

# Solo Data Acquisition



**How to find time on course before your next run!  
-not after you get home!**

Jason Kolk

ESP 190 – 1999 Camaro

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With support from:

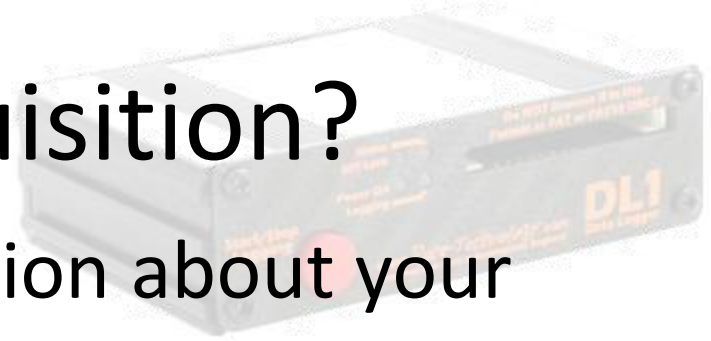


# What is Data Acquisition?

- Collecting electronic information about your car's performance to review later

## Why should you use it?

- Compare drivers
- Compare changes to the car (suspension, engine)
- Compare corner by corner instead of just lap time
- Go back later and ask different questions about the event that were not on your radar screen that day.
- **If used correctly, you can find time on your NEXT run!**



# What can you record?



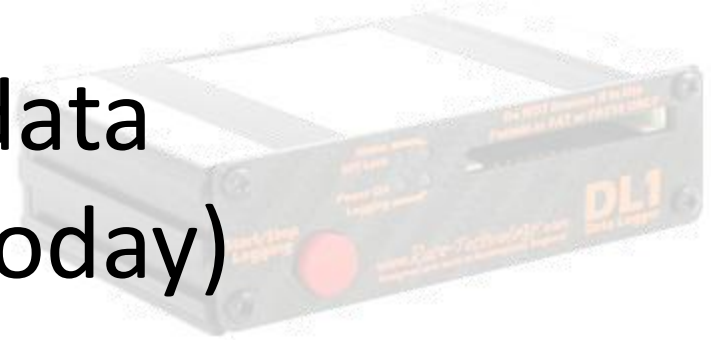
- Built In Sensors
  - Vehicle Speed (usually GPS based)
  - Lateral/Longitudinal G's (side to side / front to rear acceleration)
- ECU/ECM Parameters (connect to OBD port)
  - Throttle Position
  - Engine Speed (RPM)
  - Temperatures and Pressures (Water & Oil)
- Extra Sensors (add on)
  - Steering Position
  - Brake Pressure
  - Suspension position
  - **More possible variables than you can ever imagine!**
- **If you're starting out, don't add any sensors! Just use the built-in variables for roughly the first season.**
- **Only add sensors if you have a question that needs to be answered!**

# Main Analysis Themes



- Speed is Time on Course
  - Plot **Speed vs Distance** – First graph to look at
  - **Goal: Increase your minimum speed**
    - **More time elapses while you're going slow**
- Longitudinal Acceleration
  - Captures Throttle and Brakes
  - Getting on the gas earlier will show up in this plot
    - Indicates later apexing, more looking ahead
- Time Slip – DL1 specific curve
  - Shows specifically where time is lost

# Main uses for data (topics covered today)



- Test & Tune:
  - Evaluating changes to the car
  - Tire Pressure, Springs, Shocks, Bars, Ride Height
- In-Event Analysis
  - Learn from your co-driver, run by run
  - Break things down corner by corner
    - Never ask yourself, ‘Why is he 0.5 seconds faster?’ again!
    - You could be faster in two places and your co-driver is even faster in only one place – **You can go faster there too!**
    - **If you figure that out at home, what’s the point?**

# Data Examples: Leading up to Test



## ESP Camaro 190

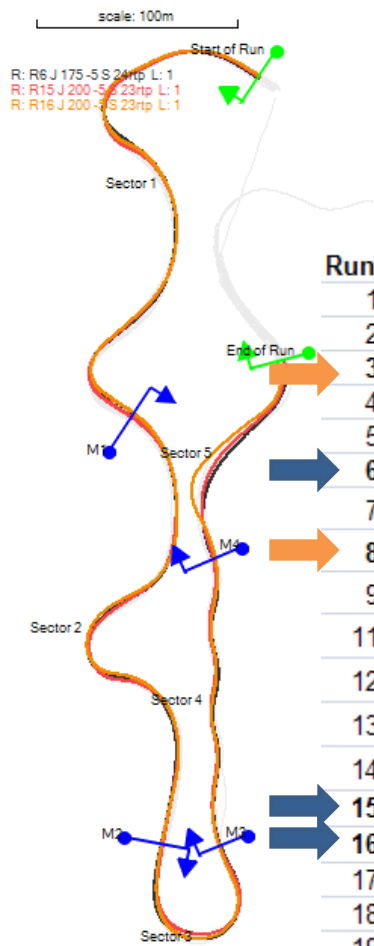
- Added Watts Link to rear for '09
  - 7 positions for rear Roll Center Height
    - Higher = Less Understeer; Lower = More Understeer
- Rear Sway Bar
  - Last year was fixed arm length
  - Now three position adjustable (due to Watts packaging)
- Rear Spring Rate Options
  - 175 lb/in & 200 lb/in



