MagneRide Performance and Challenges

Vehicle Dynamics Expo 2008

06 May 2008

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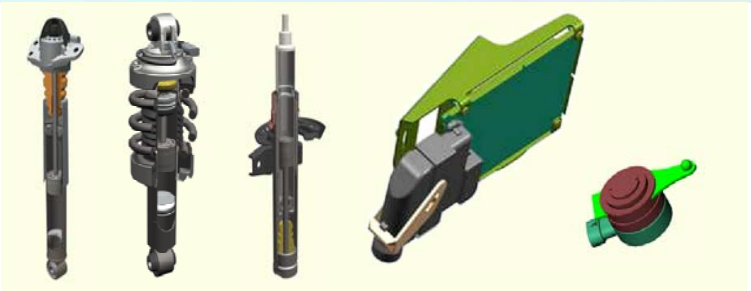
Delphi MagneRide System

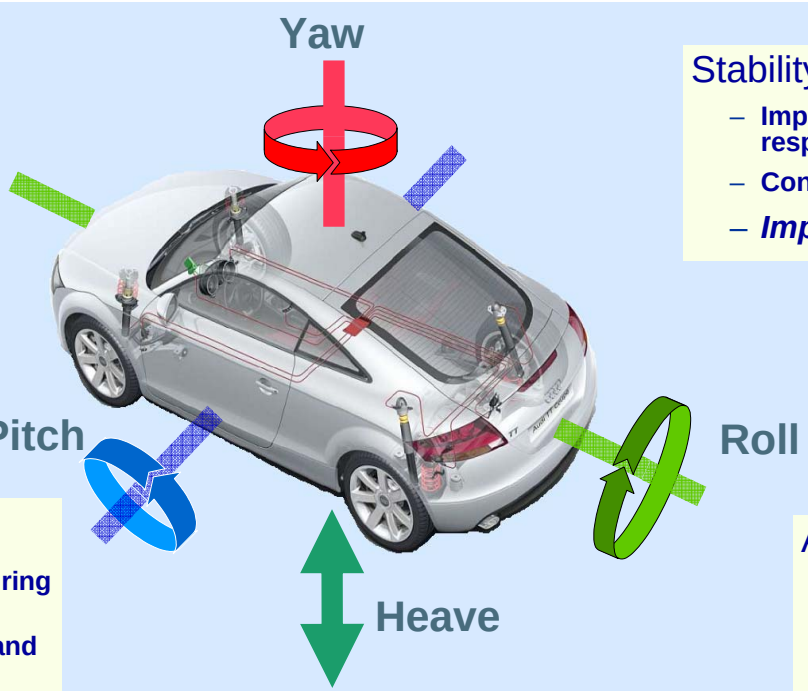
MagneRide Advantages

- **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

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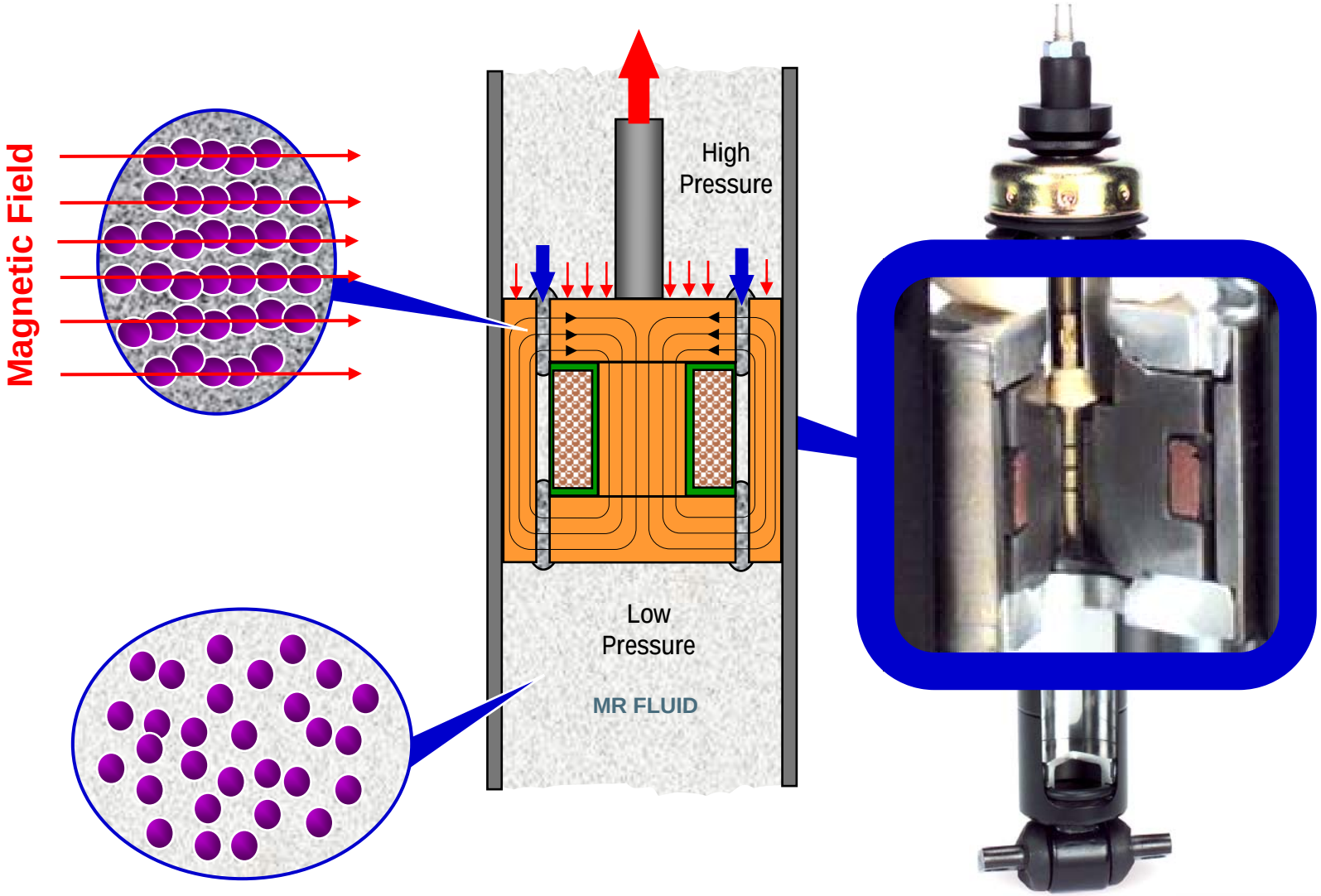
MagneRide Piston

