

Engineering the Full Spectrum

The Evolution of VI-grade Driving Simulation

Stefano Bernini – Driving Simulator Development Manager



Driving Experience

In The Real Car



Driver & Vehicle
Ride & Handling NVH



Driver & Assistant
ADAS & AV

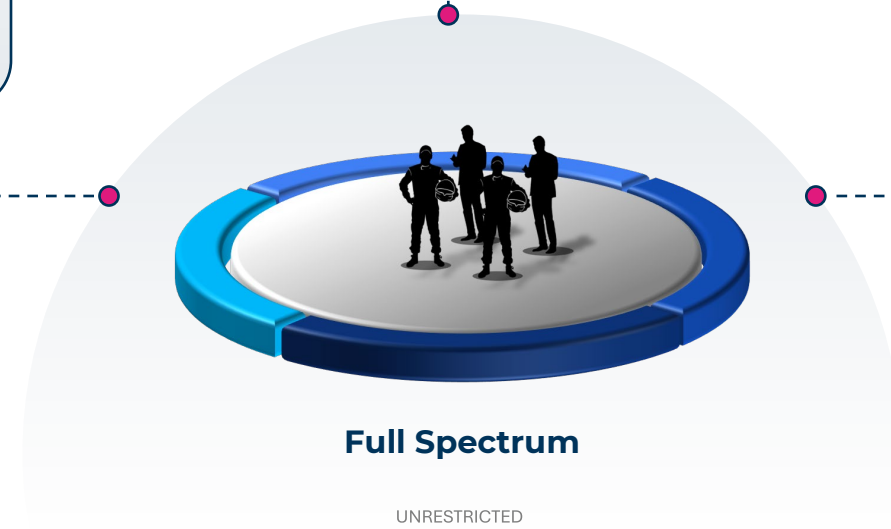
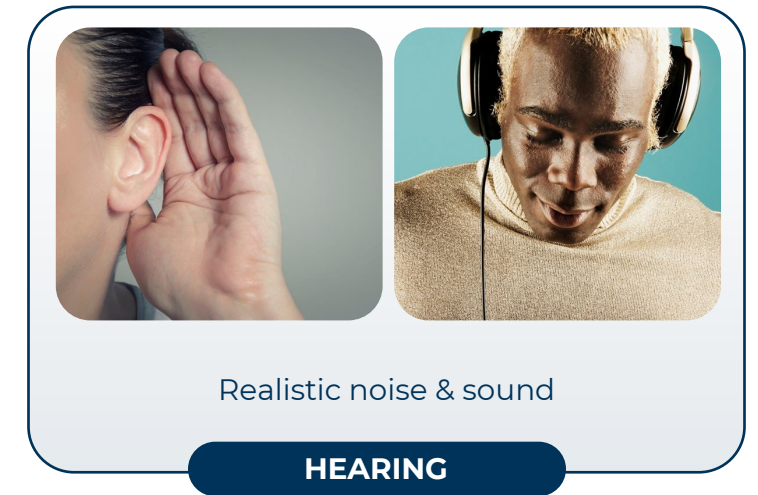
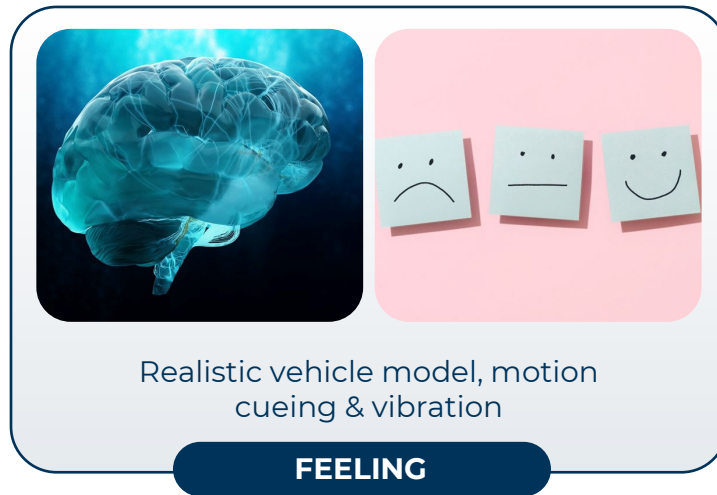


