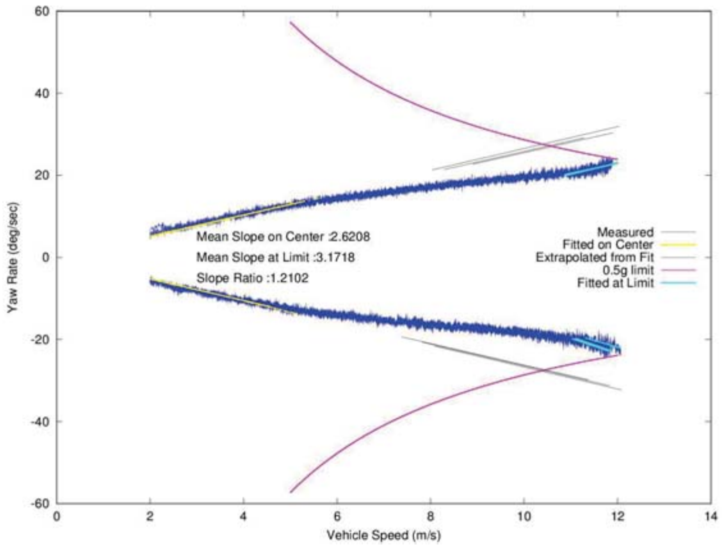
- Vehicle 9



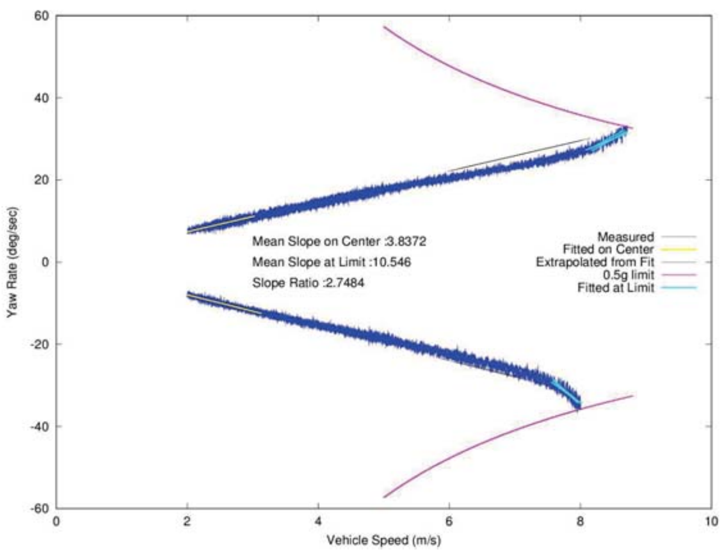
- Vehicle 10

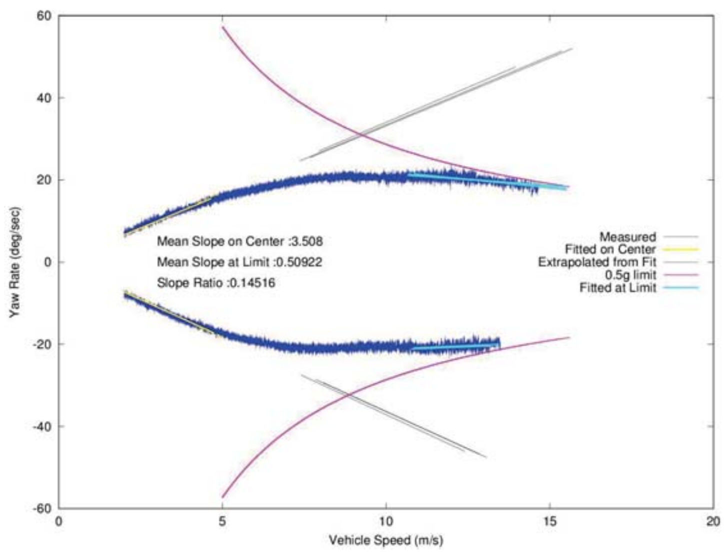


Appendix – Real Vehicle Data – 100ft

Appendix – Real Vehicle Data – 100ft

- Vehicle 12
- Vehicle 13





Appendix – Real Vehicle Data – 100ft

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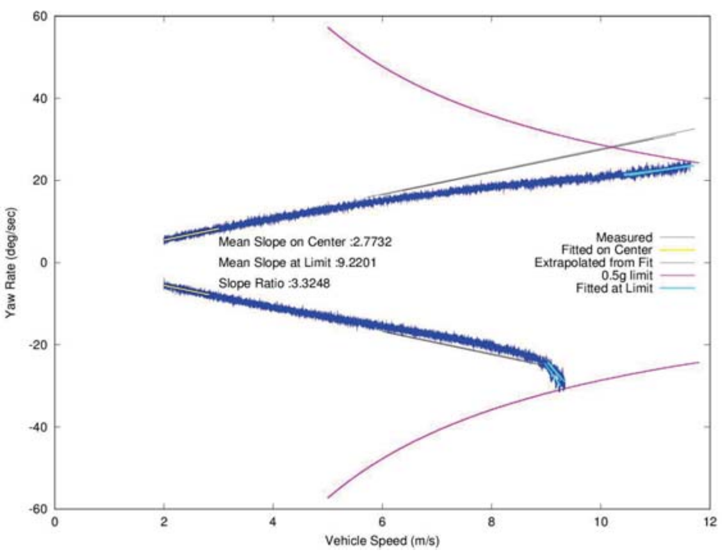
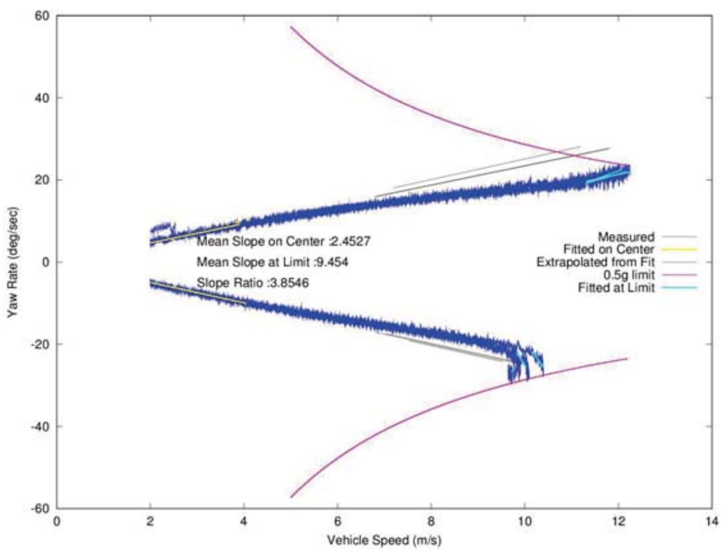
- **Vehicle 14**