Principle of Operation



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Vehicle Performance
Vehicle test and configuration

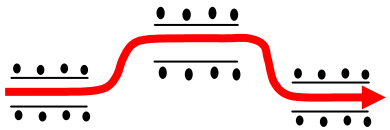
- **Vehicle:**
  - Type: Large European Luxury Car
  - Mass: **2100 kg** (distribution of 57% / 43%)
  - Tyres: Bridgestone 255/45 ZR 18

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

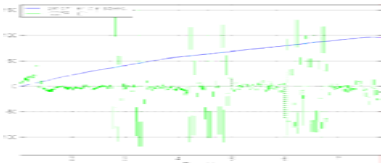
  => **Suspension modes** : Two, Soft and Hard for each vehicle

- **Vehicle Handling Tests:**

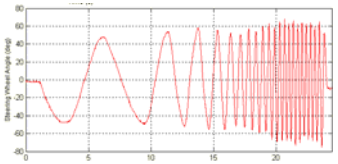
VDA ISO 7401



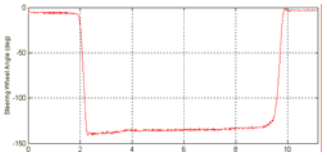
Acceleration to 90km/
on referenced bumpy road



Sweep ISO7401
Freq: 0. to 2.5 Hz



Step steer ISO 7401
80kph, 135°, >500°/s



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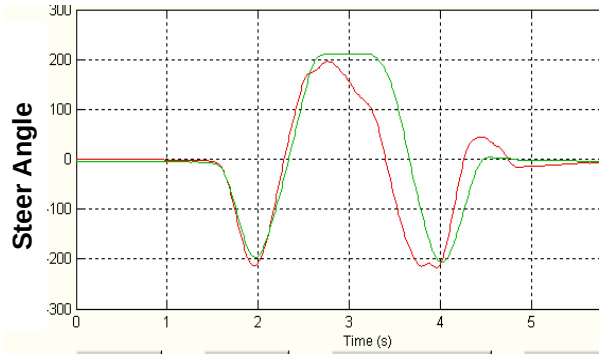
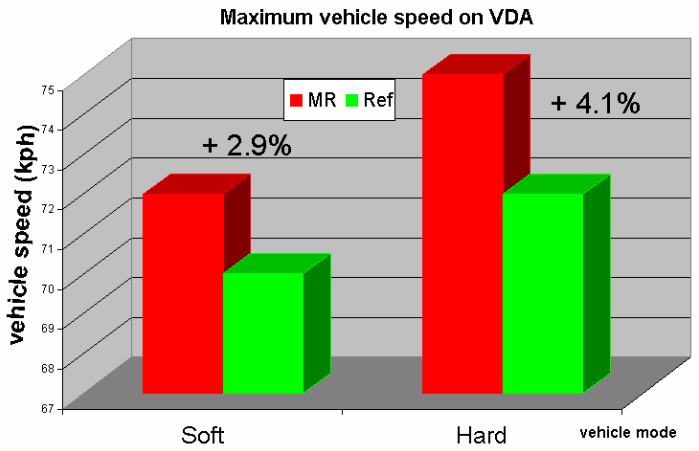
Vehicle Performance
Handling