# T&T Prior to Peru Divisional – Aug '09



- Rear spring rate change Run 6 vs Run 15&16



1&2: Offsets

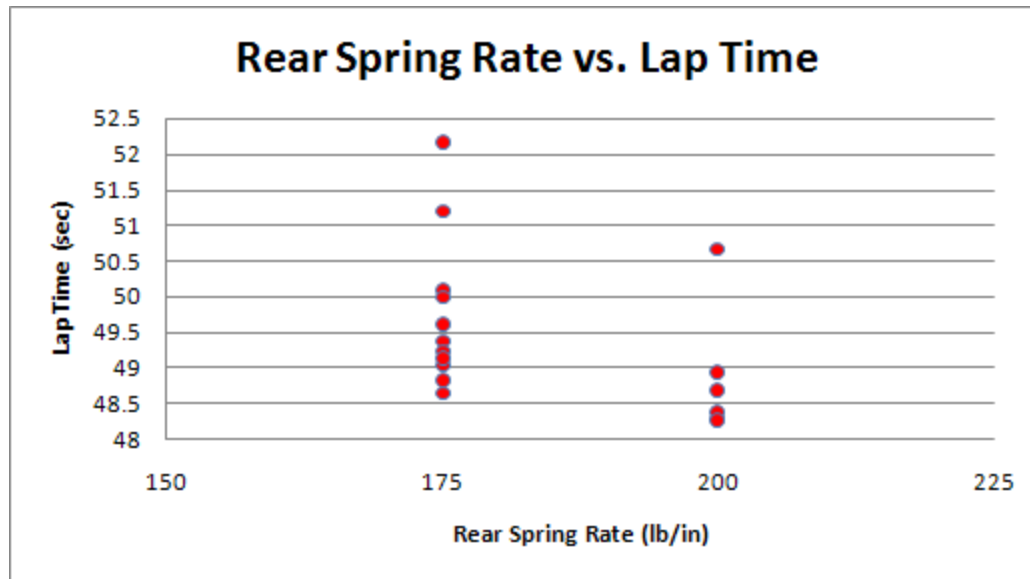
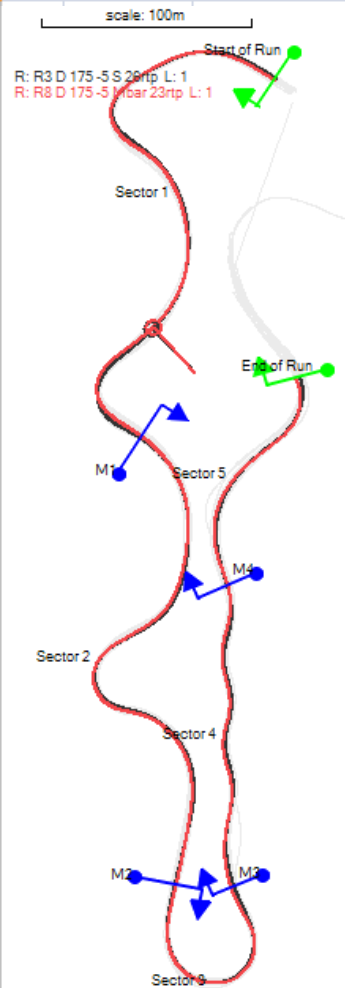
3: 180 sweeper

4: Slalom

Run	Driver	Rear spring	Watts Pos	Rear Bar	Rear Tire Pressure	Lap Time	Sec 1	Sec 2	Sec 3	Sec 4	Sec 5
1	Dave	175	-5	Soft	26	52.16	17.7	14.09	7.17	7.4	5.8
2	Dave	175	-5	Soft	26	51.19	17.8	13.89	7.15	7.21	5.86
3	Dave	175	-5	Soft	26	49.6	16.61	13.7	6.76	6.94	5.59
4	Jason	175	-5	Soft	26	50.08	16.92	13.53	7.14	6.89	5.6
5	Jason	175	-5	Soft	26	49.36	16.55	13.67	6.94	6.7	5.5
6	Jason	175	-5	Soft	24	48.63	16.34	13.36	6.85	6.63	5.45
7	Jason	175	-5	Soft	23	49.03	16.3	13.55	6.87	6.8	5.51
8	Dave	175	-5	Middle	23	49.98	16.75	13.44	6.95	7.01	5.83
9	Dave	200	-5	Soft	23	48.67	16.3	13.32	6.74	6.74	5.57
11	Dave	200	-6	Soft	23	48.27	16.23	13.23	6.71	6.68	5.42
12	Dave	200	-5	Soft	23	48.27	15.98	13.28	6.67	6.75	5.59
13	Dave	200	-6	Soft	23	48.36	16.15	13.12	6.87	6.74	5.48
14	Jason	200	-5	Soft	23	48.92	16.49	13.29	6.98	6.71	5.45
15	Jason	200	-5	Soft	23	48.25	16.03	13.65	6.78	6.47	5.32
16	Jason	200	-5	Soft	23	50.65	16.01	13.44	6.77	6.23	8.2
17	Jason	175	-3	Soft	23	49.22	16.42	13.28	6.84	6.74	5.94
18	Jason	175	-4	Soft	23	49.12	16.49	13.47	7.14	6.62	5.42
19	Dave	175	-4	Soft	23	48.81	16.44	13.39	6.76	6.67	5.55

# Rear Spring Rate Change

Run	Driver	Rear spring	Watts Pos	Rear Bar	Rear Tire Pressure	Lap Time	Sec 1	Sec 2	Sec 3	Sec 4	Sec 5	Sec 1-4	
6	Jason	175	-5	Soft	24	48.63	16.34	13.36	6.85	6.63	5.45	43.18	
15	Jason	200	-5	Soft	23	48.25	16.03	13.65	6.78	6.47	5.32	42.93	-0.25
16	Jason	200	-5	<b>Soft</b>	23	50.65	16.01	13.44	6.77	6.23	8.2	42.45	-0.73
						-0.38	-0.33	0.08	-0.08	-0.4	-0.13		