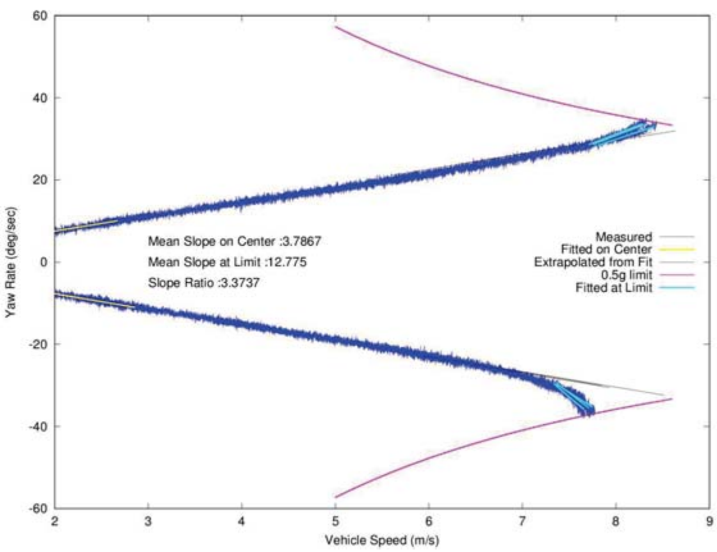


- **Vehicle 15**

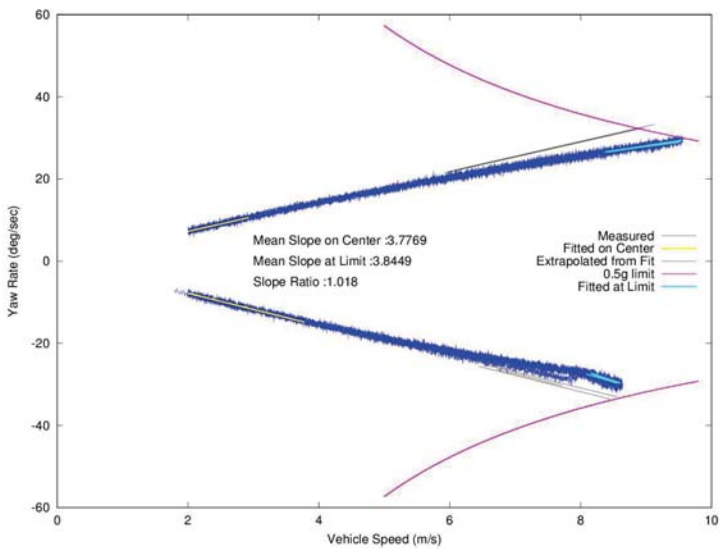


Appendix – Real Vehicle Data – 100ft

- **Vehicle 16**



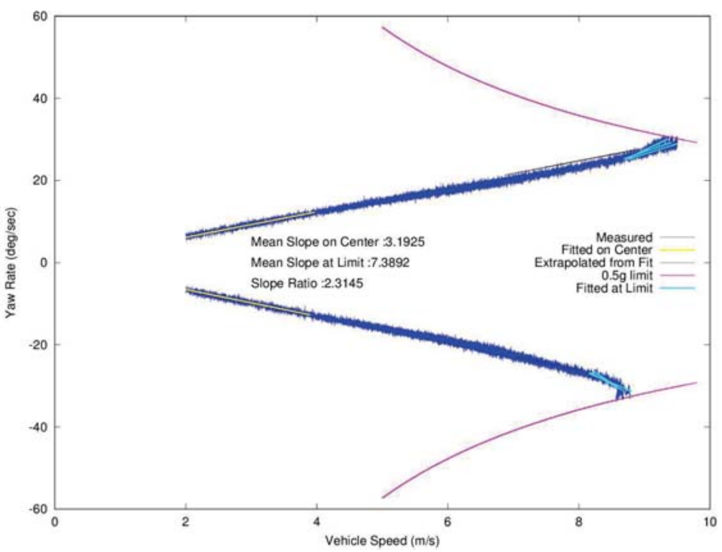
- **Vehicle 17**



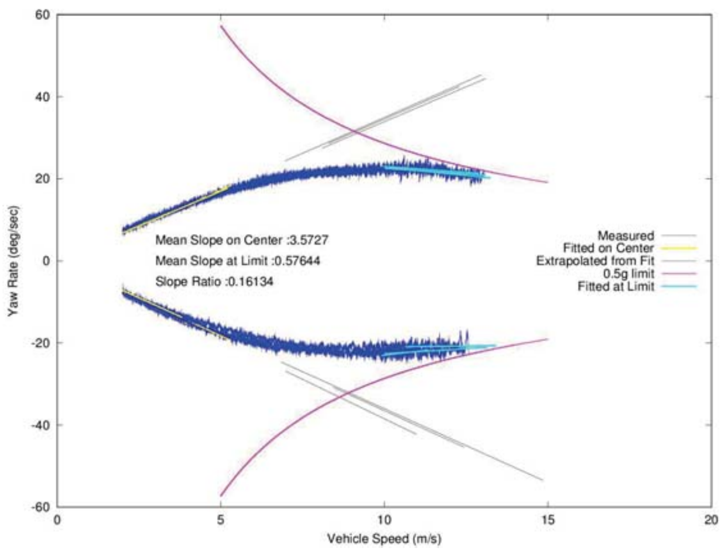
Appendix – Real Vehicle Data – 100ft

Appendix – Real Vehicle Data – 100ft

