UNIVERSITY OF LIVERPOOL

VIRTUAL ENGINEERING CENTRE

Dr Antony Robotham - Executive Director

eXtreme Data Workshop

19 - 20 April 2012

Supported by

Northwest REGIONAL DEVELOPMENT AGENCY

INVESTING IN englandsnorthwest

EUROPEAN REGIONAL DEVELOPMENT FUND

A Centre of Excellence in Virtual Engineering…

- VE best practice demonstration
- VE business development and research
- VE education and skills development

… providing VE support to the aerospace supply chain and other high valued added manufacturing sectors

Virtual Engineering Centre

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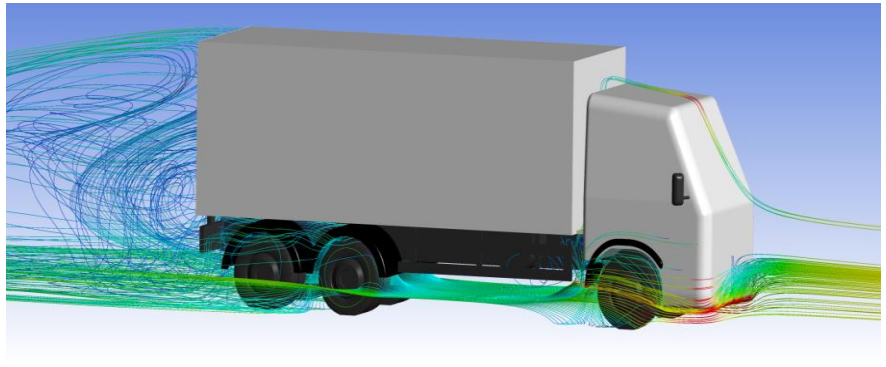
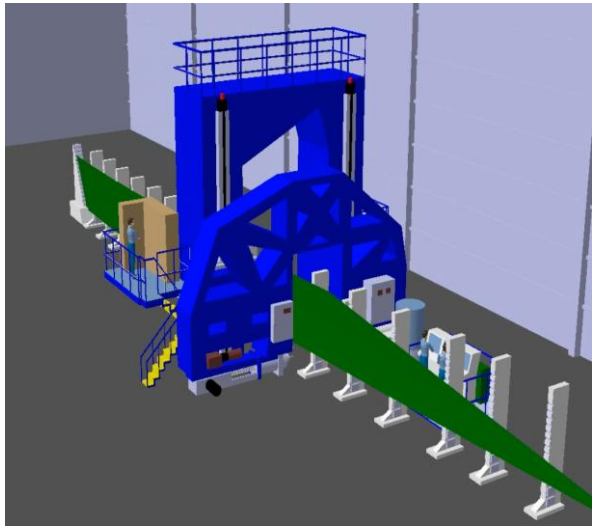
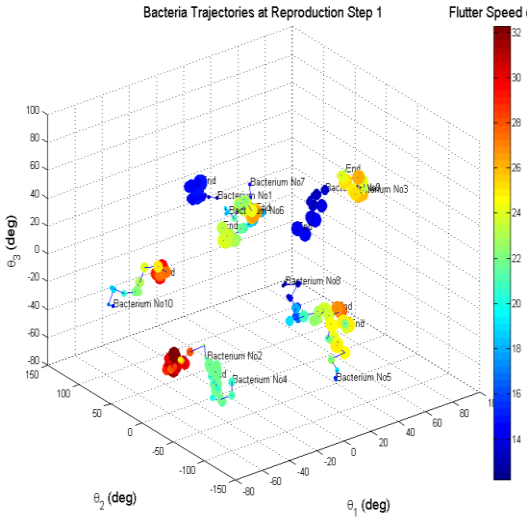
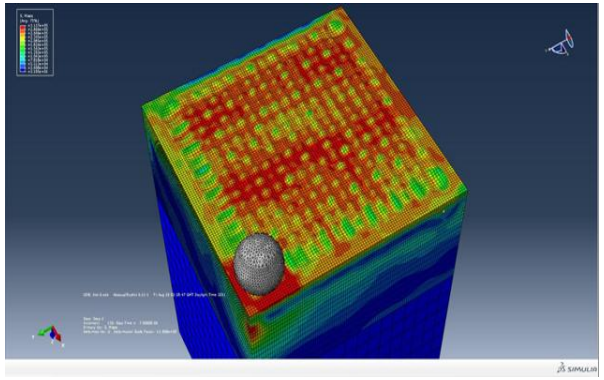
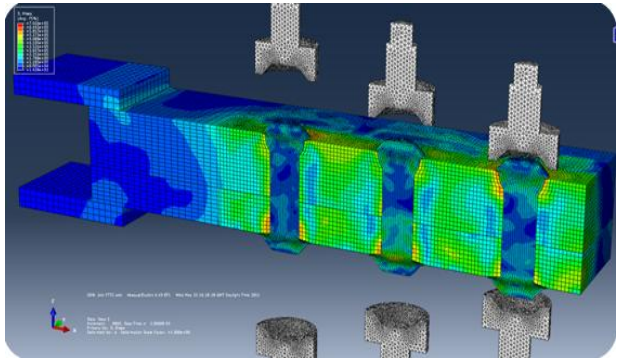
VEC123