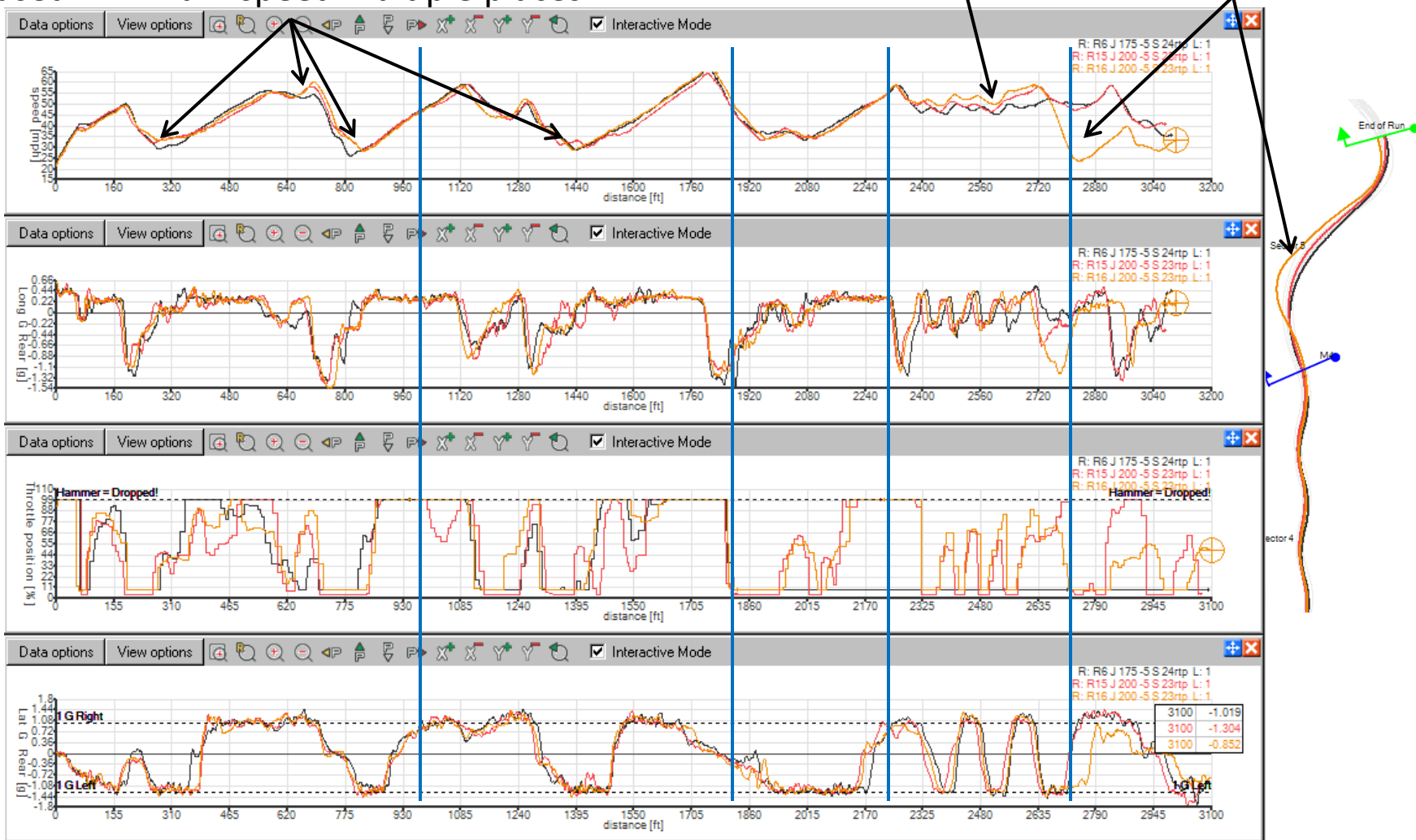
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Run	Driver	Rear spring	Watts Pos	Rear Bar	Rear Tire Pressure	Lap Time	Sec 1	Sec 2	Sec 3	Sec 4	Sec 5	Sec 1-4
6	Jason	175	-5	Soft	24	48.63	16.34	13.36	6.85	6.63	5.45	43.18
15	Jason	200	-5	Soft	23	48.25	16.03	13.65	6.78	6.47	5.32	42.93
16	Jason	200	-5	Soft	23	50.65	16.01	13.44	6.77	6.23	8.2	42.45
						-0.38	-0.33	0.08	-0.08	-0.4	-0.13	

Biggest gain was .4 seconds in the slalom

So much extra speed that I went off course!

