



# Multimatic



## Advancing Holistic Virtual Vehicle Development Capabilities with the Hyperdock

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Kielan Doo, Vehicle Dynamics Engineer  
John Burford, Simulations Engineer

# Multimatic – The Company



Multimatic delivers manufactured products and engineering services to the global automotive industry... at any volume level.

Low Volume Production

High Volume Production

Suspension Products



Structural Products



Mechanism Products


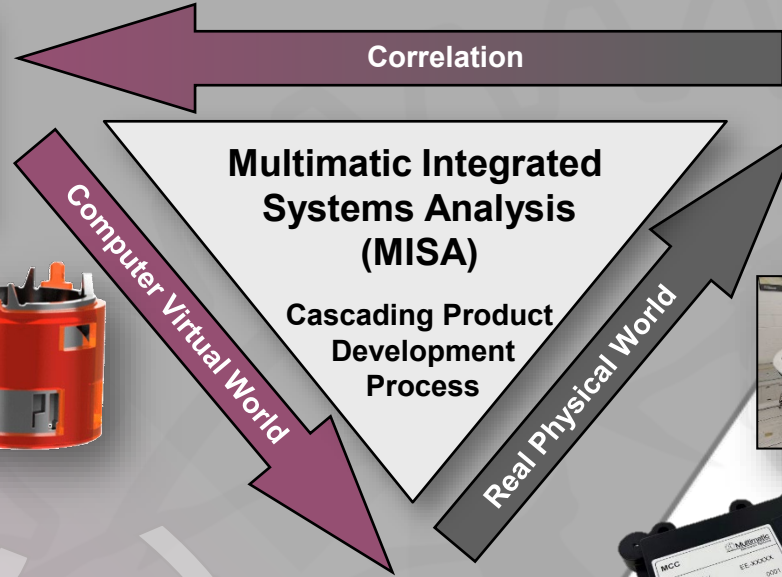


# Integrated Development

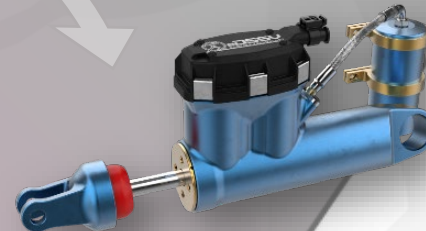
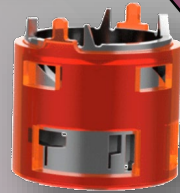
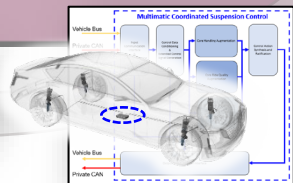
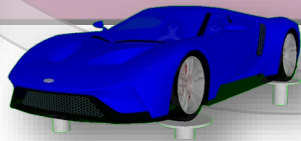
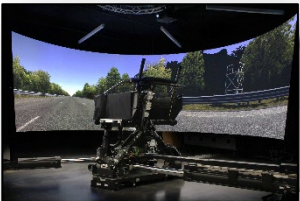
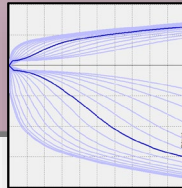
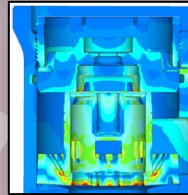
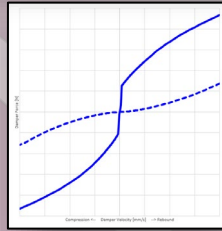
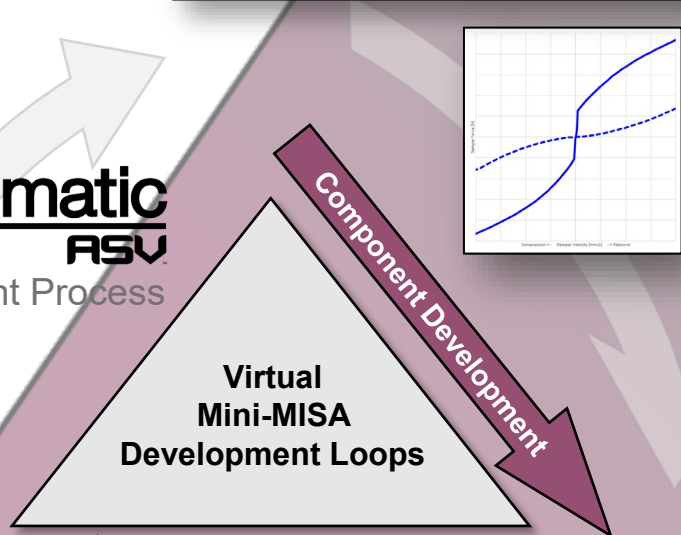