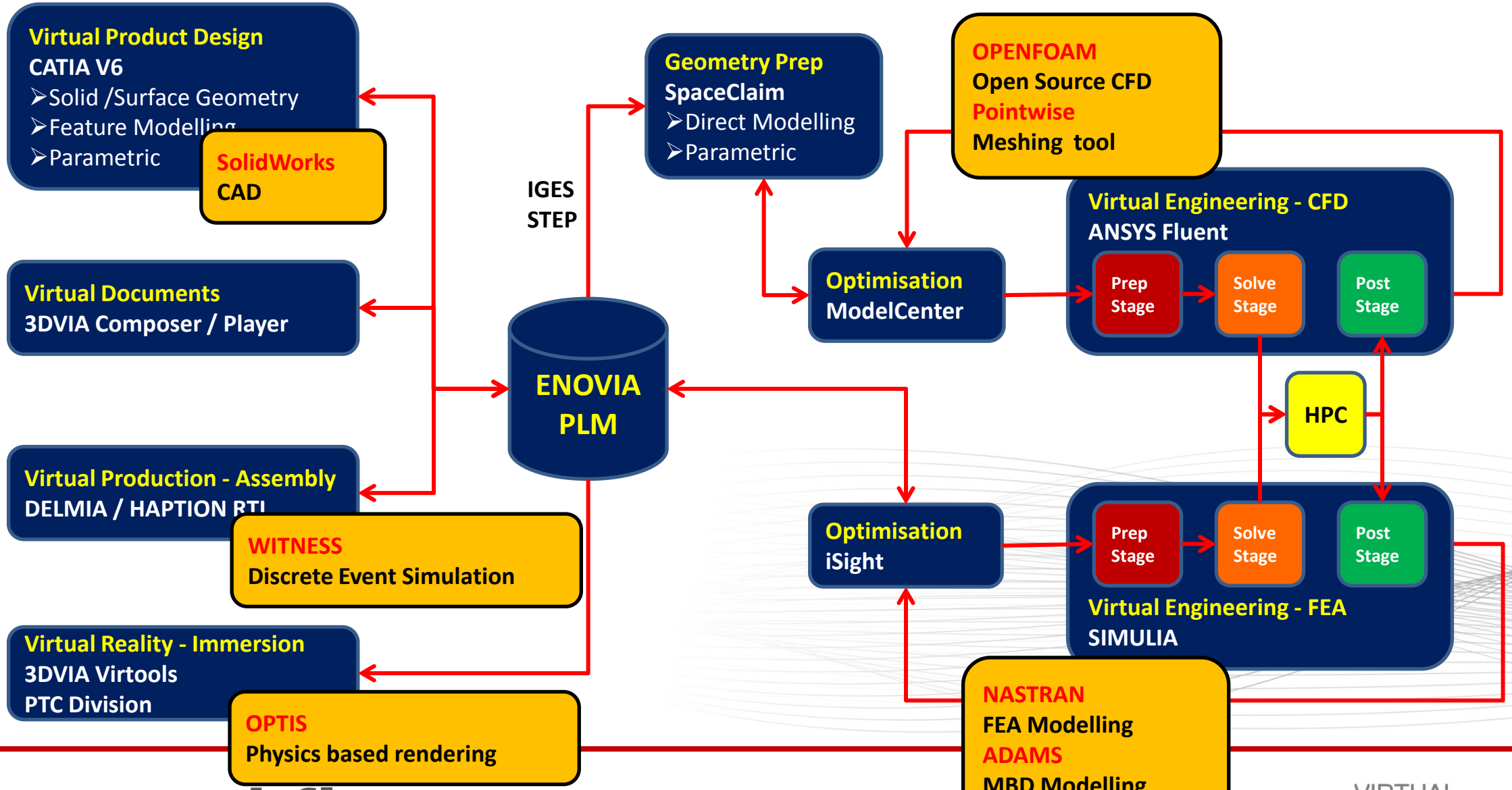





Bacteria Trajectories at Reproduction Step 1
Flutter Speed (m/s)
Bacterium No1
Bacterium No2
Bacterium No3
Bacterium No4
Bacterium No5
Bacterium No6
Bacterium No7