Increased minimum speed multiple places



# Rear Spring Rate Change – Slalom

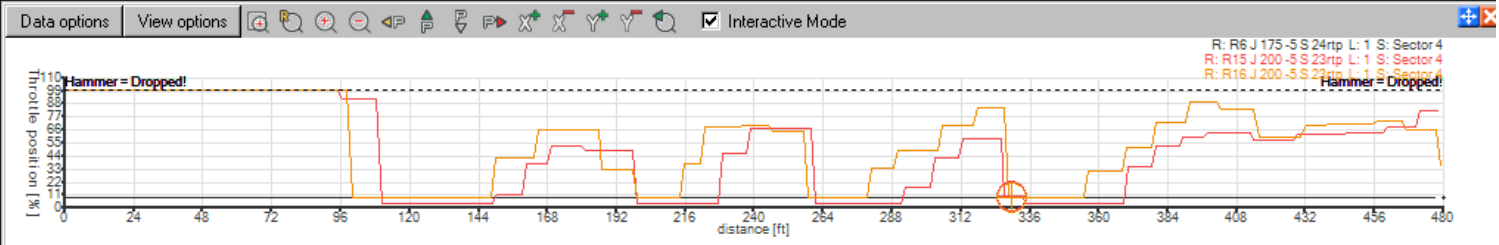
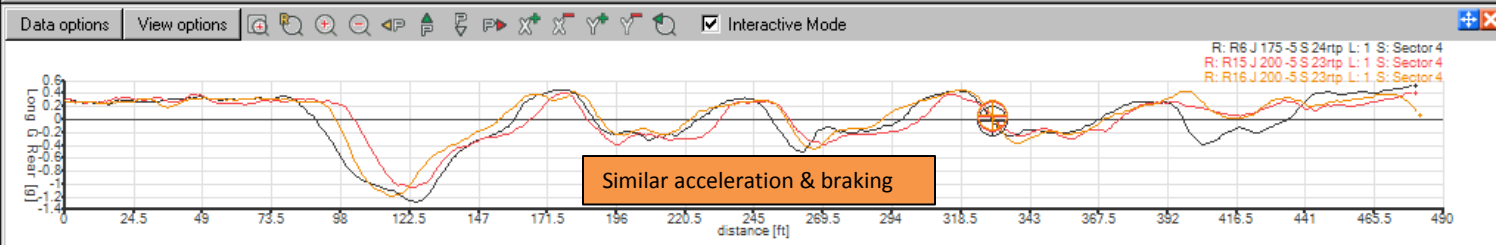
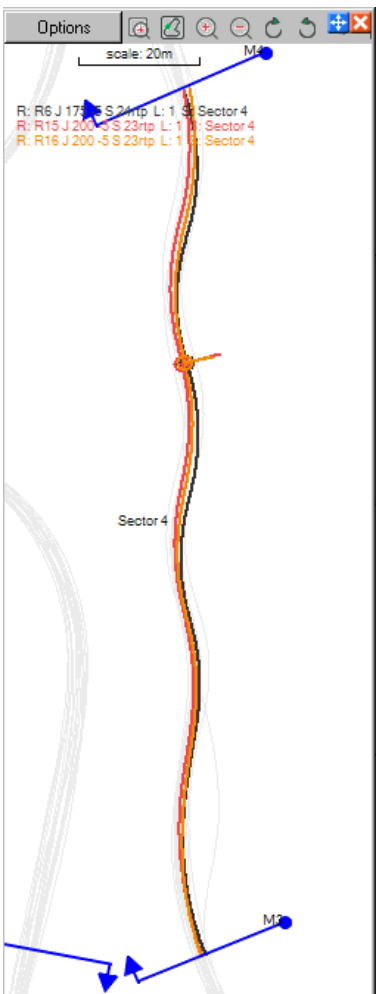
Run	Driver	Rear spring	Sec 4	
6	Jason	175	6.63	
15	Jason	200	6.47	-0.16
16	Jason	200	6.23	-0.4

175 lb/in Black  
 200 lb/in Red  
 200 lb/in Orange

46mph  
 50 mph  
 +4 mph

49mph  
 54 mph  
 +5 mph

49mph  
 58 mph  
 +9 mph





# In-Event Data Analysis

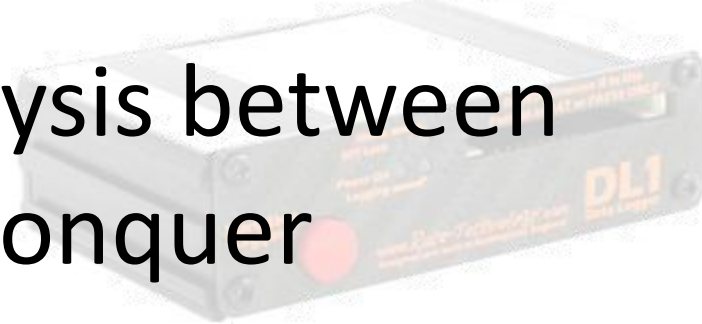
## 2009 Nationals – Run by Run

### Co-Driver Comparison

Driver 1: Dave

Driver 2: Jason

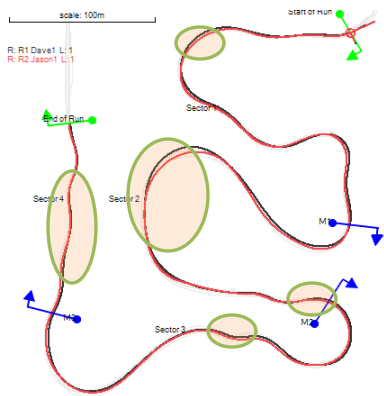
# How to handle data analysis between runs – divide and conquer



- If you want to look at data between runs
  - One driver should only work on the data
  - The other driver should take care of all car prep duties
    - Tire pressure, switch numbers, change seat, cool tires
- Look at data – determine areas to work on
  - Set goals:
    - Ex: “attack first corner, carry more speed into slalom”
- Walk away from the computer and the car!
  - Discuss how line differences might be impacting target locations on course. Look at course or map and talk to each other