The Multimatic Integrated Systems Analysis (MISA) process is employed to turn Art to Part by cascading vehicle objectives to high-value component technologies.

**Design Brief**  
 Simultaneously maximize ride comfort, handling response, and limit handling performance of a super sports car.

Virtual Development Process



# Case Study – Mustang GTD



High performance front engine, rear wheel drive supercar

Multiple suspension modes enabled by the Multimatic Adaptive Spool Valve (ASV) and Dual Height-Rate (DHR) suspension systems

- *Normal Mode*
- *Sport Mode*
- *Drag Mode*
- *Two Track Modes*

**How does the DiM250 with the Hyperdock enable mode wise ride assessment and development?**

**How does the addition of NVH content impact vehicle perception in limit handling?**





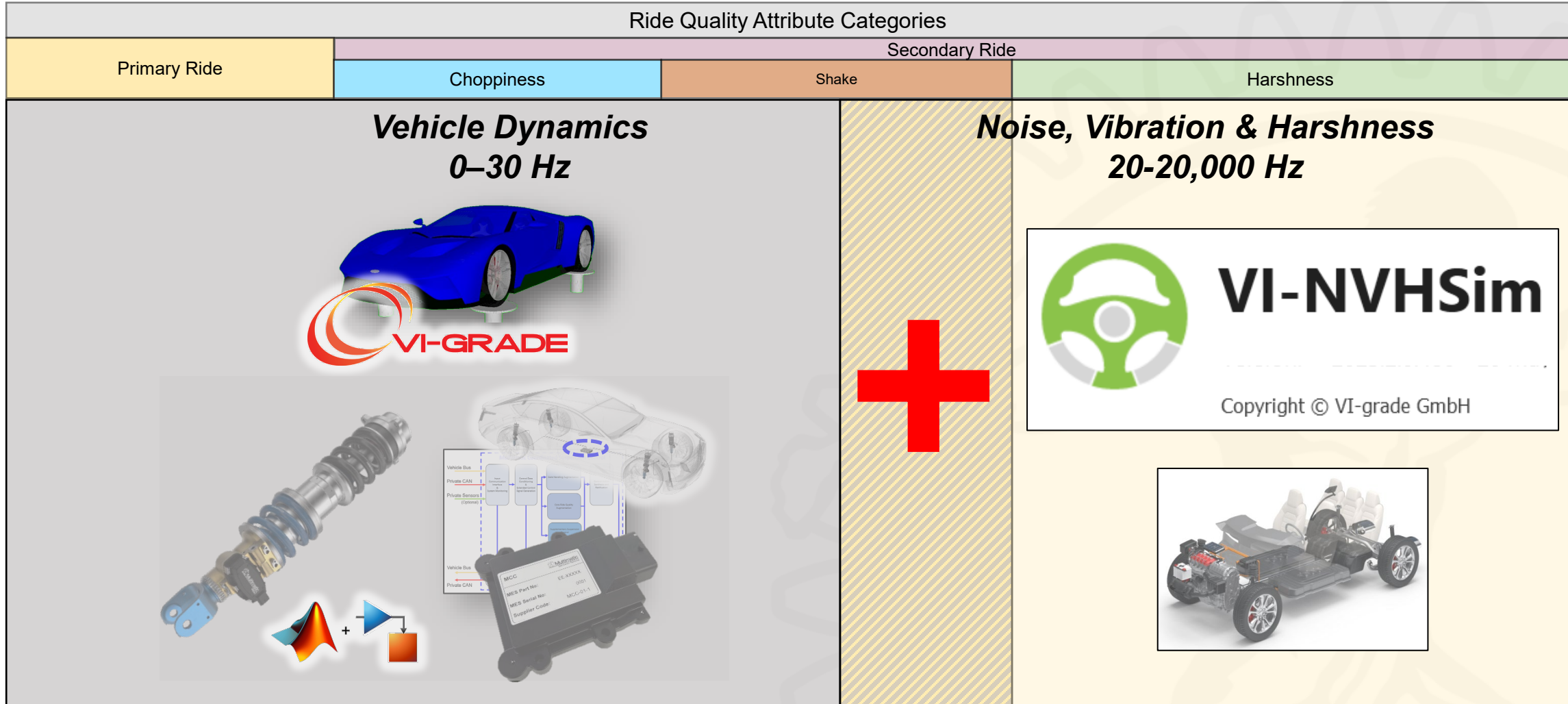
# The Hyperdock

The Hyperdock provides a lightweight, high stiffness cockpit with dedicated touchpoint shakers for simulation of high-frequency vehicle response.

- *Much lower cockpit inertia and much greater stiffness improves motion transmissibility with the hexapod.*
- *Absence of unwanted and erroneous structural modes within the cockpit.*
- *Shakers at three major touchpoints:*
  - *Seat X / Y / Z 20-200 Hz*
  - *Steering Wheel Y / Z 20-200 Hz*
  - *Heel Plate Y / Z 20-200 Hz*