Driver & Controls
HMI



Human-centric approach

On The Simulator –
Reproducing The Full Spectrum



The Multi-Attribute Simulation Journey

Full Spectrum Simulator – One For All

Log Hz

0

10

20

50

200

20000

Sight - Visual



VI-WorldSim

The Multi-Attribute Simulation Journey

Full Spectrum Simulator – One For All

Log Hz

0

10

20

50

200

20000

Sight - Visual

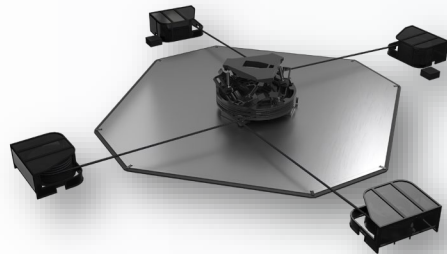
Motion - Handling, Ride & Comfort



VI-WorldSim

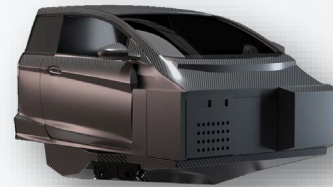
Touch - Vibration

Hearing - Acoustic



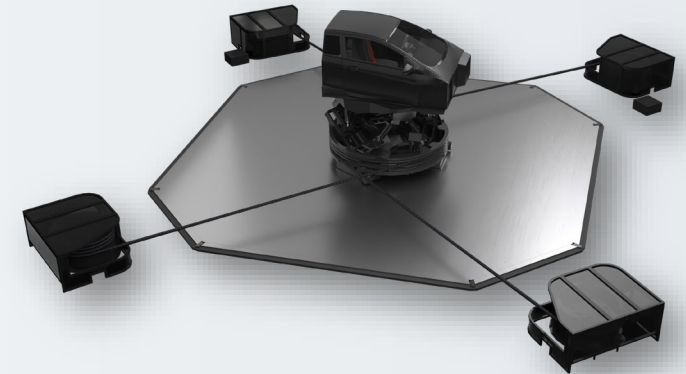
Driver-In-Motion

VI-DriveSim – VI-CarRealTime



HyperDock

VI-NVHSim – VI-SimSound X



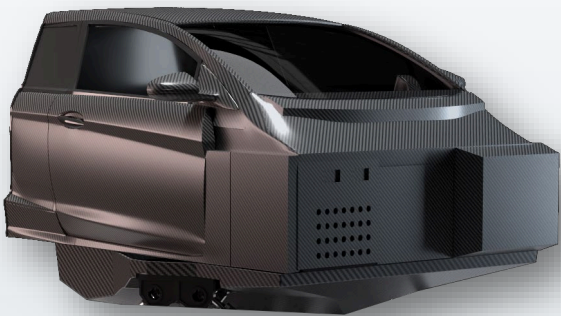
DiM FSS
Full Spectrum Simulator

The Multi-Attribute Simulation Journey

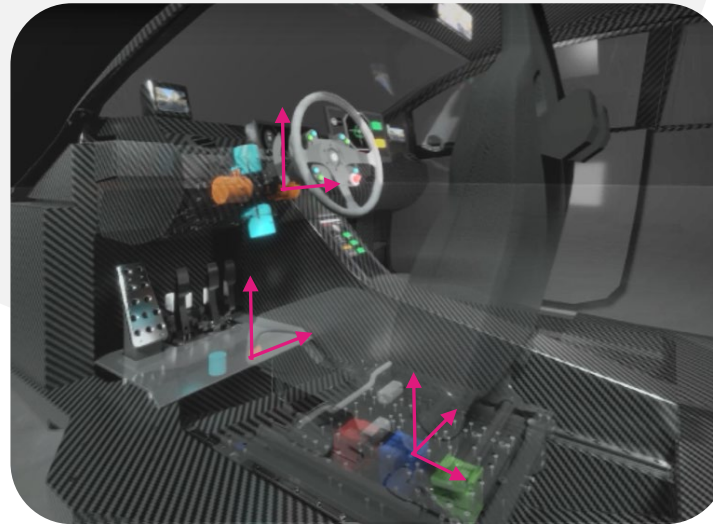
Full Spectrum Simulator (FSS) Development - HyperDock

2024

LAUNCH OF
HYPERDOCK



Main characteristics



- ◆ Reduced mass and inertia
- ◆ Lowered CoG
- ◆ Increased structural stiffness
- ◆ Increased 1st natural frequency
- ◆ Allows NVH evaluation through touchpoint calibrated vibrations

The Multi-Attribute Simulation Journey

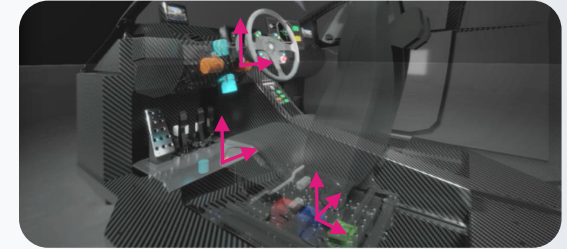
Delivering The Right Frequencies At The Right Place