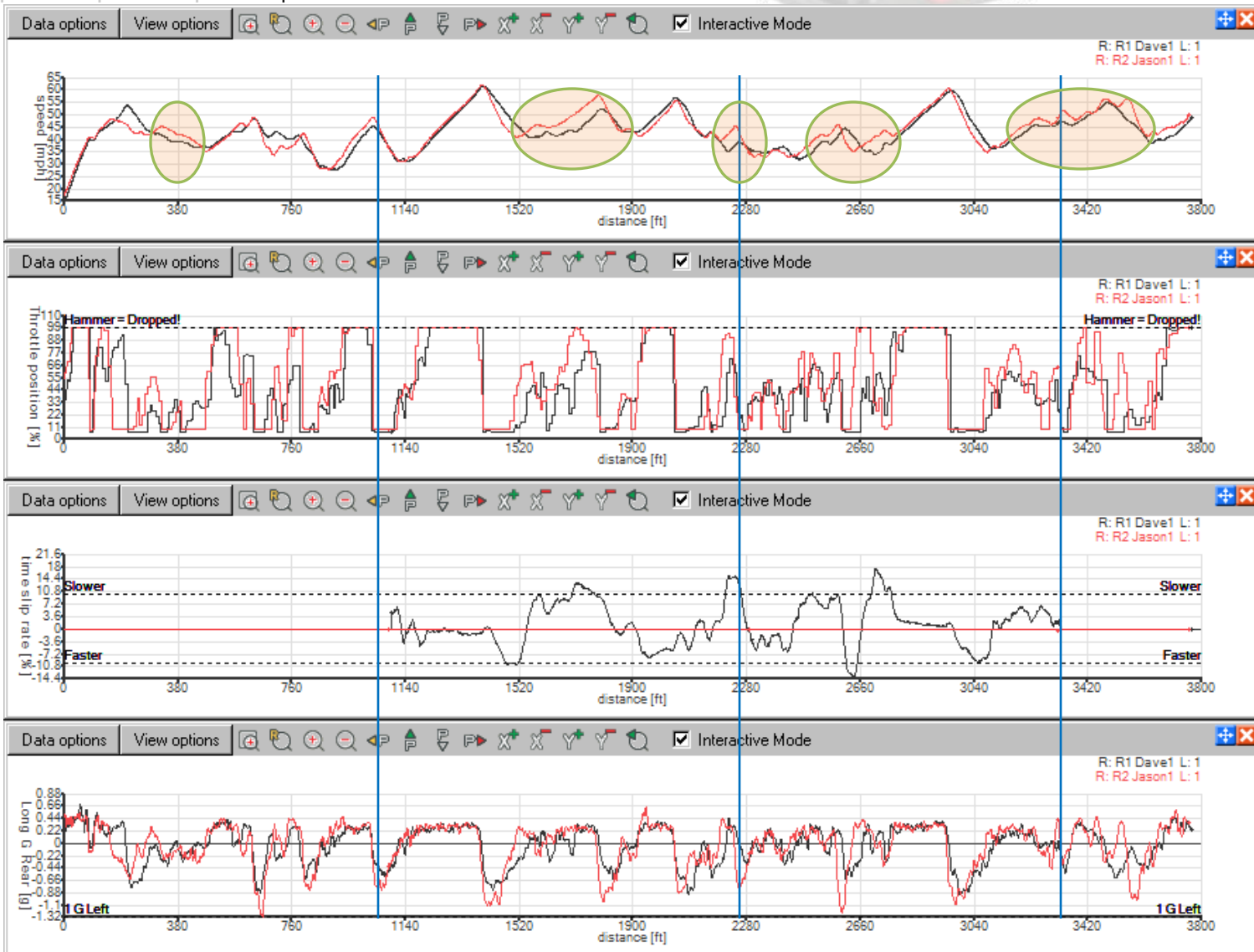
Lap times	Sector 1	Sector 2	Sector 3	Sector 4
Run "R1 Dave1" (1:01.86)				
Lap 1, 1:01.86	19.55	18.58	17.17	6.56
Run "R2 Jason1" (1:00.40)				
Lap 1, 1:00.40	19.05	18.32	16.88	6.15

# Nationals West Run 1



**Goal:** Give Dave targets to shoot for on Run #2.

Circled: Locations that Dave can match my speed (red higher than black)

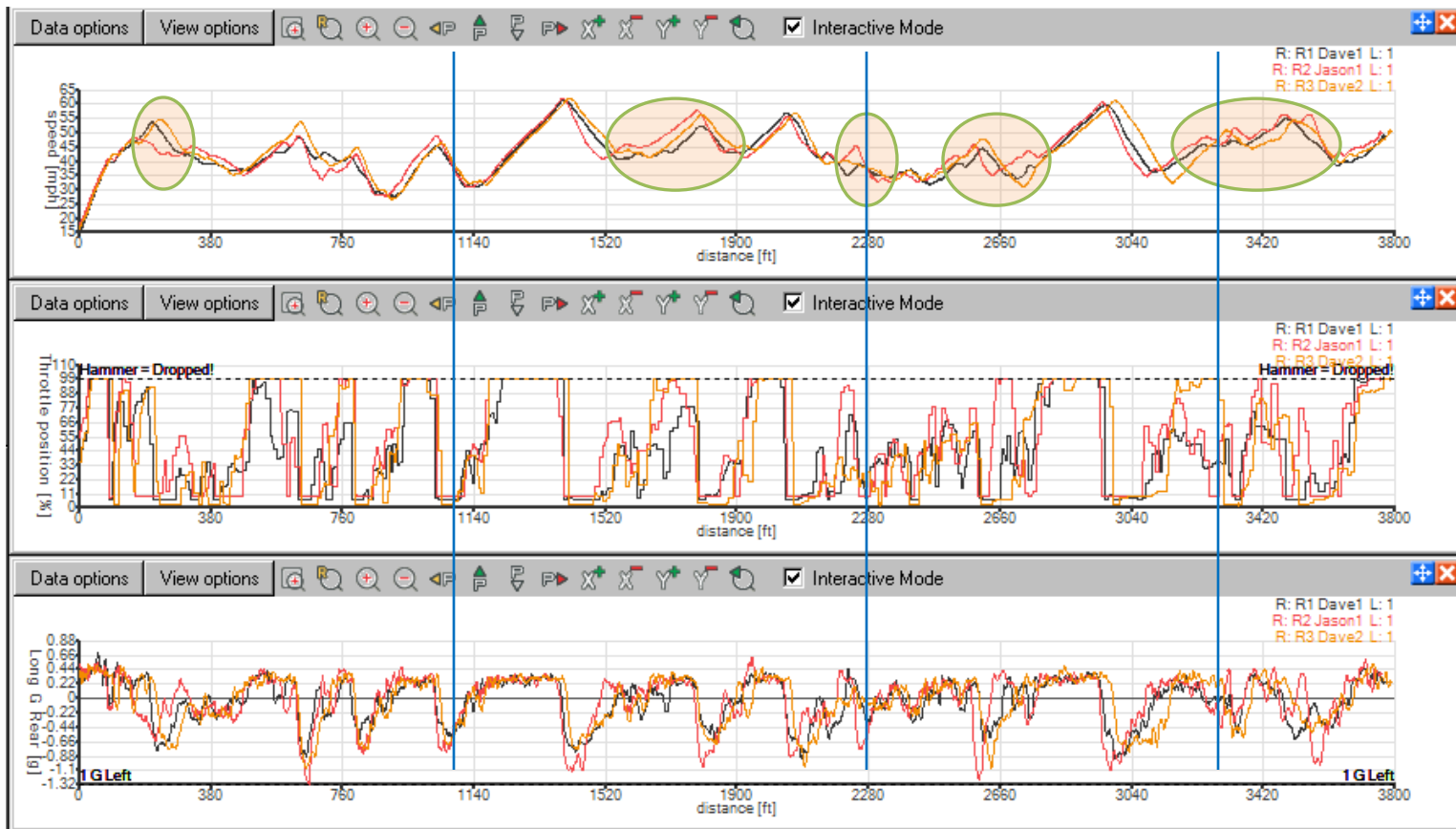
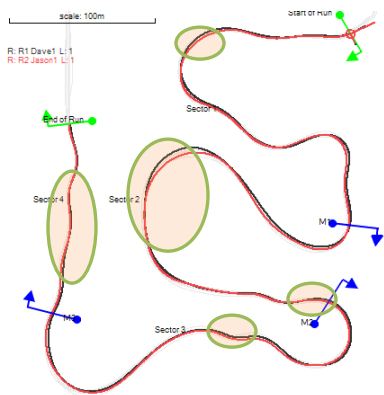