The global handling is improved on the MagneRide car

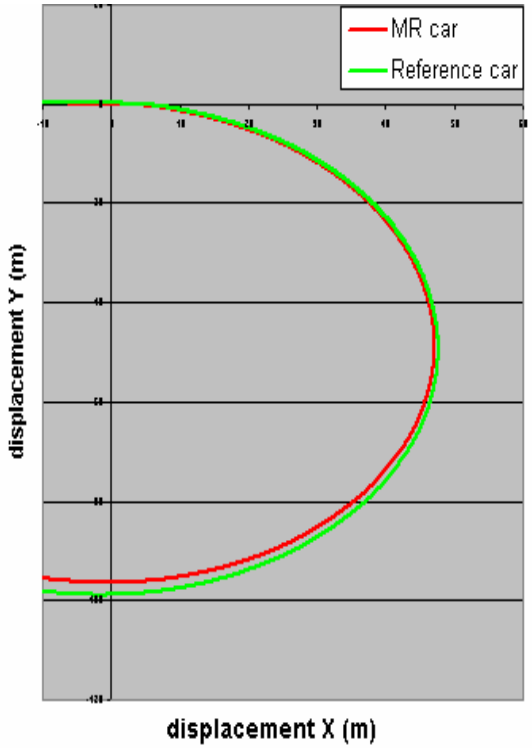
- **VDA**





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

- **Step steer at 80km/h, 135°**



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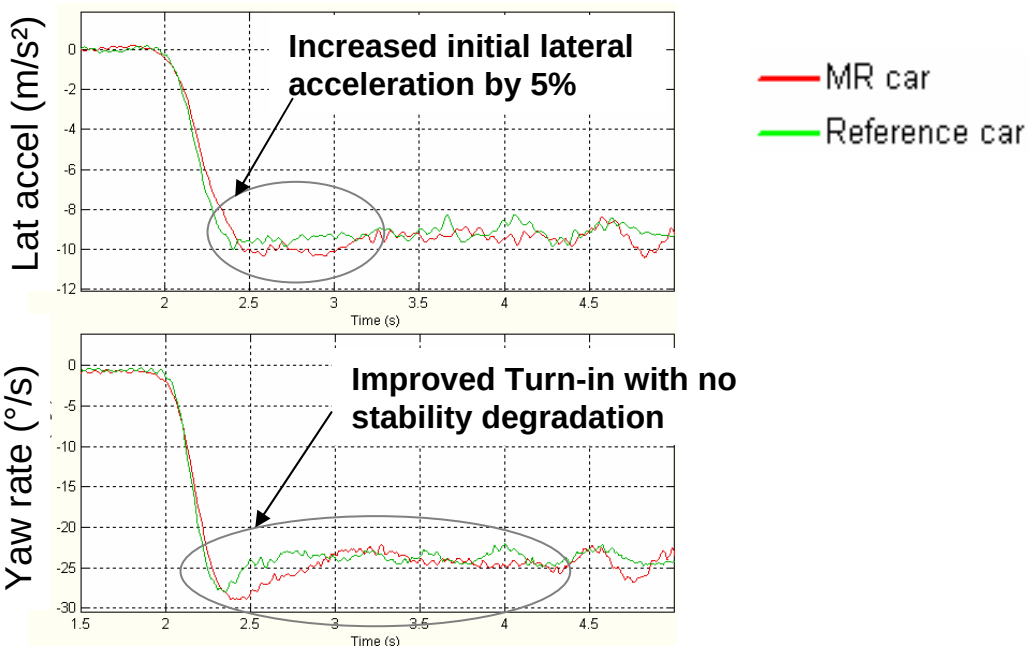
Vehicle Performance
Transient cornering

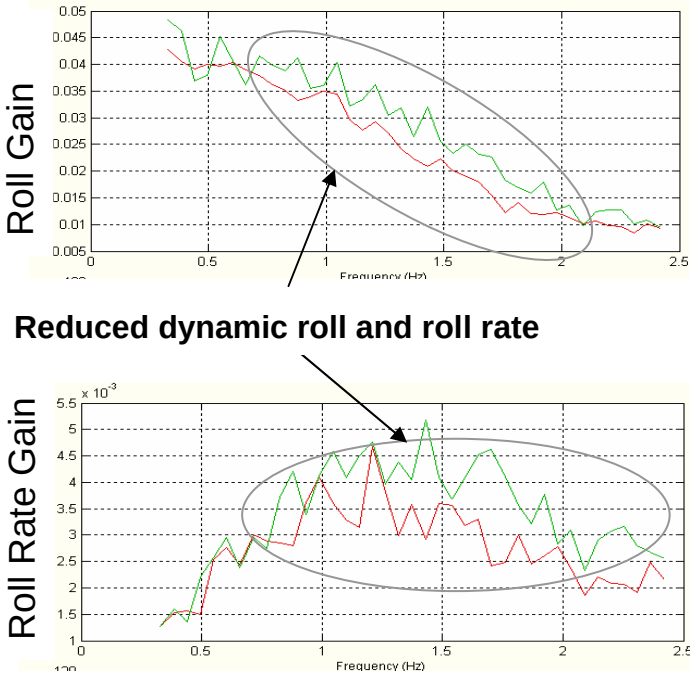
MagneRide improves Turn-in and Stability