NVH & SOUND

IN-CABIN STAGE

Shakers and sound system deliver highest frequency movements (e.g. NVH) with 9 dedicated shakers delivering vibration directly to driver touchpoints at 7 DOF

~ 20-100 Hz Shakers
> 100 Hz Sound

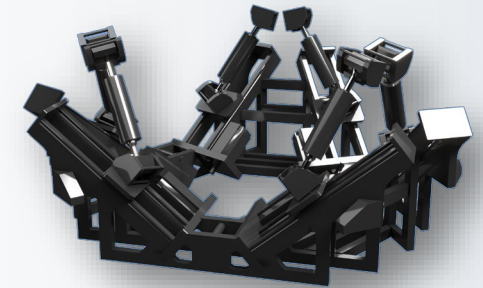


RIDE

UPPER STAGE

The upper stage delivers higher frequency movements (e.g. RIDE) with 6 DOF

~ 5-20 Hz

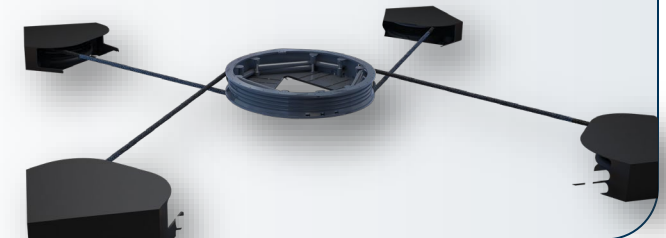


VEHICLE DYNAMICS

LOWER STAGE

The lower stage delivers low frequency movements (e.g. VEHICLE DYNAMICS) for 3 DOF

~ 0-5 Hz



The Multi-Attribute Simulation Journey

Automotive OEMs • Tier 1 suppliers • Universities • Engineering and Testing Organizations

Main characteristics



- ◆ Direct Drive Architecture: no gears, belts, or screws
- ◆ Low latency (~5ms)
- ◆ Near-silent response
- ◆ 6-DoF motion with larger simultaneous motion envelope compared to traditional Hexapod