Lap times	Sector 1	Sector 2	Sector 3	Sector 4
Run "R1 Dave1" (1:01.86)				
Lap 1, 1:01.86	19.55	18.58	17.17	6.56
Run "R2 Jason1" (1:00.40)				
Lap 1, 1:00.40	19.05	18.32	16.88	6.15
Run "R3 Dave2" (1:00.90)				
Lap 1, 1:00.90	19.05	18.34	17.02	6.49

# Nationals West Run 2a

Did Dave find improvements on Run 2?

Improved 1 second: Matched my time in sector 1 & 2

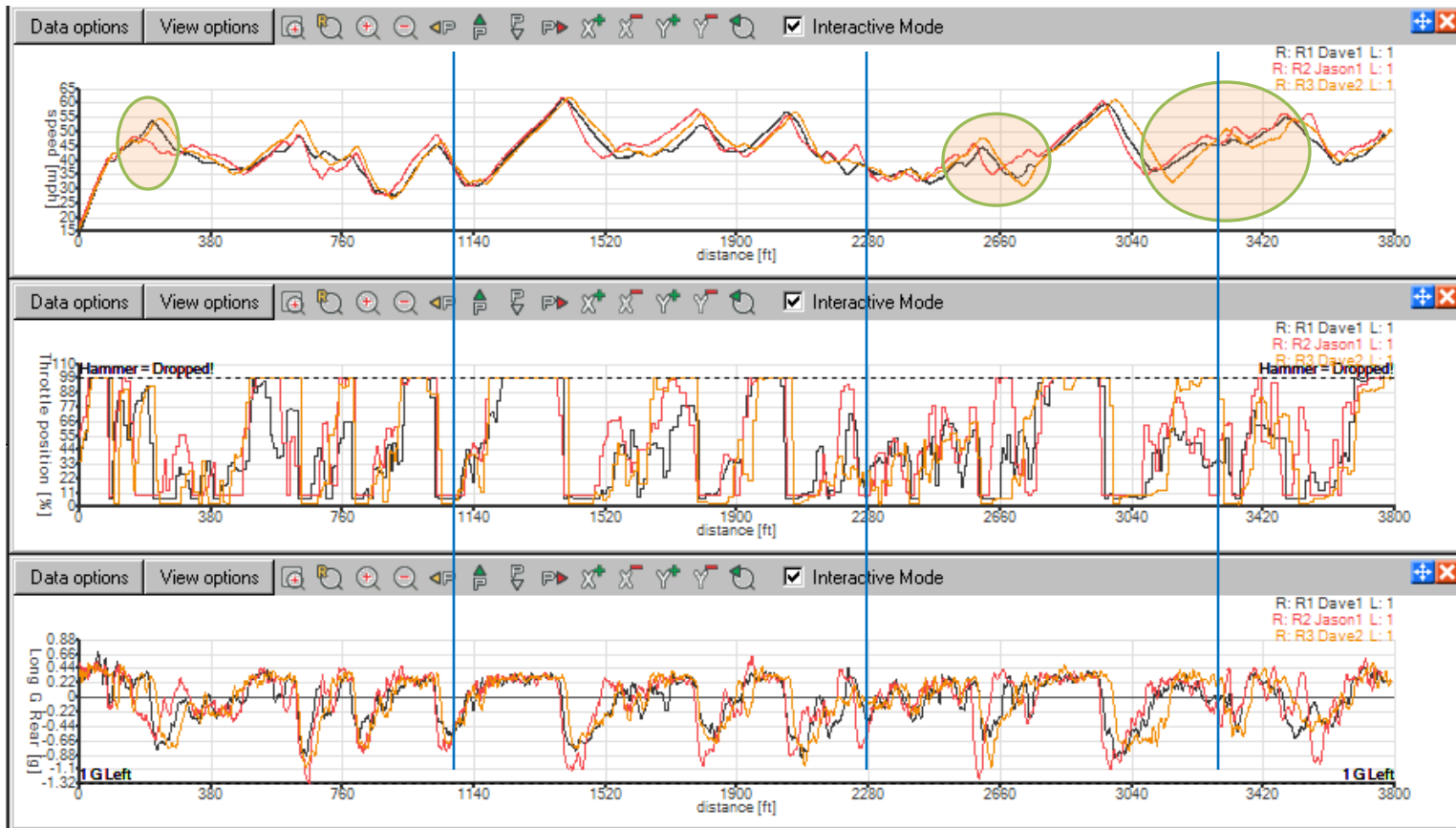
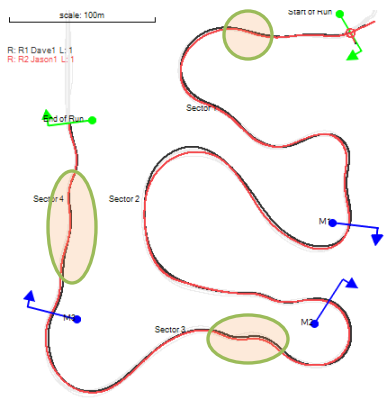