Time analysis



- **Improved vehicle response**

Frequency analysis



- **Improved dynamic body control**
- **Better stability and safety feeling**

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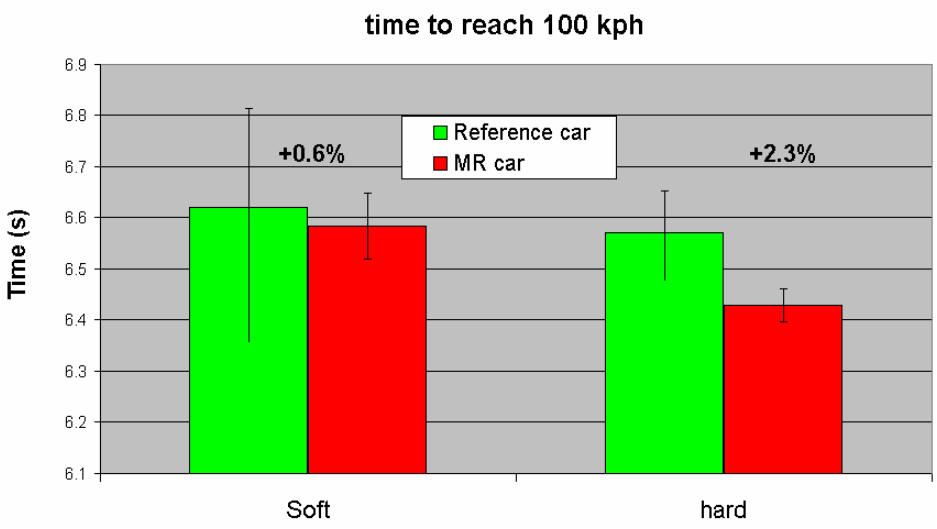
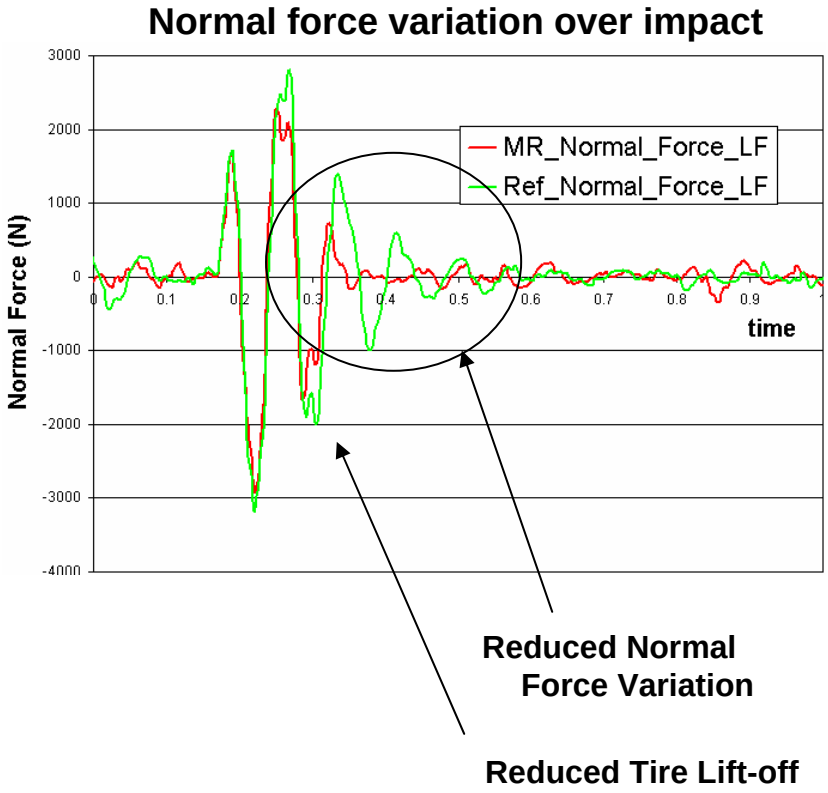
Vehicle Performance
Grip

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**

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Ride & Comfort Objective Evaluation

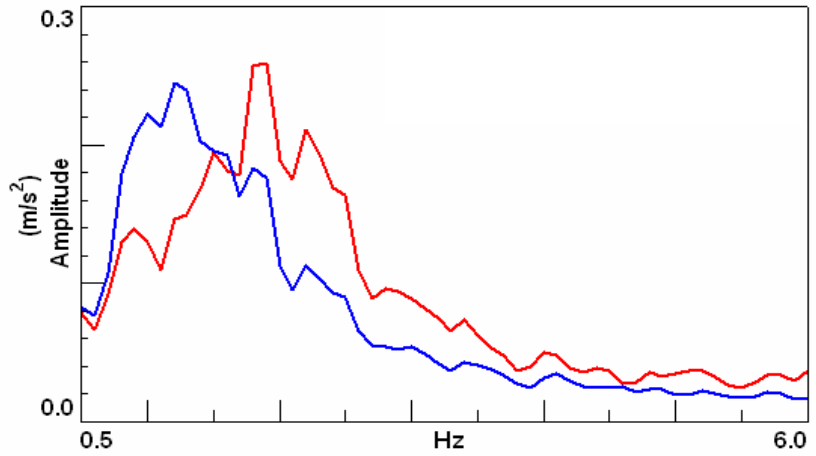
- **Primary ride adjustability**
  - 0-3Hz frequency band body control and vehicle dynamics
- **Secondary ride optimization**
  - Shake (3-8Hz)
  - Unsprung mass (8-40Hz)
  - Impact harshness (20-70Hz)
  - structurally transmissible road noise (50-250Hz)
- **Wheel input**
  - Strong vertical road input, body control: 75km/h
  - Moderate wheel inputs: 25km/h