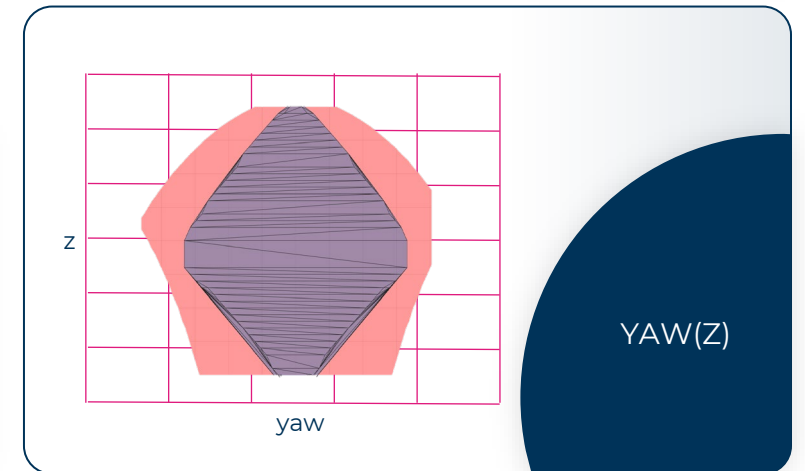
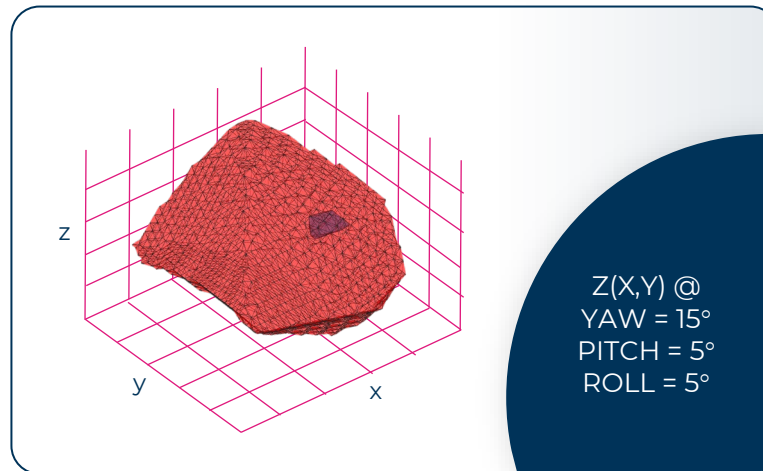
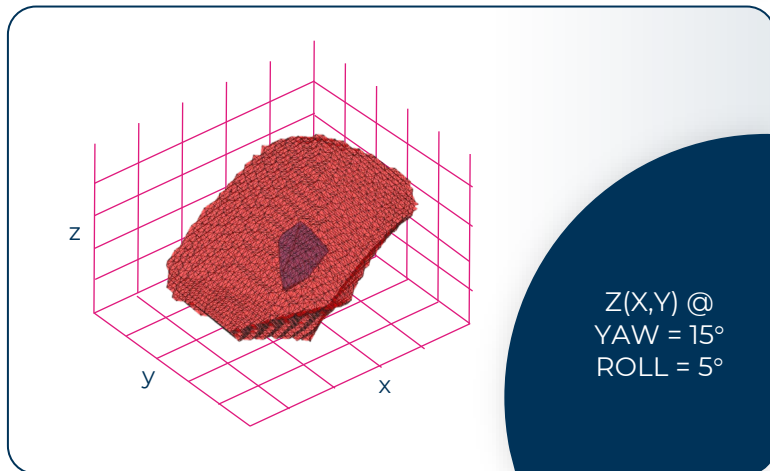
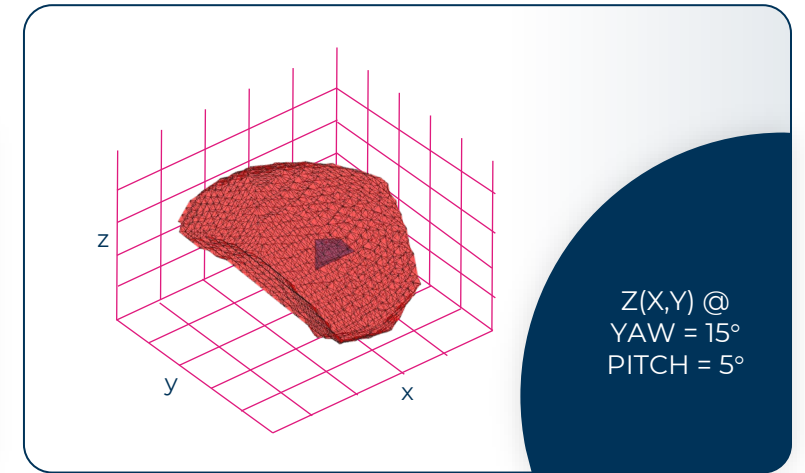
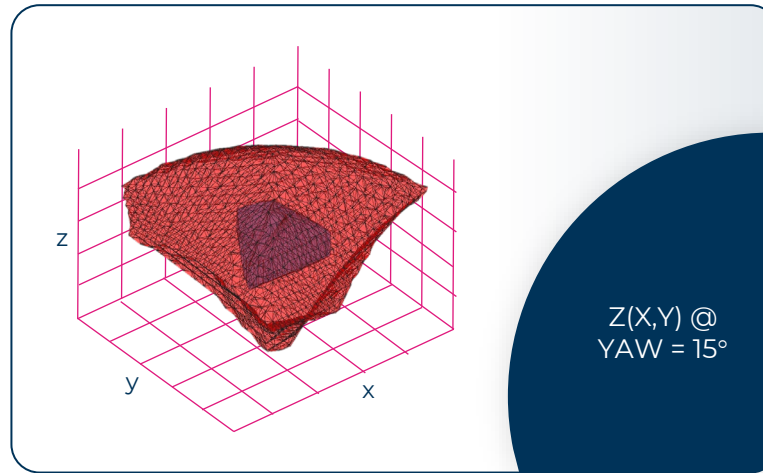
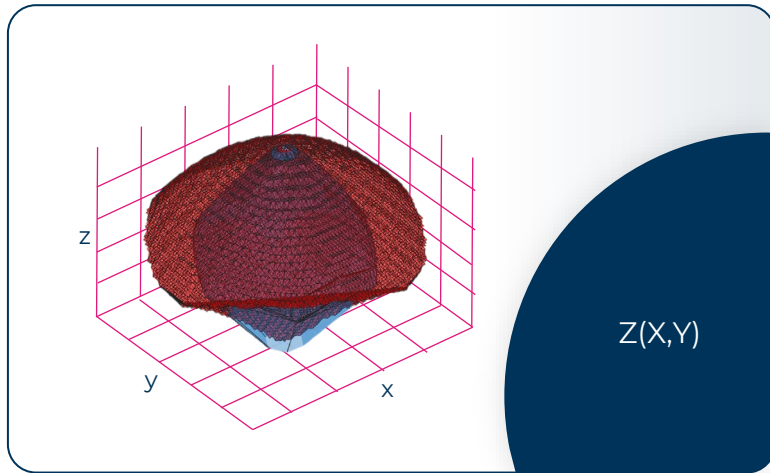
2025