Result: Slight improvements in many places – adds up to 1 second on course

Lap times	Sector 1	Sector 2	Sector 3	Sector 4
Run "R1 Dave1" (1:01.86)				
Lap 1, 1:01.86	19.55	18.58	17.17	6.56
Run "R2 Jason1" (1:00.40)				
Lap 1, 1:00.40	19.05	18.32	16.88	6.15
Run "R3 Dave2" (1:00.90)				
Lap 1, 1:00.90	19.05	18.34	17.02	6.49

# Nationals West Run 2b

Goal: Find places for Jason to go faster on Run 2  
Find where Red speed curve is lowest



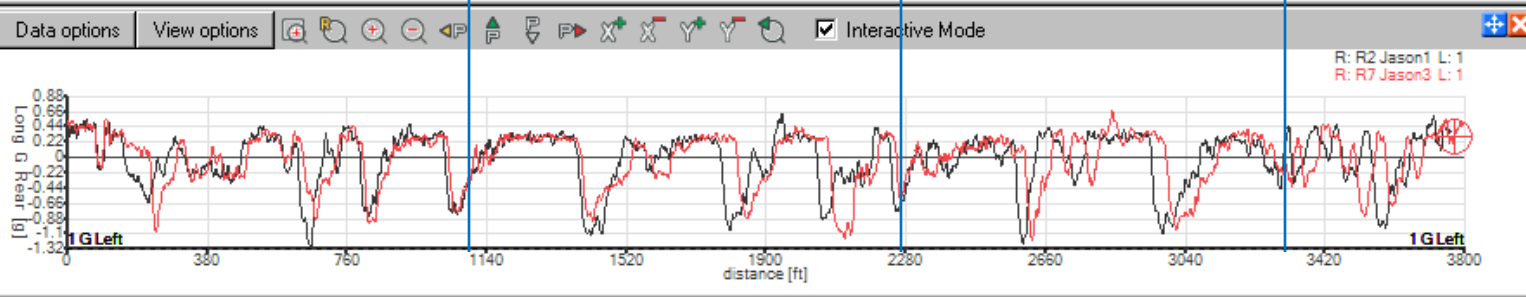
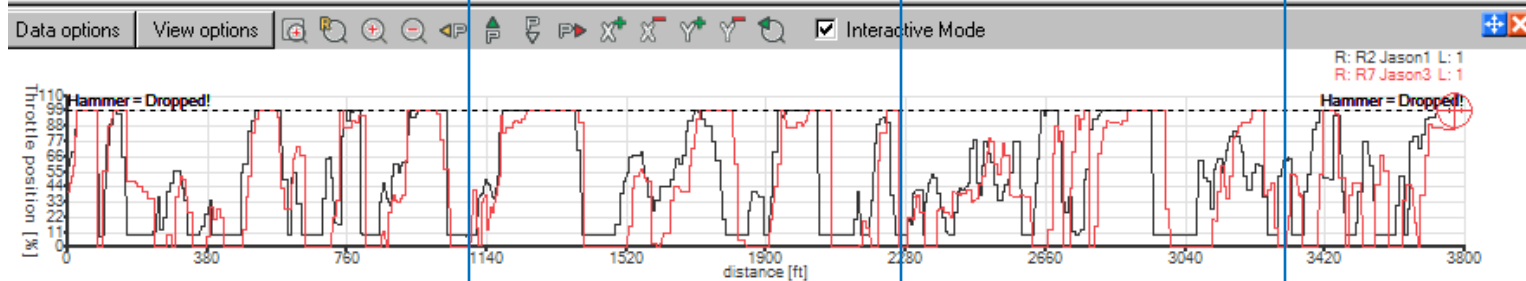
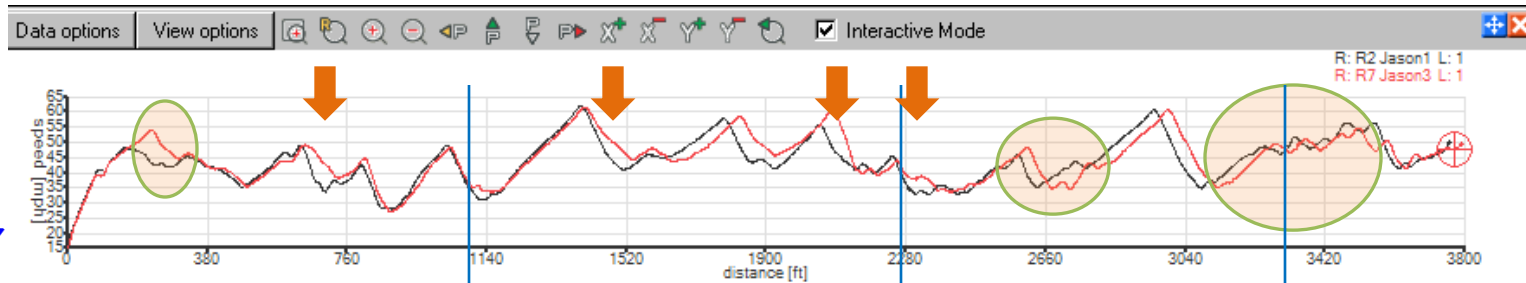
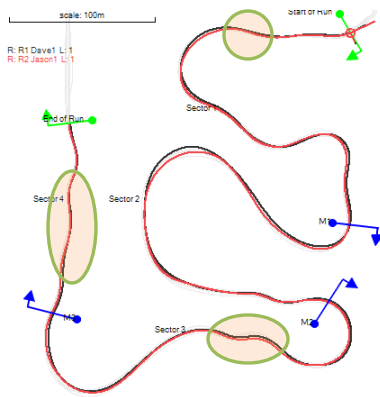
- Goals:
- 1 - Attack the start and charge into the turn-around
  - 2 - Attach slaloms

# Nationals West Run 2

## Complete

Did Jason go faster?