Primary ride

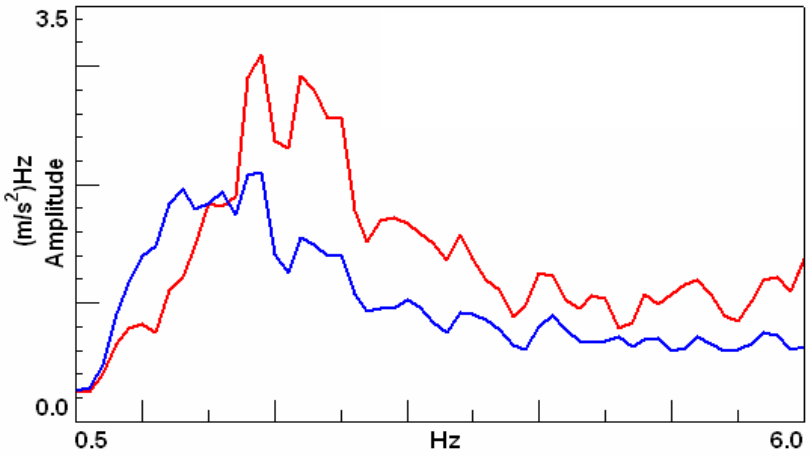
Body control – 75 km/h

- Sport mode - Comfort mode

Body Accel Spectrum

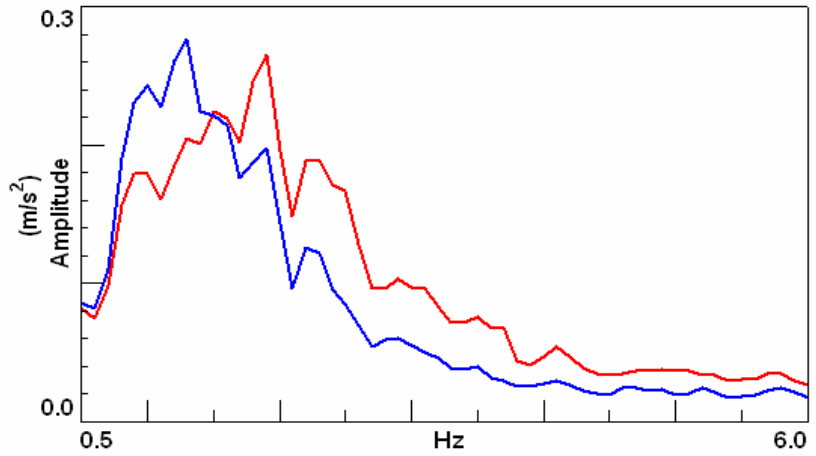


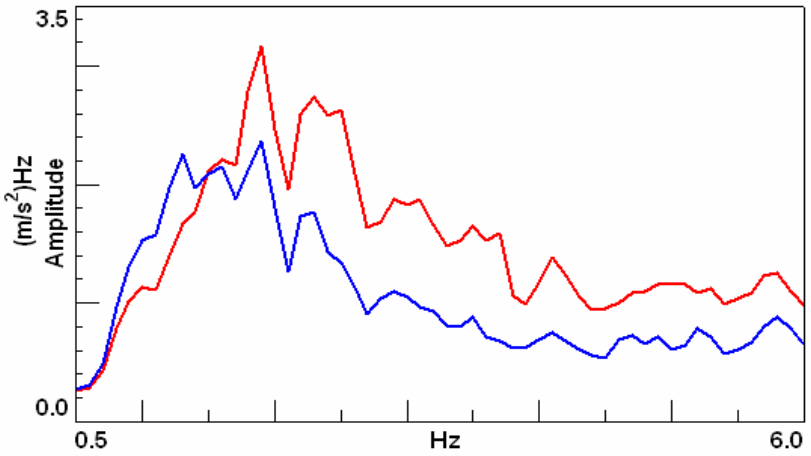
Body Jerk Spectrum



MR

Ref semi-active system





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Primary ride
Normal force variation

