Smart Data – Role computers play in Technology

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Sizzle Video 2016
Introduction:

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Smart Data – Role computers play in Technology
INDYCAR RACING

- Incredibly close competition
  - Road and Street Courses, typically 18 – 21 cars within one second
  - Indianapolis – 33 cars have a four lap average within 5.4020 mph and 10 cars have a four lap average within 1.6610 mph
- Currently competition from two manufacturers in Engines and Aero kits
  - Spec chassis, gearbox and many mechanical components
- 11 teams compete in the Verizon IndyCar Series
  - 35 cars competed at Indy qualifications
  - 23-25 car field at all other events
- Upwards of 150 engineers directly involved in the running of the case cars
SMART DATA ON BOARD
Computers on an INDYCAR

- Cosworth’s Pi Systems Lightweight Logger Box - 50 Sensors, 1,000 Parameters

- McLaren Applied Technologies TAG-400i Engine Control Unit - 40 Sensors, 200 Parameters
Computers on an INDYCAR

- MEGA-Line Assisted Gearchange System - 16 Sensors, 34 Parameters

- AP Racing Fly-By-Wire Clutch Actuation System - 5 Sensors, 26 Parameters

- Computers are interconnected via multiple Controller Area Network (CAN)-based Buses
- 1200+ Parameters Logged from 100+ Sensors at 120 KB/sec
- 1-2 GB Data Per Event, Per Car
Making Data Smarter

• Sensor Calibrations, Physical Constants, Settings carried On-Board

• On-Board Math Functions

• “Real-Time” calculations provide essential performance-related values to the engineers while driver and car are still on the track
Data Distribution in INDYCAR

- Cosworth “Live-On-Air” Telemetry
  - 400+ Parameters per Car
  - 10 KB/s Live Wireless Output
- GPS Output for Race Cars and Safety Vehicles
- INDYCAR, Media get limited access to live Team Parameters
Data Analysis in INDYCAR

- Cosworth “Toolbox” Analysis Software
  - Allows Overlays of both recorded and Live On Air data
  - Can link to Excel, MATLAB, and Simulink for powerful, automated analysis
Data Analysis in INDYCAR

- Rapid visualization and quantified analysis beyond the time domain
Performance-Based “Smart” Data in INDYCAR

- High importance of harmony between hardware and software

- Front-heavy engineering workload provides teams rapid information when time is at its most scarce

- Ability to focus on specific performance parameters is widely scalable according to the modifications that can be made to the car during the Event.
SAFETY
Safety

• No1 priority for INDYCAR. Safety is an evolutionary process and we continue to learn and improve.

• INDYCAR has dedicated resources for safety
  • On board impact recorders (much like an aircraft black box)
  • Driver ear accelerometers
  • Safer barrier development (track based safety)
  • Chassis impact sled testing
    • Seat and head surround development
    • Multiple drivers walk away from 65-70g hits
  • Steering rack sled testing for wrist and hand injuries
  • Safety vehicles equipped with on board cameras and tablets
Newgarden video clip
Safety – Impact recorder

- Doubled logging memory to 4mB from ADR 2
- (41) External signal inputs (31 more than ADR 2)
- (33) General purpose analog
- (5) General purpose timer
- (2) Variable reluctance
- (1) Beacon

General Product Description:

- **Senses and records key vehicle parameters at 1,000 samples per second prior to, during, and after a triggering event**
- Can log parameters from the vehicle’s serial data link via CAN or RS 232
  - X-Axis acceleration
  - Y-Axis acceleration
  - Z-Axis acceleration
  - yaw rate
  - earplug accelerometers
  - seat belt load cells
  - real-time clock
- Stores parameter data in memory to be retrieved later via a high speed data link to a personal computer

- Microprocessor: 32 bit, 25 MHz
- Program memory 512kB Flash EPROM
- Logging memory: 4mB
- 4 serial data links:
  - RS 232, 9600 baud
  - RS 232, 115 kbaud
  - RS 422, 921 kbaud
  - CAN, 1 Mbit

- **Internal sensor set:**
  - (3) +/- 250 g accelerometers
- High g accelerometer resolution: 0.61g (10 bit)
Safety – Ear Accelerometers

Each Ear Contains 1 Speaker and One 3 Axis Accelerometer package

Custom Left and Right Ear Moulds

Ear sensors are recorded at 1000Hz

Data Connector

Audio Connector
### Safety – Data outputs

#### Car

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**Comments**
Safety – Sled testing with THOR - FT

Test Device for Human Occupant Restraint – Frontal Technology

- Approximately 120 Channels
- On Board Data Acquisition (no cables)
Timing & Scoring

- Dedicated group within INDYCAR

- Two-Way Transponder
  - Connection to car’s CAN bus
  - Powered by DC from Car
  - Battery backup on board
  - Precision of 1/10,000 seconds
Timing & Scoring - Data

Information collected

- Results (Start/Finish)
- Passings (Crossings)
- Flag Times
- Section Times

Information distributed

- INDYCAR Race Control
- Teams / manufacturers
- TV broadcast partners
- Technical partners such as Verizon for inclusion in the Verizon App
- PDF timing reports and archive
- Black flag messaging directly to the cars
Timing & Scoring – track infrastructure
**SMART DATA**

- Smart data is not important – it is **VITAL** to INDYCAR.

INDYCAR runs on it – none of it would be possible without the computers we have today.

- TV broadcast
- At track TV feed
- Timing and scoring pylons
- Smart phone and tablet apps
- LED car position display system on the cars