Bacterium No8
Bacterium No10
θ3 (deg)
θ2 (deg)
θ1 (deg)







CAE Workflow

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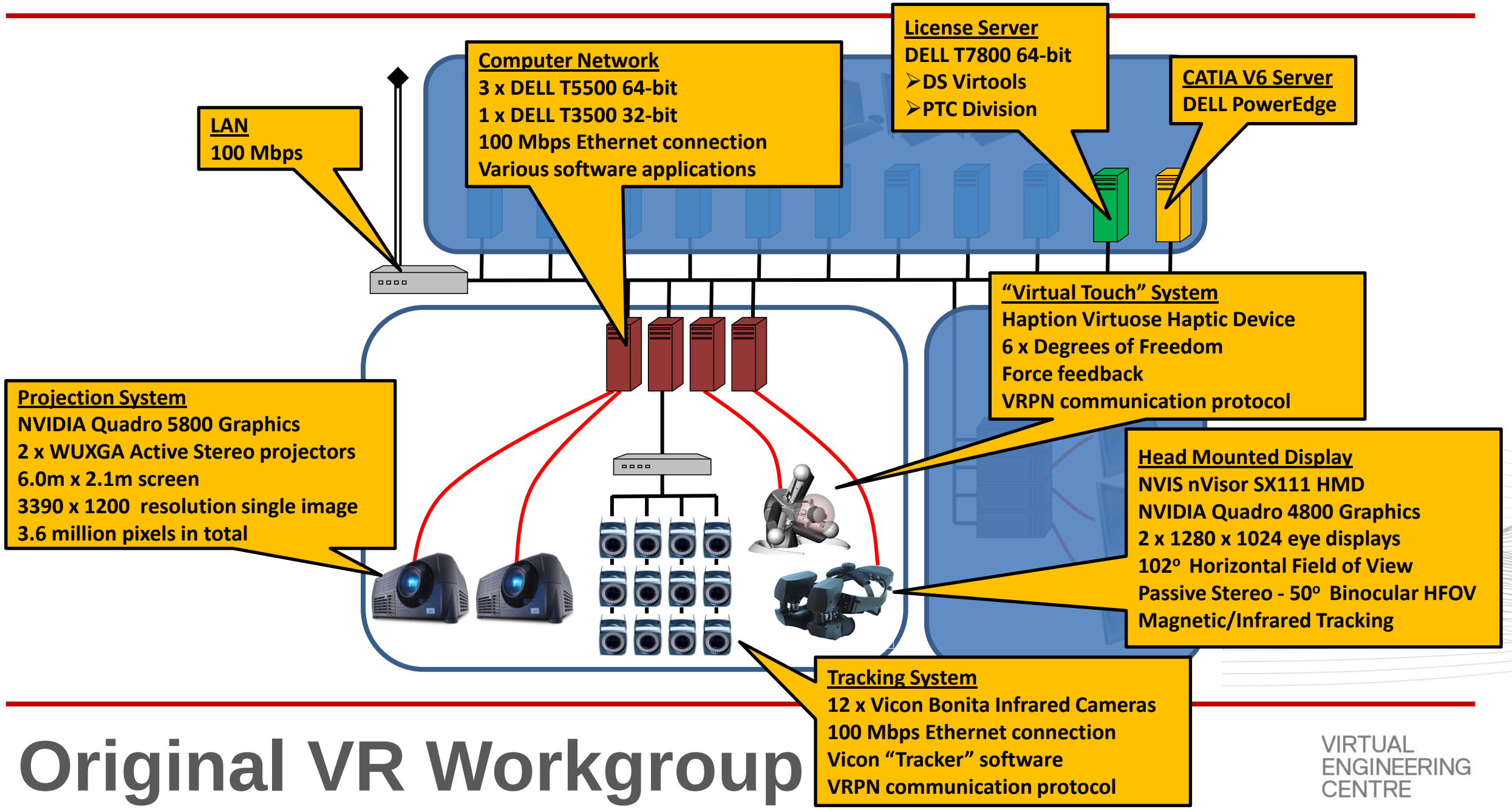
Original VR Workgroup