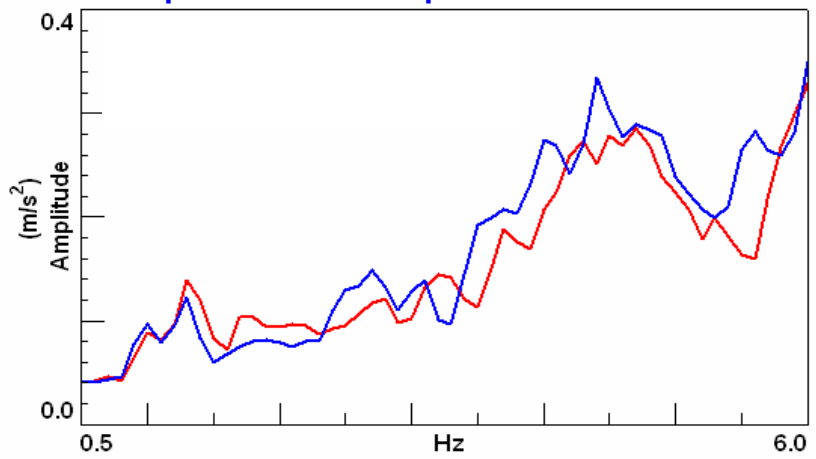
- Sport mode - Comfort mode

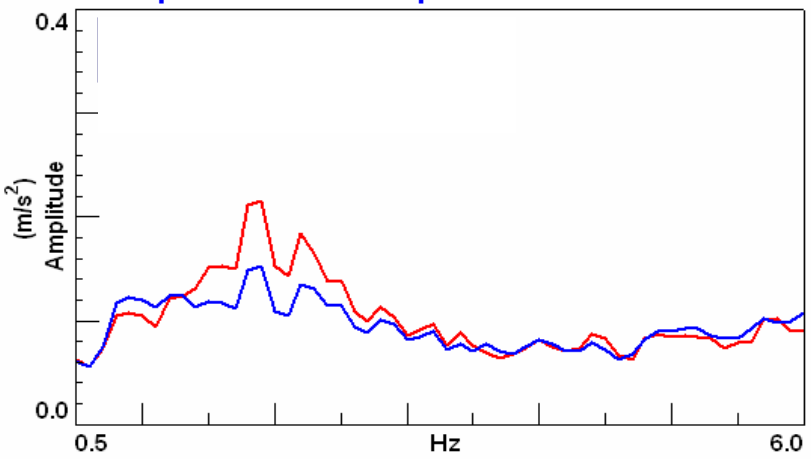
Damper Tube Accel Spectrum - 25 km/h

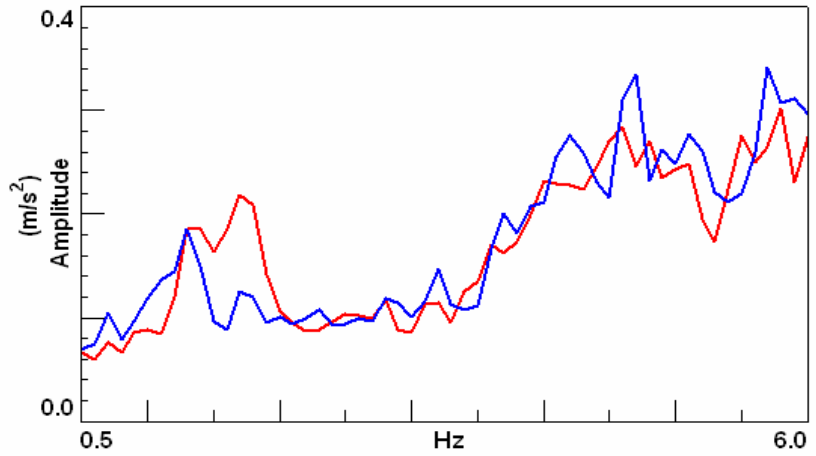
Damper Tube Accel Spectrum - 75 km/h

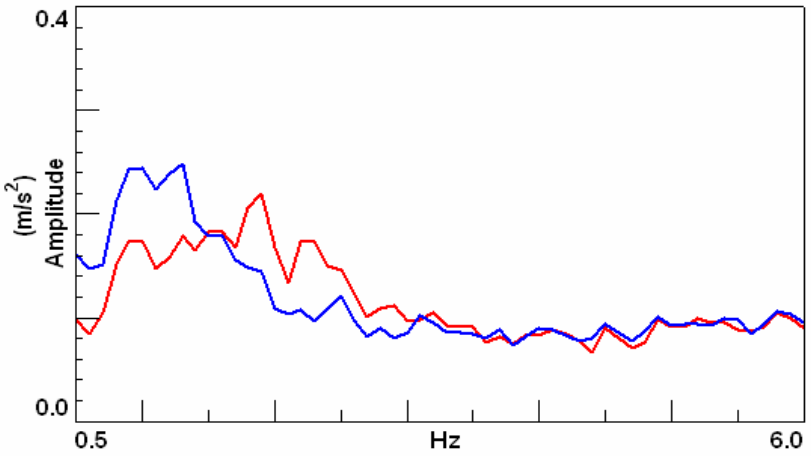
MR

Ref semi-active system









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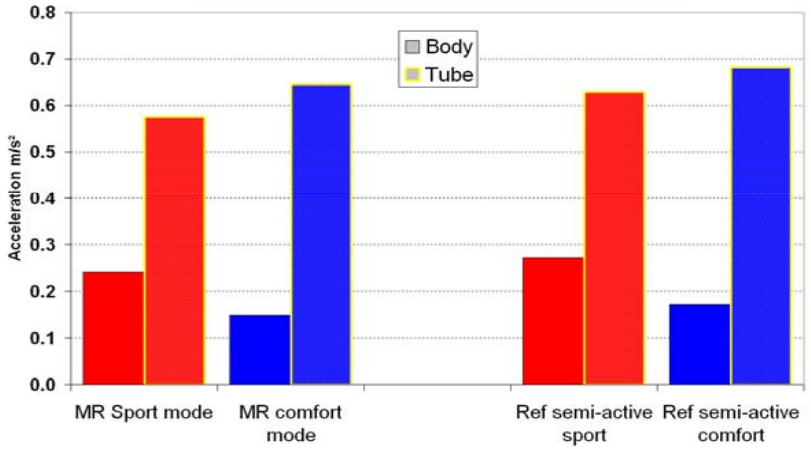
