MagneRide Performance and Challenges

Vehicle Dynamics Expo 2008

06 May 2008
Delphi MagneRide System

MagneRide Advantages
- Wide range between minimum and maximum forces
- High authority at low piston velocities
- Fast and linear response to control input
- No moving parts

Body Control
- Reduces body motions
- Improves impact isolation
- Improves ride quality and comfort

Stability and Handling Control
- Improves vehicle stability, steering response, and directional control
- Controls transient pitch/roll motions
- Improves handling

Wheel Control
- Reduces wheel shake/resonance during and after impacts
- Reduces tire normal load variation and improves road holding
- Improves feeling of safety

Adaptive Controls
- Driver Mode switch
- Load compensation
- Vehicle speed dependence
- Special events management
- Provide vehicle refinement

Delphi is a leader in Controlled Damping Systems Technology
MagneRide Piston
Principle of Operation

Magnetic Field

High Pressure

Low Pressure

MR FLUID

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Vehicle Performance
Vehicle test and configuration

- **Vehicle:**
  - Type: Large European Luxury Car
  - Mass: **2100 kg** (distribution of 57% / 43%)
  - Tyres: Bridgestone 255/45 ZR 18

- **Semi-active suspension systems compared:**
  - Reference car : Production Semi-Active Suspension with levelling (Ref)
  - Delphi car : MagneRide system with levelling (MR)

  => **Suspension modes** : Two, Soft and Hard for each vehicle

- **Vehicle Handling Tests:**
  - VDA ISO 7401
  - Acceleration to 90km/
on referenced bumpy road
  - Sweep ISO7401
    - Freq: 0. to 2.5 Hz
  - Step steer ISO 7401
    - 80kph, 135°, >500°/s
The global handling is improved on the MagneRide car

- **VDA**
  - Vehicle is more agile thanks to the better turn-in and stability
  - The trajectory is shorter

- **Step steer at 80km/h, 135°**
Vehicle Performance
Transient cornering

MagneRide improves Turn-in and Stability

**Time analysis**
- Increased initial lateral acceleration by 5%
- Improved Turn-in with no stability degradation

**Frequency analysis**
- Reduced dynamic roll and roll rate
- Improved dynamic body control
- Better stability and safety feeling

- Improved vehicle response
Vehicle Performance
Grip

MagneRide improves wheel control; reduces normal force variation and wheel lift-off

- Acceleration on bumpy road

- Tire grip is improved with less variation
- Better repeatability
- Improved power hop and vibration

![Graph showing time to reach 100 kph and normal force variation over impact]
Ride & Comfort Objective Evaluation

- **Primary ride adjustability**
  - 0-3Hz frequency band body control and vehicle dynamics

- **Secondary ride optimization**
  - Shake (3-8Hz)
  - Unsprung mass (8-40Hz)
  - Impact harshness (20-70Hz)
  - Structurally transmissible road noise (50-250Hz)

- **Wheel input**
  - Strong vertical road input, body control: 75km/h
  - Moderate wheel inputs: 25km/h
Primary ride
Body control – 75 km/h

- Sport mode
- Comfort mode

Body Accel Spectrum

Body Jerk Spectrum

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Primary ride
Normal force variation

- Sport mode  - Comfort mode

Damper Tube Accel Spectrum - 25 km/h

Damper Tube Accel Spectrum - 75 km/h
Secondary ride
Comfort criteria with stronger road input (75km/h)

**Shake (RMS 3-6Hz)**
- Strong vertical road input, body control: 75km/h

**Un-sprung mass resonance (RMS 8-40Hz)**
- Strong vertical road input, body control: 75km/h

**Impact harshness (RMS 20-70Hz)**
- Strong vertical road input, body control: 75km/h

**Structural transmission of road noise (RMS 50-250Hz)**
- Strong vertical road input, body control: 75km/h
Secondary ride
Comfort criteria with moderate road input (25km/h)
Discussion