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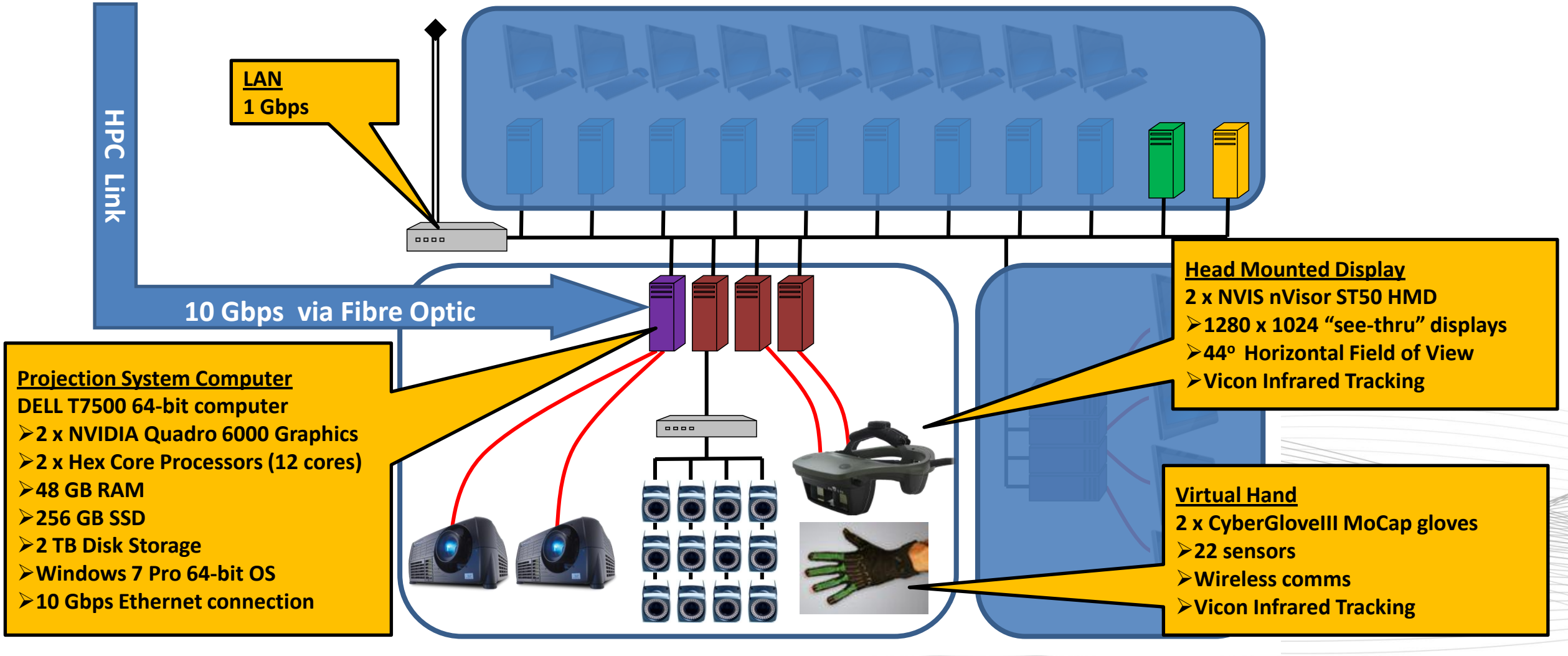
Upgrades to VR Workgroup