- Vehicle 18



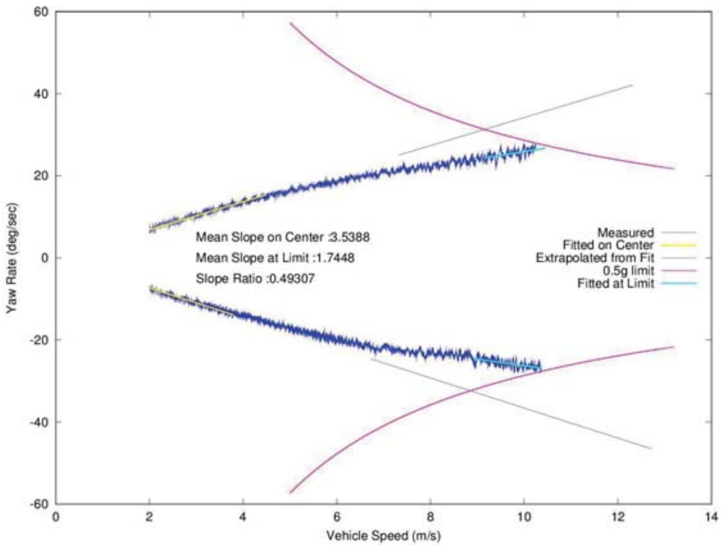
- Vehicle 19



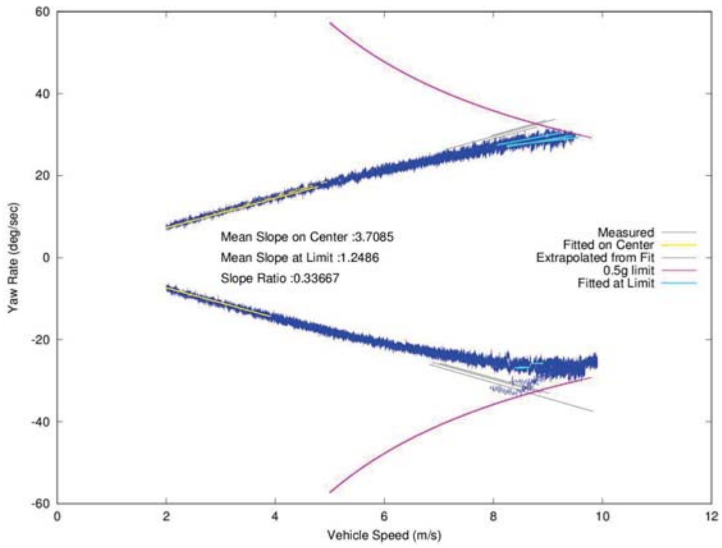
Appendix – Real Vehicle Data – 100ft

Appendix – Real Vehicle Data – 100ft

- Vehicle 20



- Vehicle 21



Appendix – Real Vehicle Data – 100ft

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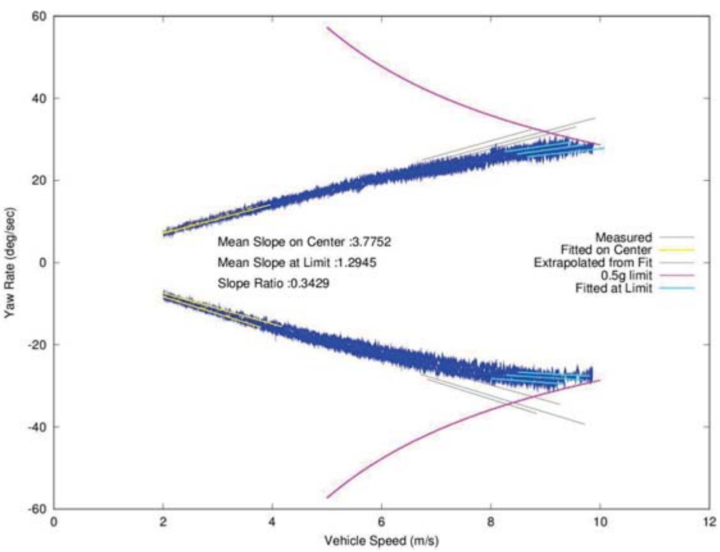
