VeD Village Hall
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Monday 26th July (afternoon)

Agenda
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1300hrs to 1630hrs (210mins)

Paul Chappell
Technical Specialist – Steering and Handling Analysis
• What is a Simulator?
• JLRs Driving Simulator
• Vehicle Models
• Subjective tuning of the vehicle model
• Improving driver cues (motion and others)
• Development of the driving experience with simple tricks
• Future Potential Development Activities
**Oxford Dictionary Definition:**

“a machine designed to provide a realistic imitation of the controls and operation of a vehicle, aircraft, or other complex system, used for training and research purposes”

Implicit function is the need to provide sufficient sensory feedback to allow the driver to control the vehicle.

**Sensory feedback categories:**

- Visual (synchronised to simulated motion)
- Vestibular (simulator motion)
- Somatosensory (force feedback to steering wheel or pedals)
- Auditory (road, wind, & powertrain sounds)
Collaborative effort between Cruden / IPG / NoViSim

Cruden:
- Simulator Hardware
- 2 Phase Deployment
- Integration of JLR specific elements
  - Seat
  - Wheel
  - Pedals
- Rendering Software (Racer Pro)
- Software Integration Platform: ePhyse

IPG
- Carmaker Office Pro
- Custom Simulink blocks for external road interface

NoViSim
- SimSound software
### Data Communication

1. Steering Angle / Torque
2. Pedals / Gear Shift
3. Audio (NoViSim)
4. Visualisation (Racer)
5. Platform Motion (IPG / Cruden)
6. Telemetry & Operator
IPG Carmaker Pro 3.5.4

- Engine & Powertrain
  - Non-suspended engine currently
  - Internal engine model and JLR
- Suspension System
  - Standard Carmaker
  - JLR generated SKC
- Steering System
  - Pfeffer plus JLR customisation
- Tyres
  - MF5.2 & TNO 6.1
- Brakes
  - Standard Carmaker
IPG Supported Tyre Models

IPG RealTime Tire
• Not evaluated as yet

Magic Formula Models
(Preferred for commonality with other JLR toolsets)
• Type : MF5.2 & 6.1
• Data Sources : Calspan & TNO

Michelin TameTire
• Not evaluated as yet
• Promising feature content, especially for SCS
Implemented
Simple ABS (IPG demo model)
Continuously Variable Damping (CVD)
Electronically Actuated Differentials (EDIFF)
Active Roll Control (ARC)
Electronic Power Assistance Systems (EPAS)

Available but not yet implemented
Bosch Electronic Stability Program (ESP)
Continental Teves Electronic Stability Control (ESC)
Air Suspension
Only 4 months development so far!

Steering Model
Effort levels
• Sensor calibration, wheel diameter, wheel mass / mass offset, boost curves, pump flow on test…..
Pfeffer model complex, but requires careful parameter choice
  E.g. Friction, damping, stiffness etc.

Tyres
• Correction for differences between FlatTrac grit paper and Tarmac
• Low vs. High angle slip data

Controls
• Pedal Feel
• Pedal sensitivity
Driver Cues: Motion

We’re using a ‘Stewart Platform’ to provide the vestibular motion-cues to the driver.

Bad News first: however good we make these, they’ll never be able to replicate the real vehicle’s displacements, velocities, and accelerations, however….

They can provide useful information.

We can use quirks of perception to fool the driver.

For example, by making the driver perceive a steady-state acceleration, we can add a roll or pitch angle to the platform.
With a limited envelope of motion we cannot provide limitless cues. E.g. Large bump in a bend.

We need to prioritise cues depending on the manoeuvre:

**Steering**
- Prioritise initial response related cues

**Handling**
- Prioritise stability related cues

**Ride**
- Prioritise vertical and roll motions
Great benefits of higher fidelity audio

NoViSim allows us to place sound sources in their correct position
Markedly increases sense of immersion
Should allow assessor to determine origin of noise, e.g. tyre squeal

Less obvious benefits
Synthesised from real test data (road noise includes stone flicks)
Engine note allows driver to pre-empt vehicle response
Room Environment

Wall Colour
- Sides and back in white
- Front wall and sides within peripheral view in black

Diming the Lights

Simulator Environment

Carpet under heel
Road roughness inclusion
Future Potential Development Activities

Further Controllers

ESP / ESC

More extensive plug-in models
Engine
Driveline
Questions