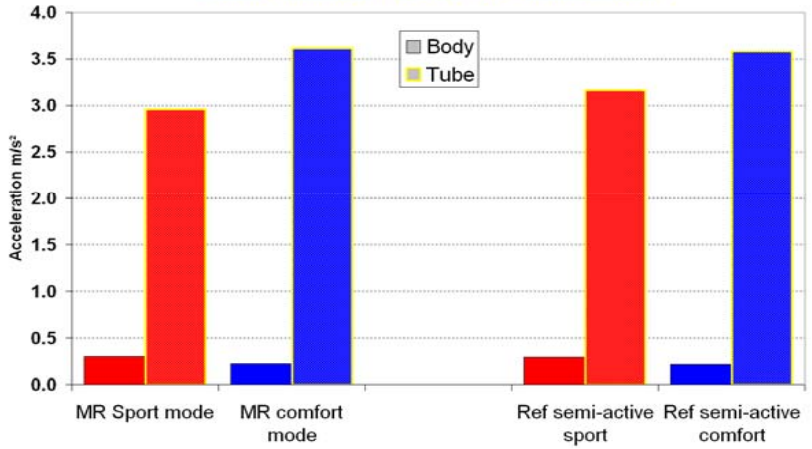
Secondary ride

Comfort criteria with stronger road input (75km/h)

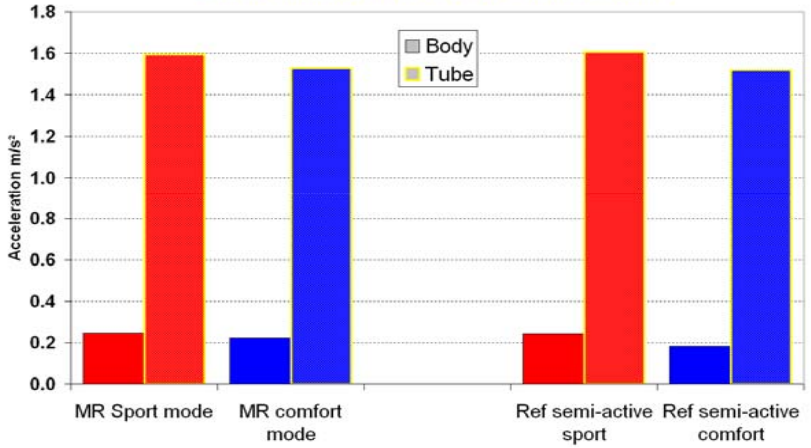
Shake (RMS 3-8Hz)
Strong vertical road input, body control: 75km/h



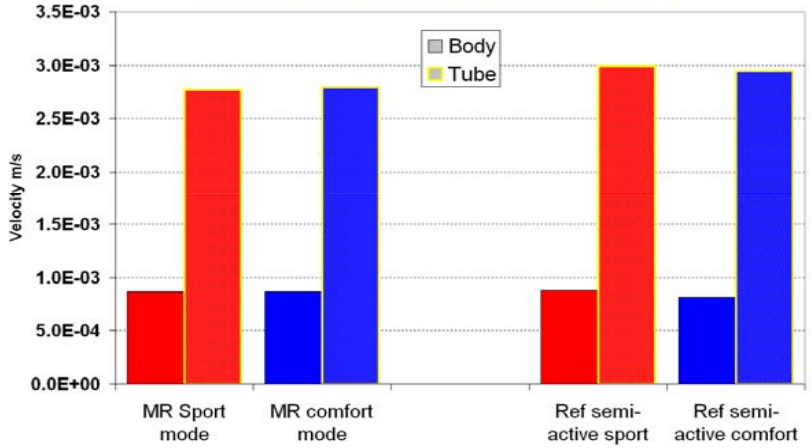
Un-sprung mass resonance (RMS 8-40Hz)
Strong vertical road input, body control: 75km/h