Lap times	Sector 1	Sector 2	Sector 3	Sector 4
Run "R2 Jason1" (1:00.40)				
Lap 1, 1:00.40	19.05	18.32	16.88	6.15
Run "R5 Jason2b" (1:00.14)				
Lap 1, 1:00.14	19.00	18.06	16.88	6.20
Run "R7 Jason3" (59.96)				
Lap 1, 59.96	18.89	17.87	16.99	6.21



Results:  
1 – Did attack the start and entry to first turn-around  
2 – First slalom goal failed. Gained the lost  
3 – Last Slalom didn't find improvements

Interestingly, wasn't working on increasing minimum speed, but did in multiple spots in sector 1 & 2

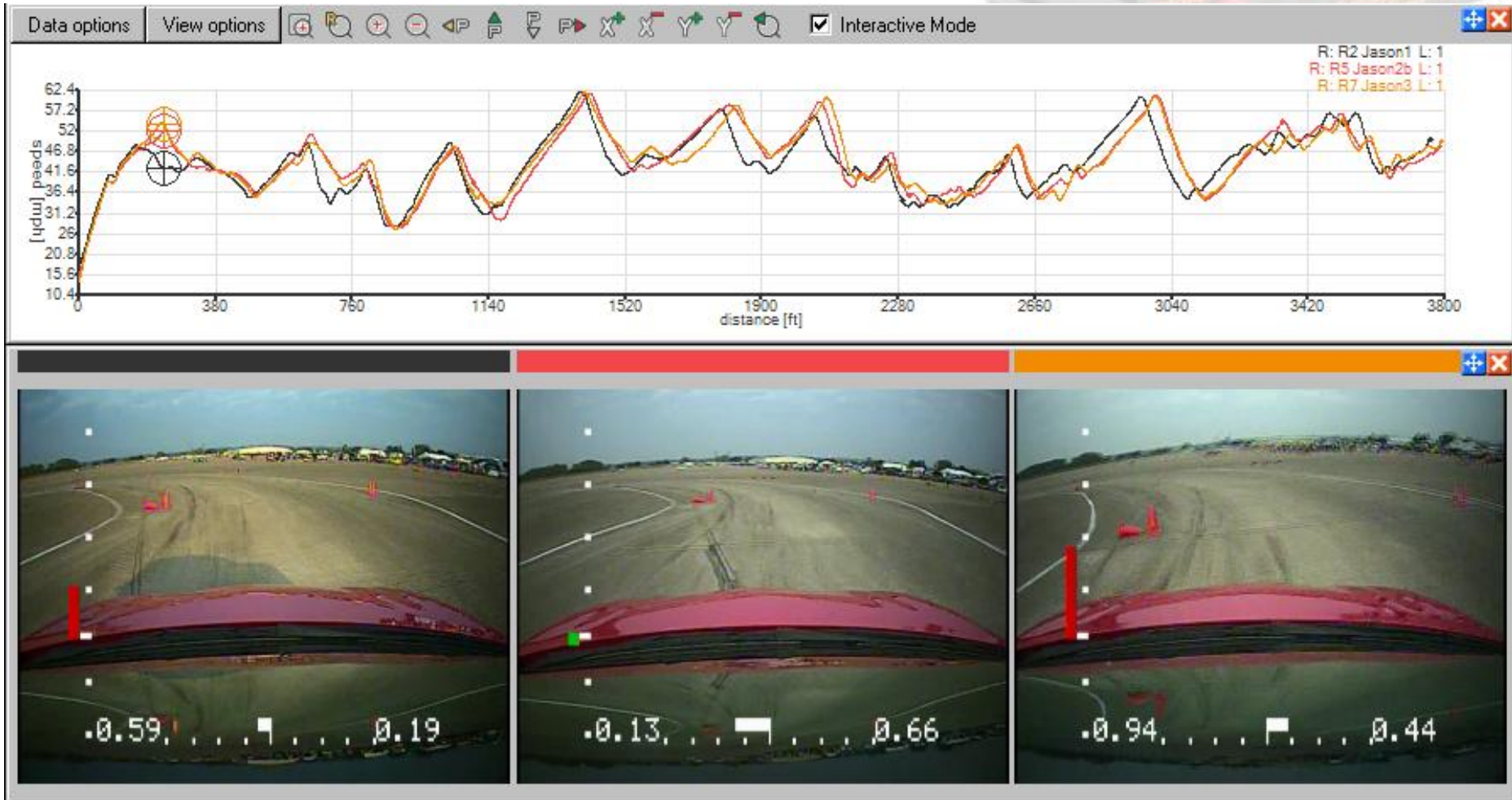


# Conclusions



- Dividing up tasks between runs can free up one driver to focus on finding areas of improvement
- Knowing where you can go faster is better than wondering if you can go faster in a certain corner
- Knowing where you can go faster doesn't guarantee that you'll execute it!

# Using Video to investigate line differences





Questions?

# Advanced topic: Calculated Channels

- Wheel spin: Use gear ratios and tire size to convert GPS speed to expected engine RPM
  - $\text{Wheel spin} = \text{Engine RPM} - \text{Expected (GPS) engine RPM}$
- Oversteer / Understeer
  - Compare two lateral accelerometers (front and rear axles)
- Shock position
  - Shock speed histogram -> advanced shock tuning
  - Understand actual ride heights during the run
    - What is roll center doing?