# The Modelling Approach

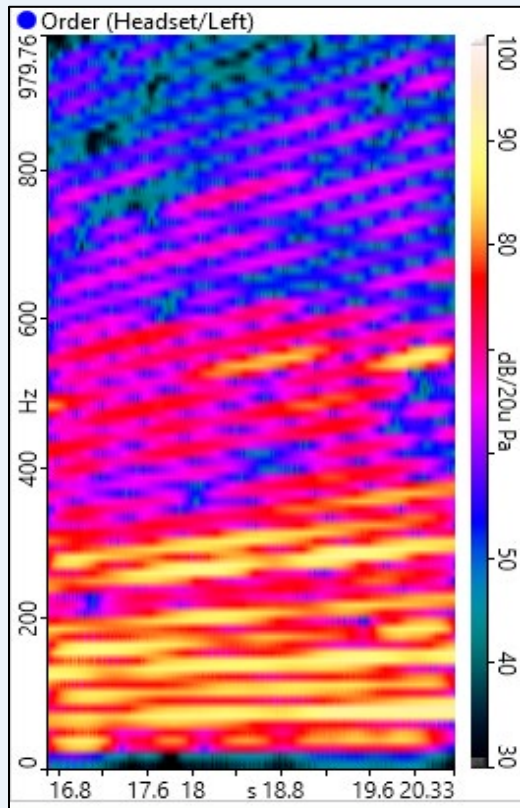


# NVH Modelling

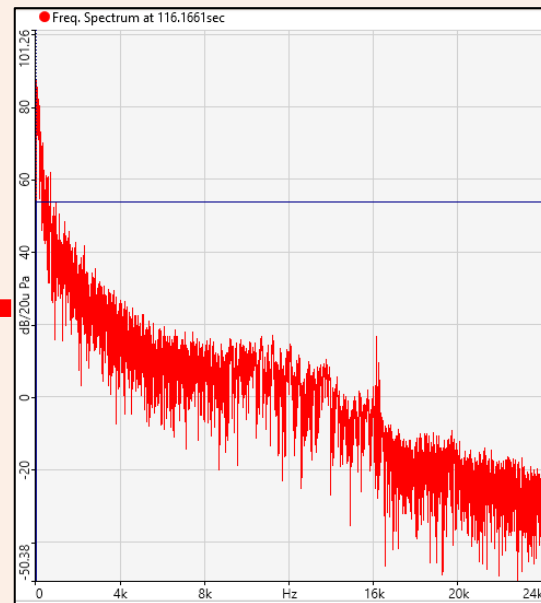


## Noise, Vibration & Harshness 20-20,000 Hz

Powertrain Noise + Vibration  
Constructed With Order-based  