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



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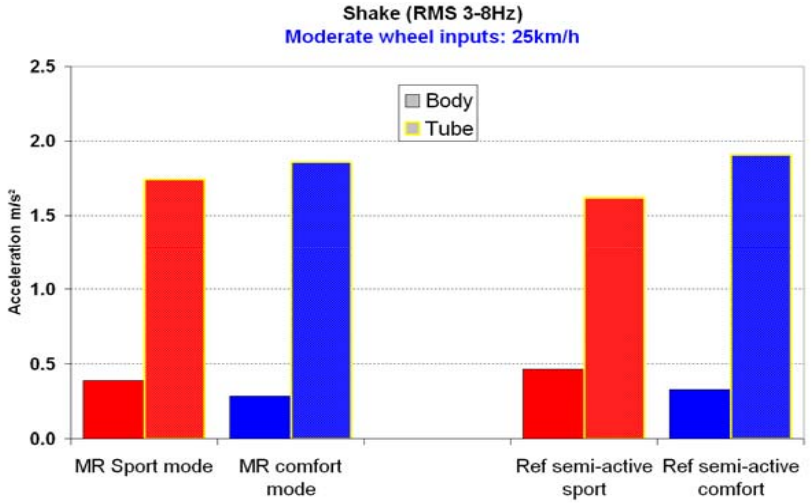
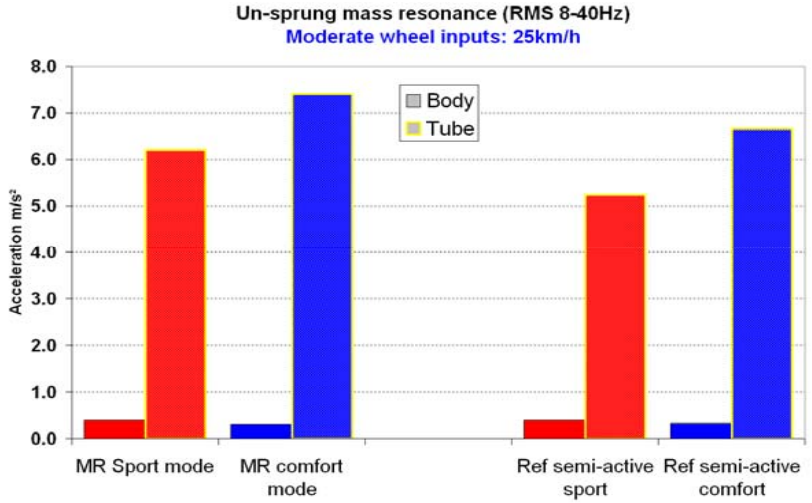
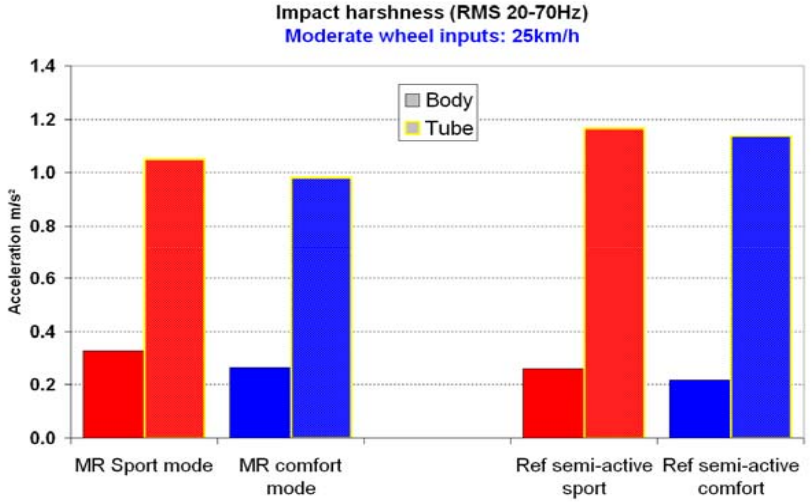
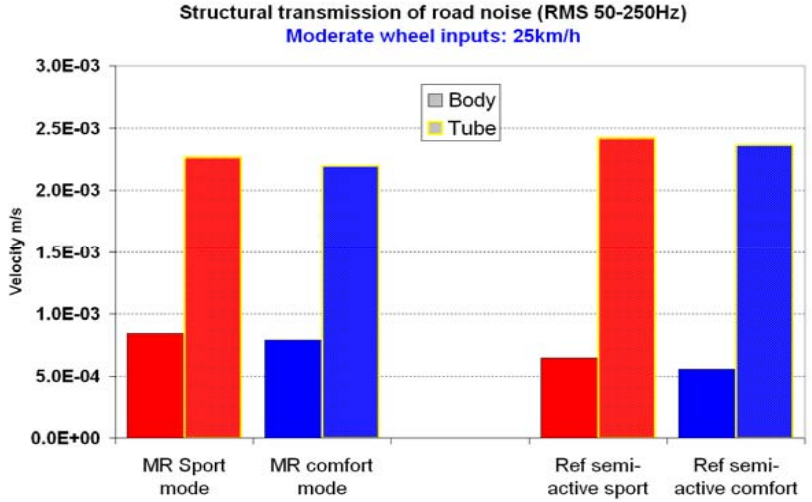
Secondary ride

Comfort criteria with moderate road input (25km/h)









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Discussion