LAUNCH OF HEXAREV



The Multi-Attribute Simulation Journey

Mechanical Characteristics: HexaRev vs Standard Hexapod with similar footprint



The Multi-Attribute Simulation Journey

Full Spectrum Simulator (FSS) Development - HexaRev

Main application areas



HexaRev is relevant across multiple use cases, including ride & handling, NVH, ADAS & AV, HMI, and motorsport applications.



This makes it a flexible platform for teams that need one advanced simulator environment to support several development workflows.

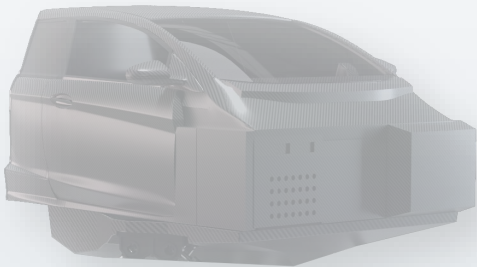


The Multi-Attribute Simulation Journey

Full Spectrum Simulator (FSS) Development

2024

LAUNCH OF
HYPERDOCK



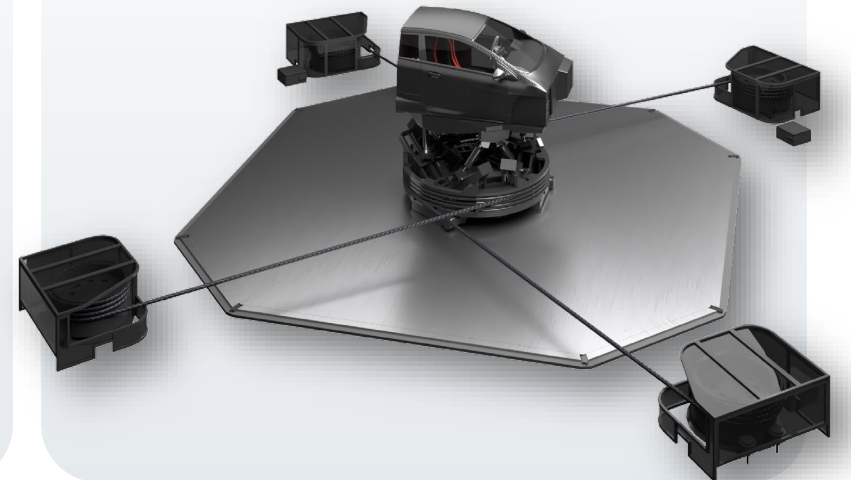
2025

LAUNCH OF
HEXAREV



2026

LAUNCH OF
NEW GENERATION CABLE
DRIVEN SIMULATORS



Cable Driven Simulators

System Characteristics

9 DoF

Frequency split for ride and handling

Motion envelope

Large and scalable

Lateral velocity and acceleration

1.4g -real- lateral acceleration

Acoustic performances

< 60 dB during operations

Simple Design

Cable-driven architecture

Cable Driven Simulators – New Gen

Improved Performances



Mechanical

kinematic, structure, ...



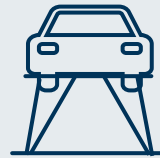
Software

Control, frequency, ...



Payload: +60%

800 kg vs 500 kg



Reduced Latency: -13%

Less than 5ms across motion bandwidth

Motion Bandwidth: +40%

> 60 Hz



Motion Envelope:

YAW: +66% - ± 100 deg

LONG – LAT: +120% on Upper Stage

+9% combined – ± 2.72 m

Cable Driven Simulators – New Gen

Upgrade For Existing Sim

SOFTWARE

New Controller

Improved frequency response

Improved overall efficiency

Faster load – unload driver procedure

Better error management

Soft ramp down instead of hard stop

Brand new UI

New functionalities

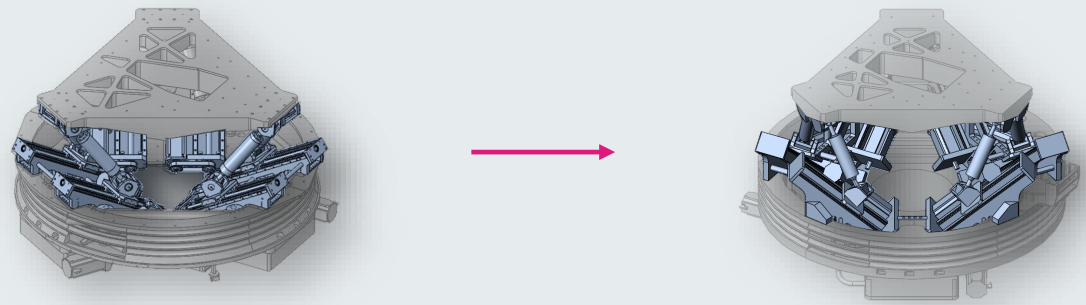
For debugging and testing

Improved data logging and monitoring

HARDWARE

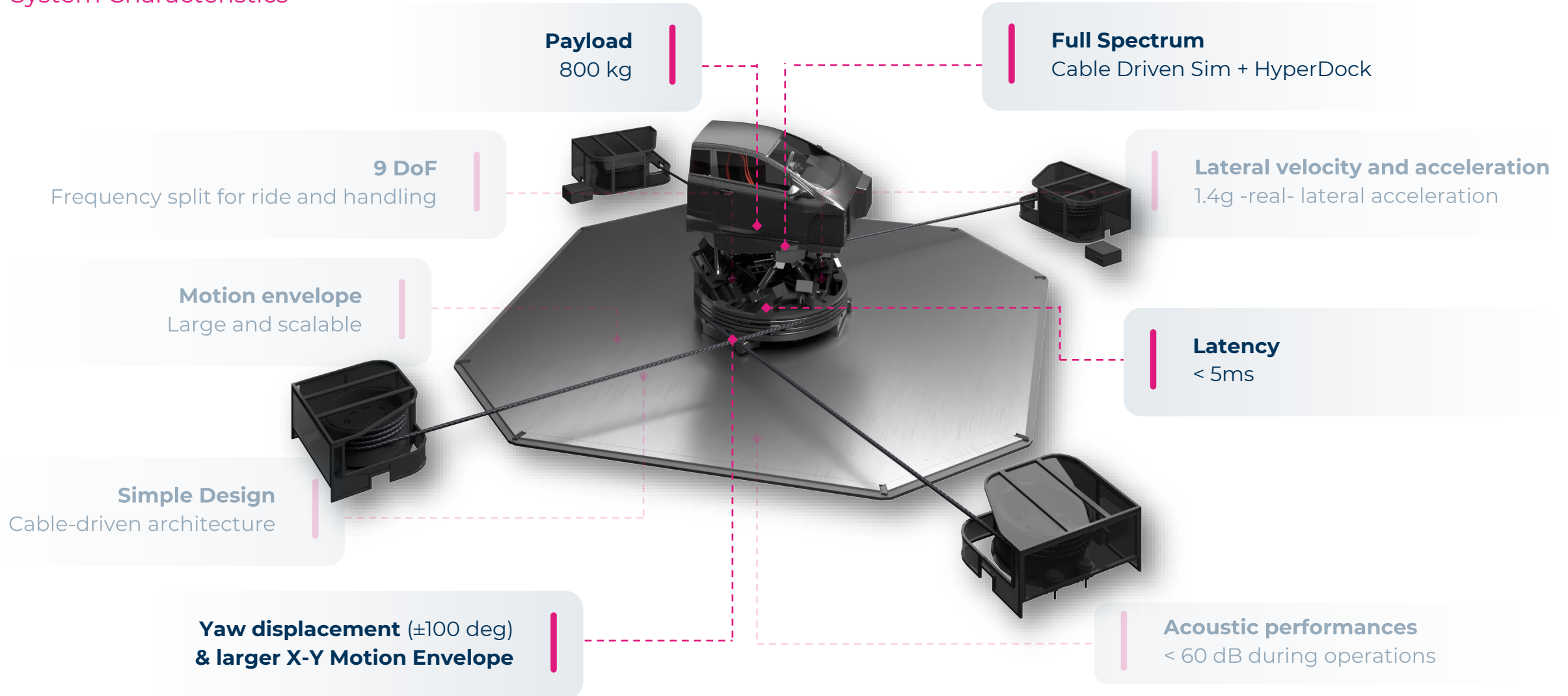
Udine SimCenter DiM400 will be fully updated to New Gen before end of 2026