Sound Objects

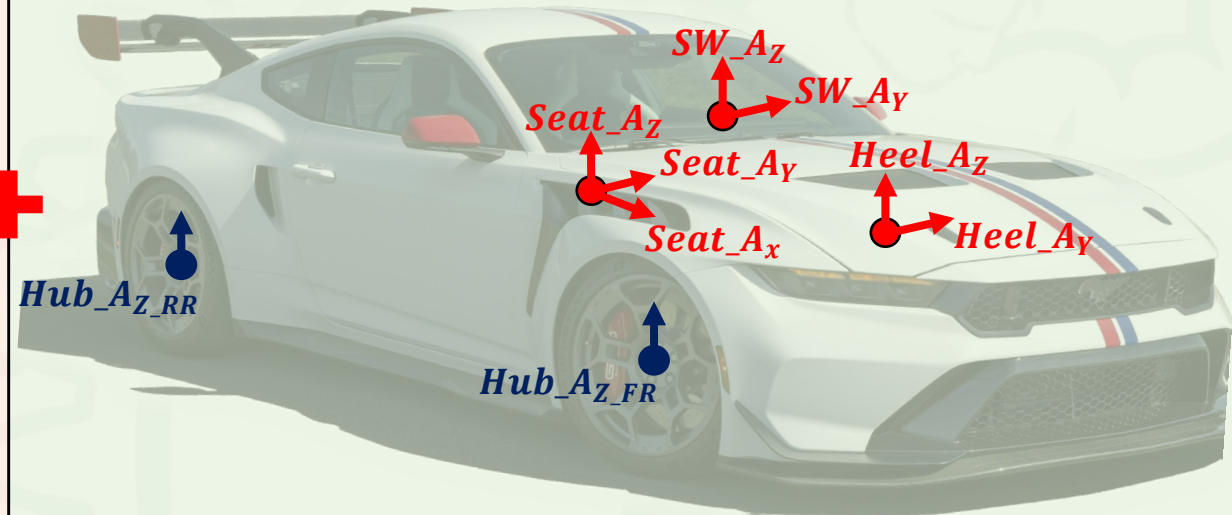


Road and Wind Noise +  
Vibration Constructed with  
Array-based Sound Objects



Touch Point Vibration Response To Road Inputs Constructed  
with T-Matrices