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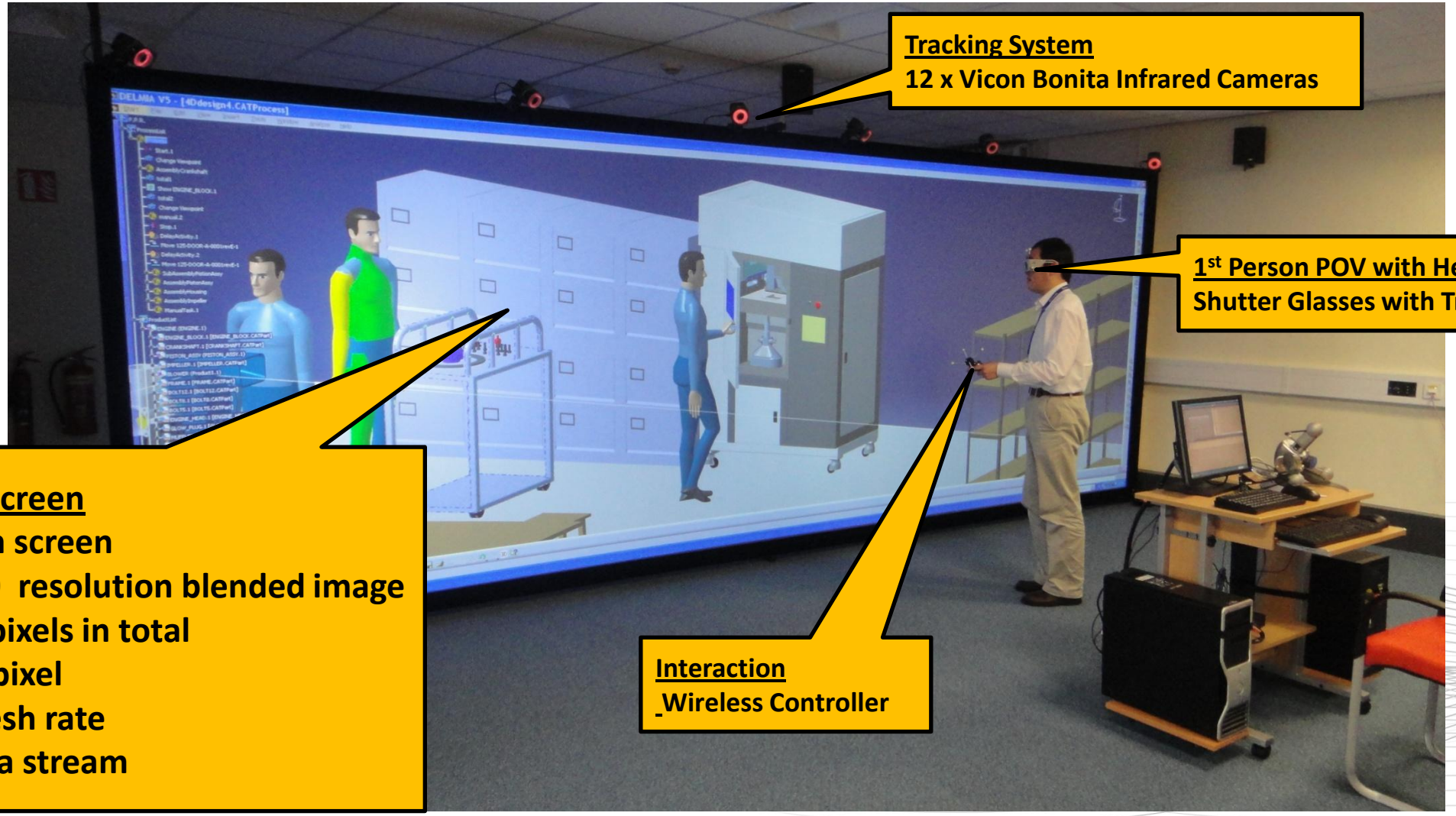