Improved frequency response



Cable Driven Simulators – New Gen

System Characteristics



Worldwide Success - Automotive OEMs



JLR
2 SYSTEMS

DESKTOP NVH · STATIC NVH



Bentley
3 SYSTEMS

DESKTOP NVH · COMPACT FSS
STATIC NVH



BMW
2 SYSTEMS

DIM150 · LARGE NVH



ZEEKR
2 SYSTEMS

DESKTOP · DIM250

DAIMLER TRUCK

Daimler Truck
2 SYSTEMS

DESKTOP · LARGE NVH



Ford
21 SYSTEMS

3 × DESKTOP · 8 × DESKTOP NVH
3 × COMPACT R&H · 3 × COMPACT NVH
STATIC · STATIC NVH · DIM250
HEXAREV



General Motors
3 SYSTEMS

DESKTOP NVH · 2 × COMPACT
NVH



HONDA
Honda
7 SYSTEMS

DESKTOP · DESKTOP NVH
2 × COMPACT R&H · COMPACT
NVH
DIM250 · DIM300

HYUNDAI MOTOR GROUP

Hyundai Motor Group
6 SYSTEMS

DESKTOP · 3 × DESKTOP NVH ·
STATIC
STATIC NVH



Mercedes-Benz
1 SYSTEM

LARGE NVH



Stellantis
15 SYSTEMS

DESKTOP · 5 × DESKTOP NVH
2 × COMPACT R&H · COMPACT HMI
STATIC · DIM150 · 3 × DIM250
CUSTOM



TOYOTA
Toyota
5 SYSTEMS

2 × DESKTOP NVH · COMPACT
R&H
COMPACT NVH · DIM150



Volvo Cars
2 SYSTEMS

STATIC · DIM150



Volkswagen
2 SYSTEMS

2 × STATIC NVH



Škoda Auto
1 SYSTEM

COMPACT NVH



SUBARU
Subaru
1 SYSTEM

COMPACT R&H



SUZUKI
Suzuki
1 SYSTEM

COMPACT NVH



NIO
NIO
1 SYSTEM

DIM150



CEER
CEER
1 SYSTEM

COMPACT NVH



Changan Automobile
1 SYSTEM

COMPACT R&H



FAW
2 SYSTEMS

DESKTOP · COMPACT NVH



Lucid Motors
2 SYSTEMS

DESKTOP · COMPACT FSS



Nikola
1 SYSTEM

DESKTOP NVH



Nissan
2 SYSTEMS

DESKTOP · DESKTOP NVH



PACCAR
1 SYSTEM

DESKTOP



Rivian
4 SYSTEMS

2 × DESKTOP · DESKTOP NVH
COMPACT NVH



Tesla
3 SYSTEMS

3 × DESKTOP NVH



Xiaomi EV
1 SYSTEM

DESKTOP



Harley-Davidson
2 SYSTEMS

DESKTOP NVH · STATIC

July 2026 installed-base master · Regional sites consolidated by customer · Counts reflect simulator systems in the master list

Worldwide Success - Automotive Tier 1s



Brembo
1 SYSTEM

COMPACT R&H



Bridgestone
4 SYSTEMS

DESKTOP · DESKTOP NVH
COMPACT NVH · DIM500



Goodyear
4 SYSTEMS

2× COMPACT R&H · 2× DIM250



Hankook Tire
1 SYSTEM

STATIC



Astemo
1 SYSTEM

COMPACT FSS



Michelin
3 SYSTEMS

2× DESKTOP · COMPACT R&H



Pirelli
3 SYSTEMS

3× STATIC



Toyo Tires
1 SYSTEM

COMPACT FSS



HARMAN
2 SYSTEMS

2× STATIC



KYB
1 SYSTEM

COMPACT FSS



Marelli
2 SYSTEMS

DESKTOP NVH · COMPACT R&H



MRF
1 SYSTEM

COMPACT FSS



SHOWA
2 SYSTEMS

COMPACT R&H · CUSTOM



Sumitomo Rubber Industries
2 SYSTEMS

DESKTOP · DESKTOP NVH



ZF / TRW
1 SYSTEM

COMPACT R&H

July 2026 installed-base master · Regional sites consolidated by customer · Counts reflect simulator systems in the master list

Worldwide Success - Motorsport And Supercars



Alpine Cars
2 SYSTEMS

COMPACT FSS · Dim250



Mercedes-AMG
3 SYSTEMS

STATIC · Dim250 · Dim500



Aston Martin
1 SYSTEM

COMPACT R&H



Audi Sport
1 SYSTEM

Dim150



DS Performance
2 SYSTEMS

2× STATIC



Ferrari S.p.A.
4 SYSTEMS

DESKTOP · DESKTOP NVH · STATIC
Dim150



Porsche / Porsche Motorsport
4 SYSTEMS

STATIC · Dim150 · Dim400
LARGE NVH



Bugatti Rimac
1 SYSTEM

COMPACT R&H



Lamborghini
4 SYSTEMS

DESKTOP · DESKTOP NVH · 2× STATIC



Ford Performance
4 SYSTEMS

4× CUSTOM



McLaren
1 SYSTEM

COMPACT FSS



Multimatic
2 SYSTEMS

2× CUSTOM



Pagani Automobili
1 SYSTEM

DESKTOP



Virgin Racing
1 SYSTEM

STATIC

July 2026 installed-base master · Regional sites consolidated by customer · Counts reflect simulator systems in the master list