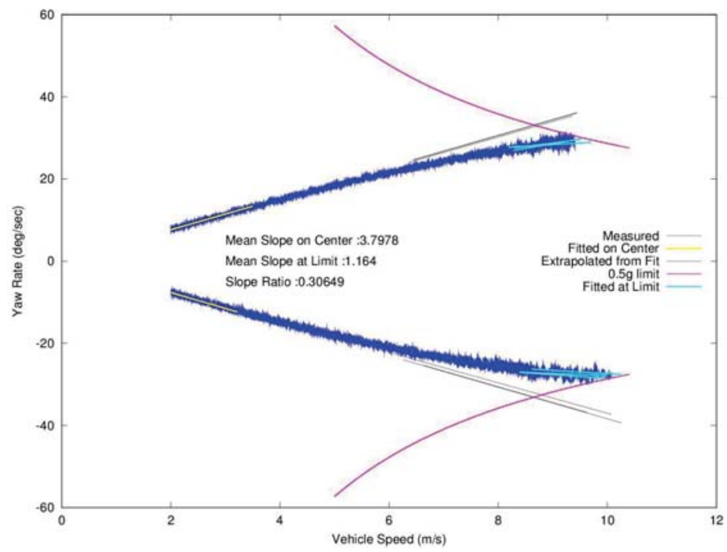
- **Vehicle 22**



- **Vehicle 23**



Appendix – Real Vehicle Data – 100ft

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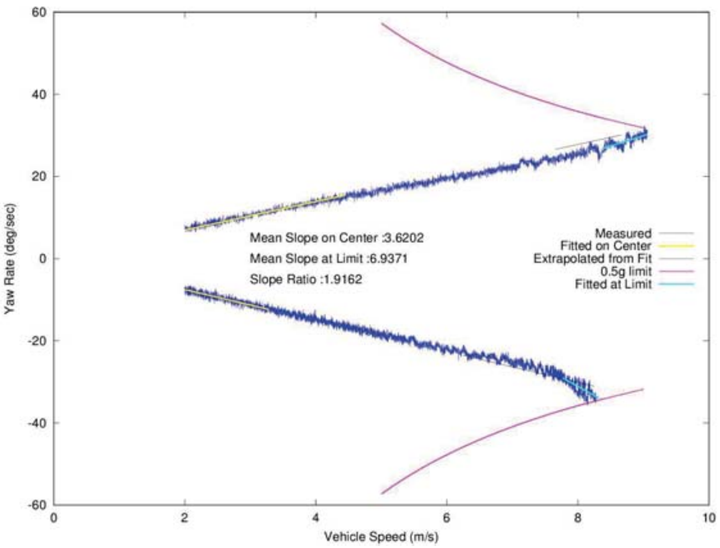
- **Vehicle 24**



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