Using Data to Improve You and Your Cars Performance

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Todays Agenda

• Introduction
• Overview of Data Acquisition and Analysis
• Improving Driver Performance
• Improving Vehicle Performance
• Improving Vehicle Health
• Questions and Answers ?
Overview of Data Acquisition and Analysis
How to Use Data Acquisition

Basic Data Analysis Steps
- What is Happening (many stop here!)
- Where is it Happening
- Why is it Happening

Data Analysis Triangle
- Driver Performance
- Vehicle Performance
- Vehicle Health

Money Channels
- Lap Times and Speed
- All Other Channels Strongly Support the Money Channels

Vehicle or Driver
- Is the Driver Reacting to the Vehicle Movement
- Or is the Driver Creating the Vehicles Movement
- Critical Component of the ‘Why is it Happening’
Why Use an Electronic Display Dash?

Replace This:

Simple, less clutter
Easy to change
Display only what you need, when you need it
Programmable lights to help you brake harder, not just when to shift

With This:
What Does the Dash Do?

Display or Convey Information – Now in Color
- Lap time, speed, temperatures, etc.
- Controls shift lights & warning lights
- Trigger audible tones directly into ear piece for brake lockup
- Rear view camera display, provides better view out the back

Alarms
- Notify driver of alarms, water hot, low oil press, etc.

Calculate Things
- Lap gain/loss (predicted lap timing), gear detection,
  fuel prediction of laps remaining, engine logs

Last but Most Important
- Logging data!

What is Data Acquisition
The act of recording information which can be measured on the race car, then analyzing to benefit the driver or car
What Kind of Sensors Exist?

Sensors measure physical things, outputting a voltage. The voltage is measured by the dash and converted to the physical measurement.

**Some other sensors:**

- **Driver Inputs:** Steering, Throttle Position, Brake Pressure
- **Ride Height:** Roll, Pitch, Tire squish
- **Yaw Rate:** Rate of turn
- **Strain Gauges:** Measure load on tire, Downforce
- **Air Pressure:** Barometric, Ram air effect of intake, etc.
- **Pitot Tube:** Air speed over car
- **Crankcase Pressure:** Tells you if your piston is cracking
- **Air/Fuel (lambda):** Rich or lean mixture
- **Tire:** Pressure & Temperatures
All current cars have a huge network of electronics on the car. And they all talk to each other on the CAN Bus.....

Even cars from 1999 had a CAN bus.... Example; a BMW E46 car provides all of these channels or sensors for free!

Wheel Speeds, Vehicle Speed, Brake Pressure, Brake Switch, ASC active + error, DSC active + error, Steering Wheel Angle, Engine RPM, Throttle Pedal, Throttle Pos, Engine Torque Actual, Engine Torque Theoretical, Air Temp/Pressure, Gear, Oil Level Low, Oil Temp, Water Temp, Gearbox Oil Temp, Fuel Used, Fuel Level, Clutch Switch, MAF error, Odometer, more!

So we can listen in and get overloaded with every kind of data for almost no extra cost!
Improving Driver Performance
G-G Diagram or Scatter Plot

Drive the Tire Grip Curve all the time!

Maximize your tires at every point around the race track by driving at the car’s maximum. Let the data tell you where to go faster... safely!
This method maintains the highest “minimum corner speed” possible through a corner. Driving the *Traction Circle* is the fastest way through this corner.

Inner Radius Speed  = 45mph  
Outer Radius Speed = 50mph  
Text Book Radius  =  60mph
Late Apex Line

When a corner precedes a long straight, it might be better to NOT drive the Traction Circle. That is no trail braking. A later apex results in a lower minimum corner speed, but allows a faster exit speed. That extra exit speed is carried down the entire length of the straight.

0.05 seconds slower in middle of corner, but 0.15 faster down straight
Net gain = 0.10 seconds
How to Compare 2 Laps

These two lap times look identical, but how would you know there’s 0.5 seconds of difference is between them!
Section Timing – Identify which laps to study

Blue = fastest section times

Eclectic is the theoretical best lap time if you add up all of the fastest sections

More Green = More Consistent

Fastest rolling lap
Video & GPS

Unbelievable study material when you combine video + data
Improving Vehicle Performance
How to Find Understeer / Oversteer

- Speed Increases
- Steering Increases meaning more Understeer
- Constant Lateral G-Force
- Throttle Lifting by Driver
We are showing rear tire temps sampled in 3 places across each tire. The Rear Left tire is not too bad while the Rear Right tire has some significant differences.
Fuel Mixture to Help Your Engine Run Better

Gasoline: Air/Fuel ratio of 14.7 = 1 Lambda

*EASY MATH, lambda of .96 is 4% leaner than lambda of .92
Improving Vehicle Health
Lap Reports

Heat soak happens when a car isn’t moving

Make sure you’re on time mode when looking at engine stuff

Quick easy way to see minimums, maximums & averages for every lap!

Export your data to easy to read Excel reports
Engine Oil Pressure Drops

We are showing:
- GPS_Speed
- Engine RPM
- Oil Pressure

The Oil Pressure is showing drops at seemingly random positions on the track.
Engine Oil Pressure Drops

We are showing:
- **Oil Pressure**
- vs **Lateral G's**
  (GPS_LatAcc)

The **Oil Pressure** is showing consistently low when (down to 25psi) when the Lateral G's are exceeding appx -1.0g (left cornering)
Battery Voltage Drops

We are showing:
- GPS_Speed
- Engine RPM
- Oil Pressure

The Oil Pressure is showing drops at seemingly random positions on the track.
Questions?

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