Worldwide Success - Universities And Engineering Services



 Applus IDIADA 4 SYSTEMS DESKTOP NVH · COMPACT R&H 2x DIM250	 CICV 1 SYSTEM DIM400	 Danisi Engineering 2 SYSTEMS STATIC · DIM150	 EDAG 1 SYSTEM DIM500	 HORIBA MIRA 3 SYSTEMS DESKTOP NVH · COMPACT R&H DIM250	 Millbrook 1 SYSTEM COMPACT R&H	 Multimatic US 1 SYSTEM DIM250	 Politecnico di Milano 4 SYSTEMS DESKTOP · 2x COMPACT R&H DIM400	 VIRTUAL VEHICLE (Vf) 1 SYSTEM STATIC	 AiAdoption 1 SYSTEM DESKTOP	 CAE VALUE 1 SYSTEM DESKTOP	 中汽中心 CATARC 1 SYSTEM DIM50	 Esslingen University of Applied Sciences 1 SYSTEM CUSTOM	 Fraunhofer Institute 1 SYSTEM COMPACT R&H
 KMITL 1 SYSTEM DESKTOP	 Meccanica42 1 SYSTEM COMPACT R&H	 NTSEL 1 SYSTEM DIM150	 OFFIS 1 SYSTEM CUSTOM	 Porsche Engineering 3 SYSTEMS 3x DESKTOP	 Progress Technology 1 SYSTEM DIM300	 RSE 1 SYSTEM DESKTOP	 Servus 1 SYSTEM COMPACT R&H	 Solize 1 SYSTEM COMPACT R&H	 Stackpole Engineering Services, Inc. 1 SYSTEM DESKTOP	 Trier University 1 SYSTEM CUSTOM	 McMaster University 2 SYSTEMS DESKTOP NVH · STATIC	 University of Bologna 1 SYSTEM COMPACT R&H	 University of Brescia 1 SYSTEM COMPACT R&H
 Changzhou University 2 SYSTEMS COMPACT R&H · COMPACT FSS	 Chuo University 1 SYSTEM COMPACT FSS	 Concordia University 2 SYSTEMS DESKTOP · COMPACT R&H	 Lund University 1 SYSTEM MOTION SYSTEM	 University of Minnesota 1 SYSTEM DESKTOP	 University of Naples Federico II 3 SYSTEMS 2x DESKTOP MOTION SYSTEM	 University of Padua 3 SYSTEMS DESKTOP · 2x COMPACT R&H	 UNIVERSITÀ DI PISA 1 SYSTEM DESKTOP	 Sapienza University of Rome 1 SYSTEM DESKTOP	 UNIVERSITÀ DEL SALENTO 1 SYSTEM MOTION SYSTEM	 USP 1 SYSTEM STATIC	 UNIVERSITÀ DEGLI STUDI DI UDINE 1 SYSTEM DESKTOP	 UNIVERSITY OF WORCESTER 4 SYSTEMS 2x DESKTOP · STATIC CUSTOM	 UNIVERSITY OF WATERLOO 1 SYSTEM STATIC

July 2026 installed-base master · Regional sites consolidated by customer · Counts reflect simulator systems in the master list

Conclusions

Engineering the Full Spectrum



◆ **One synchronized Driver-in-the-Loop environment** combining handling, ride, tactile vibration, acoustics & driver interaction for true multi-attribute development.

◆ **Fidelity where it matters: at the driver.** Balanced motion cueing plus calibrated vibration at the seat, steering wheel & heel plate delivers a more complete and controllable experience than platform performance alone.

◆ **Different motion architectures for different engineering needs.** COMPACT FSS, HyperDock, HexaRev and New Generation Cable-Driven DiM provide scalable solutions within one common VI-grade ecosystem.

◆ **Continuous technology evolution brings greater motion envelope,** improved combined-motion capability, higher payload, stronger dynamic performance & Full Spectrum applicability.

◆ **Proven engineering value:** earlier subjective evaluation, more design variants before physical prototypes & greater confidence in cross-attribute vehicle decisions.