- *Hub Accel Z to Touch Point Accel X/Y/Z*



# Objective Model Correlation



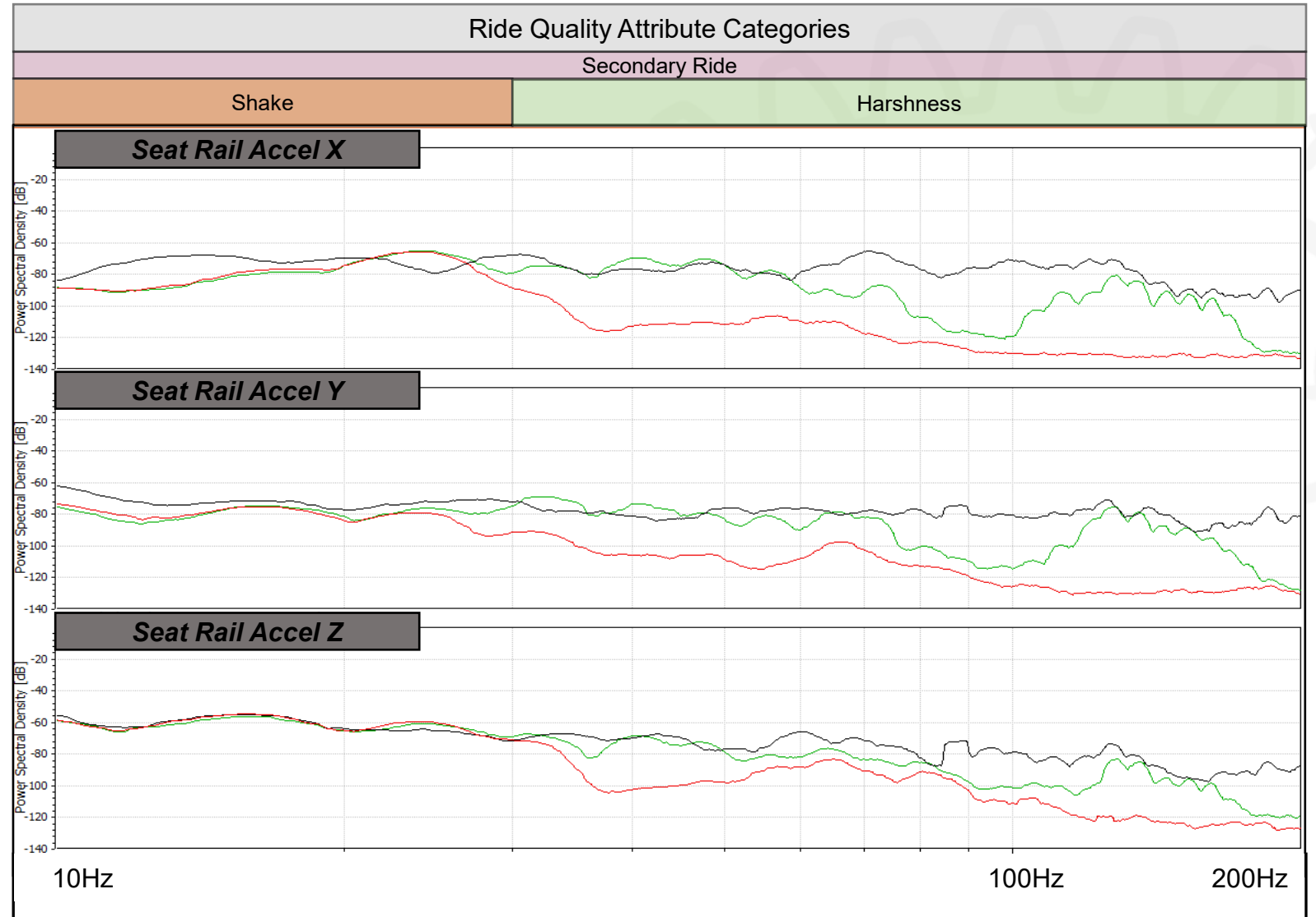
## Road Test Data

### DiM Cockpit Data

- Platform only, shakers off

### DiM Cockpit Data

- Platform and Shakers



# Objective Model Correlation



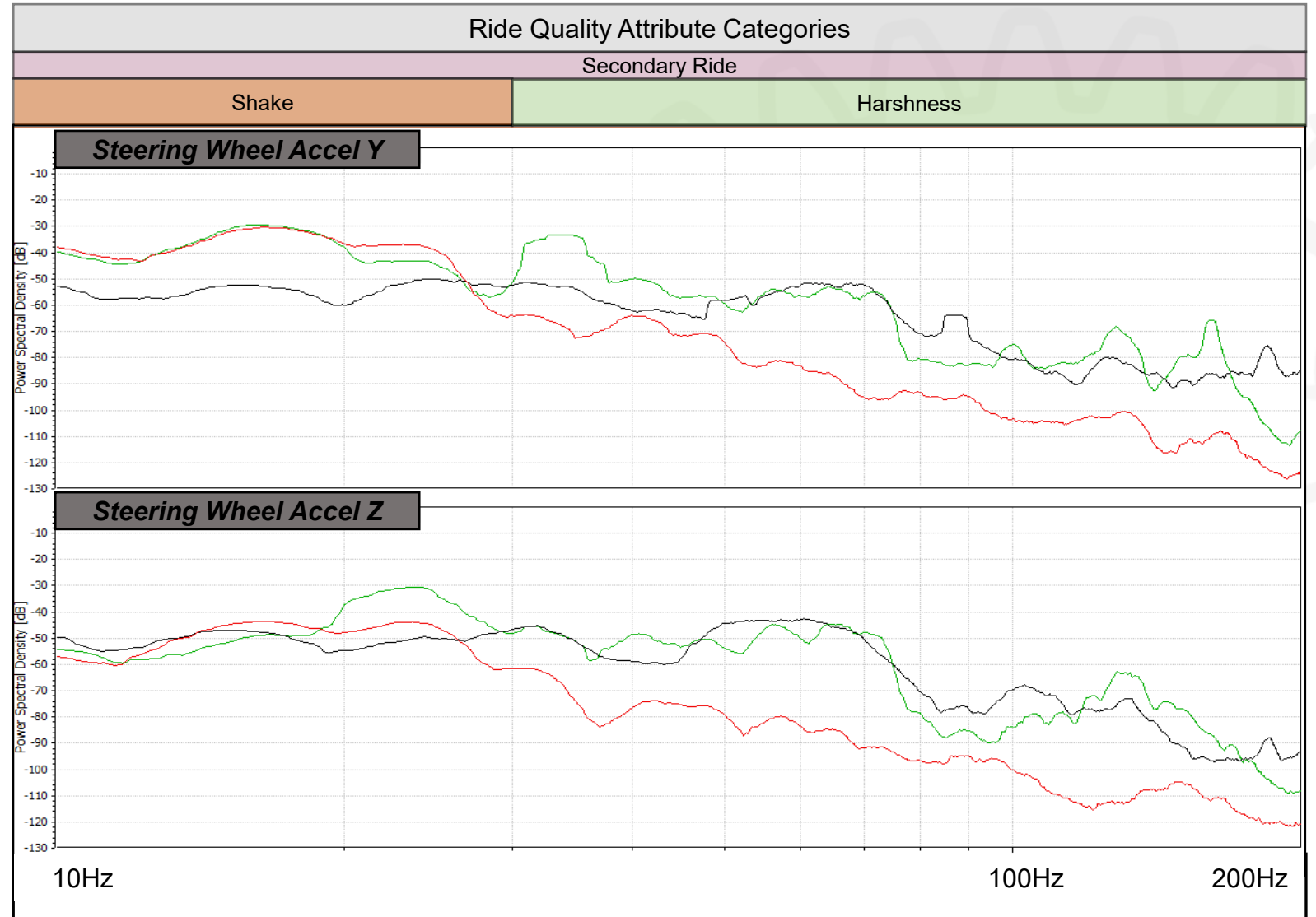
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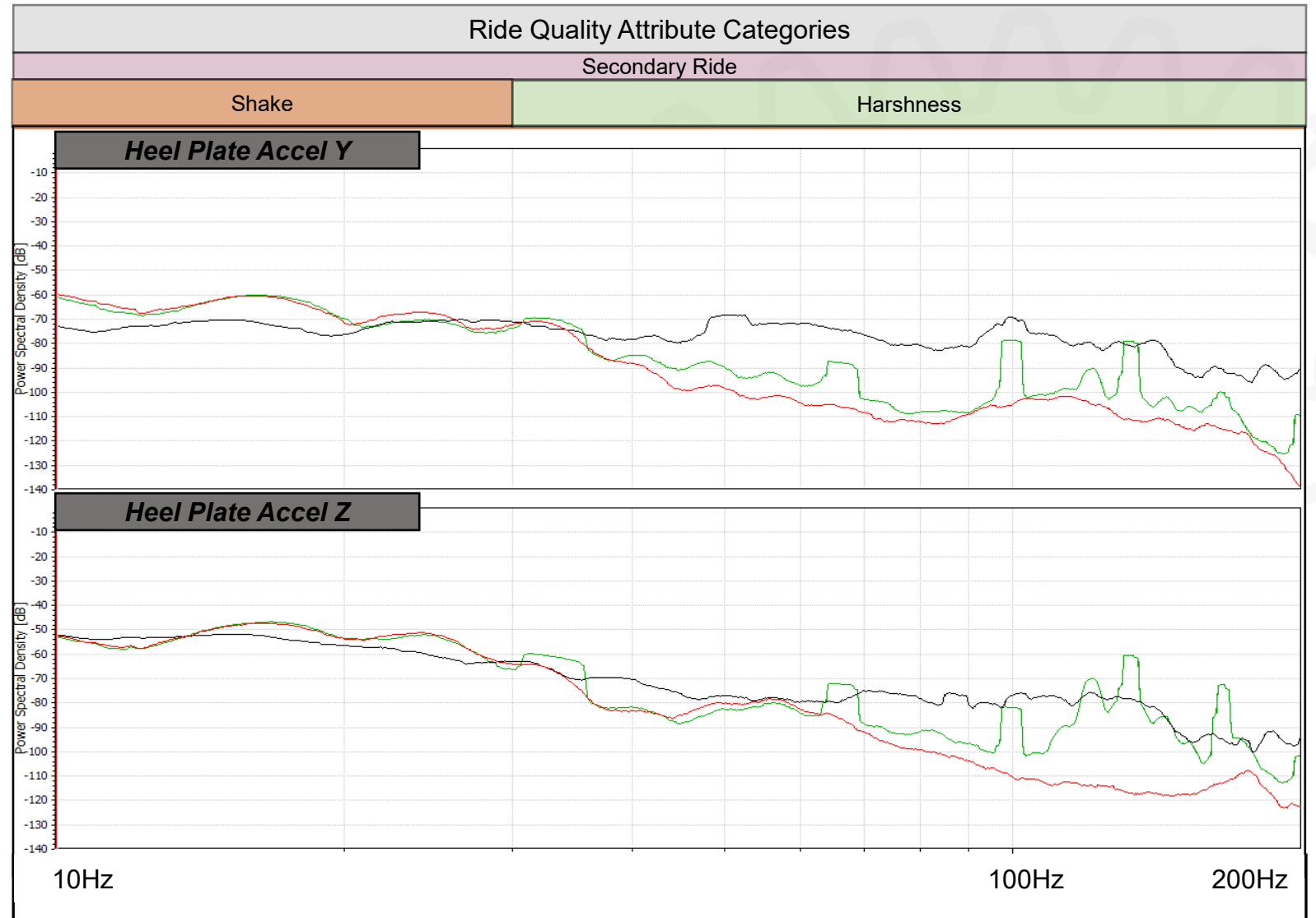
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# Subjective Assessment - Ride



How does the DiM250 with the Hyperdock enable mode wise ride assessment and development?



Ride evaluation performed by Murray White, Technical Director, Vehicle Development at Multimatic.





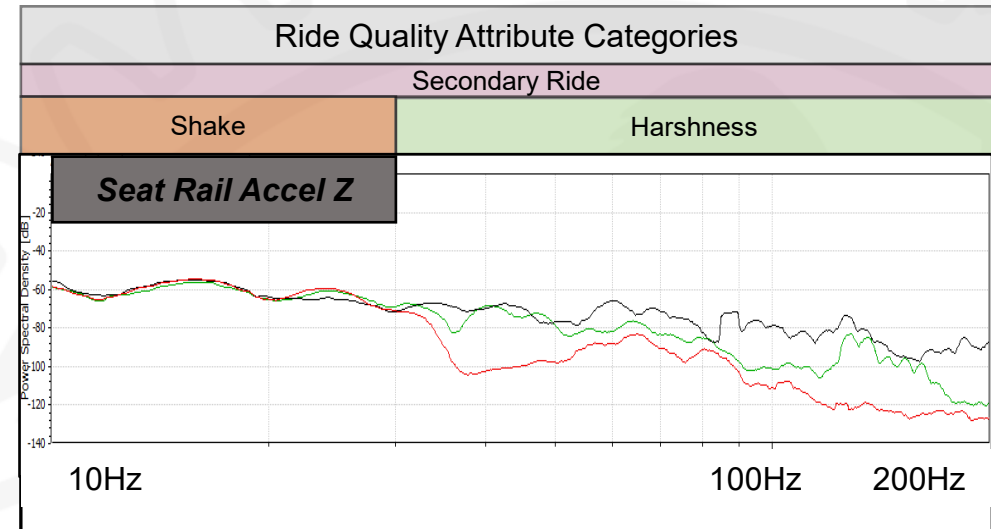
# Subjective Assessment - Ride

“The Hyperdock provides a much more realistic experience driving a GTD down Coolidge.”

- The lighter, stiffer cockpit provides much better mid-high frequency response from the hexapod, without inducing unwanted shakes/rattles.
- Improvements in the noise model provide a more realistic environment when paired with the enclosed cockpit.

“The A to B (GTD Normal to Sport) comparison was reasonable. We got a close delta in normal to sport ride perception on the DiM compared to that on the vehicle.”

Ride evaluation performed by Murray White, Technical Director, Vehicle Development at Multimatic.



## Road Test Data

**DiM Cockpit Data**

**Platform only, shakers off**

**DiM Cockpit Data**

**Platform and Shakers**



# Subjective Assessment – Limit Handling



How does the addition of NVH content impact vehicle perception in limit handling?

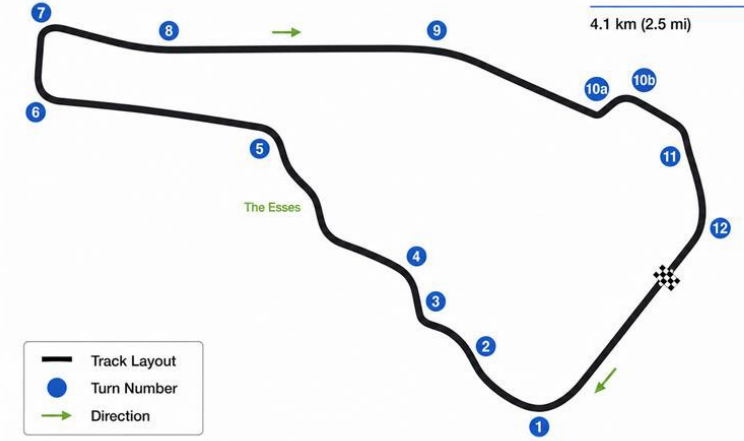


## ROAD ATLANTA

GEORGIA, USA

Michelin Raceway  
Road Atlanta

4.1 km (2.5 mi)



## SEBRING

FLORIDA, USA

Sebring Int Raceway

6.02 km (3.74 mi)



# Subjective Assessment – Limit Handling



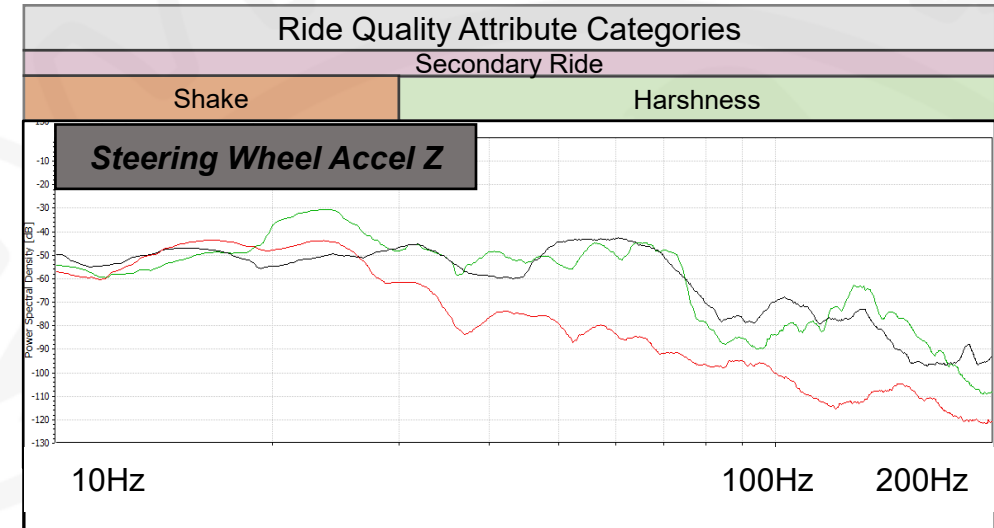
“Without the shakers it feels like something is missing. Overall, the car feels numb.”

“The more realistic the experience the better - the fact you're more immersed in it helps the evaluation of the things that do matter because it makes you more tuned into the vehicle. I was surprised by how much a value add this is.”

*Murray White, Technical Director, Vehicle Development at Multimatic.*

“The feedback from the cockpit is nice... it's so close to the real car. It makes me feel very comfortable and I have a big smile on my face.

*Dirk Mueller, Mustang GTD Development Driver*



## Road Test Data

**DiM Cockpit Data**

**Platform only, shakers off**

**DiM Cockpit Data**

**Platform and Shakers**



# Conclusion



The Hyperdock upgrade to the DiM250 has significantly improved the fidelity and range of attributes which can be subjectively assessed on the simulator for both ride and handling.

- The Hyperdock enables subjective assessment of shake and road texture effects within the context of holistic vehicle ride and handling.

## Next Steps

- Investigations into higher fidelity vibration transfer function development.
- Improvements to high frequency road noise and vibration transmission to the driver.
  - *Shorter wavelength road models*
  - *Shorter wavelength higher frequency tire models*
  - *Virtual NVH model generation*





# Q & A