Virtual Reality Technologies at VEC

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BENTLEY

www.bentleymotors.com

Case Study with Bentley Motors

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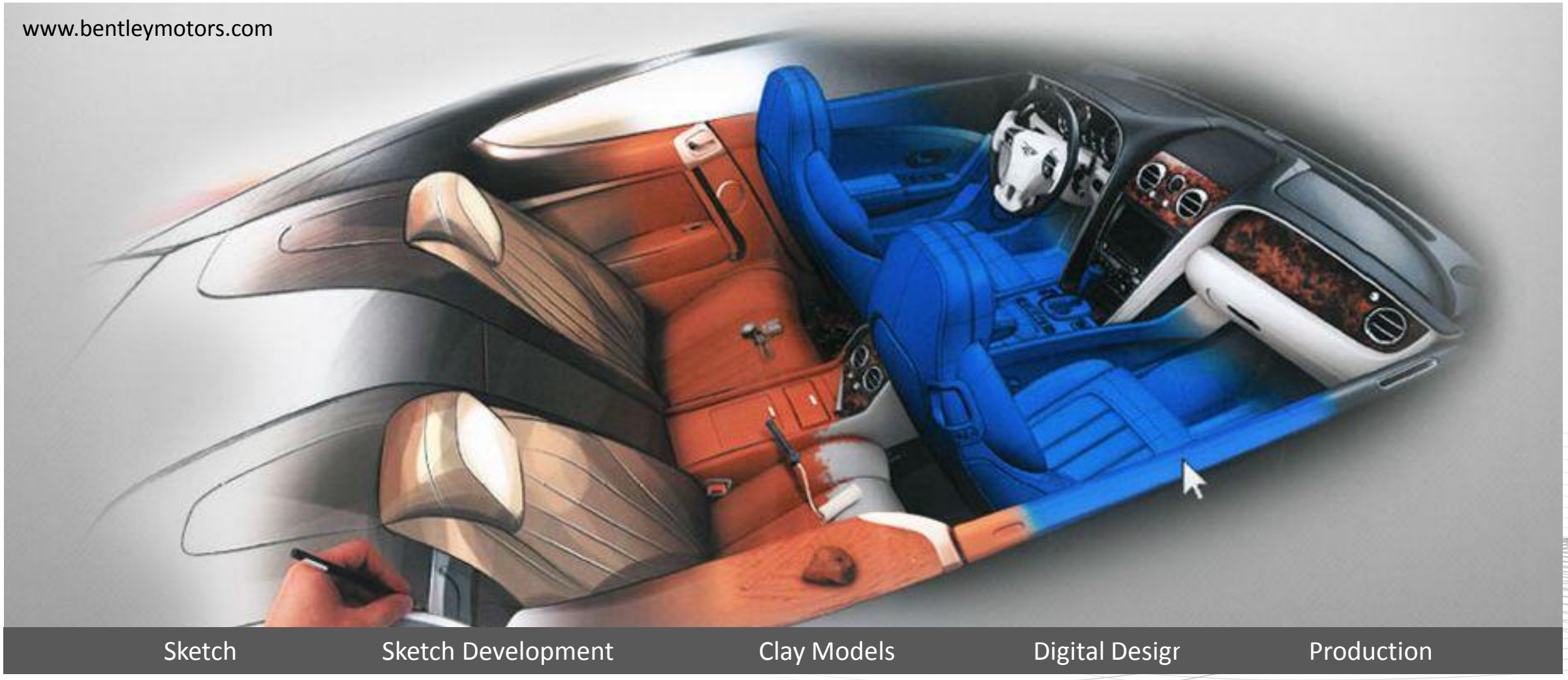

Design Development

BENTLEY

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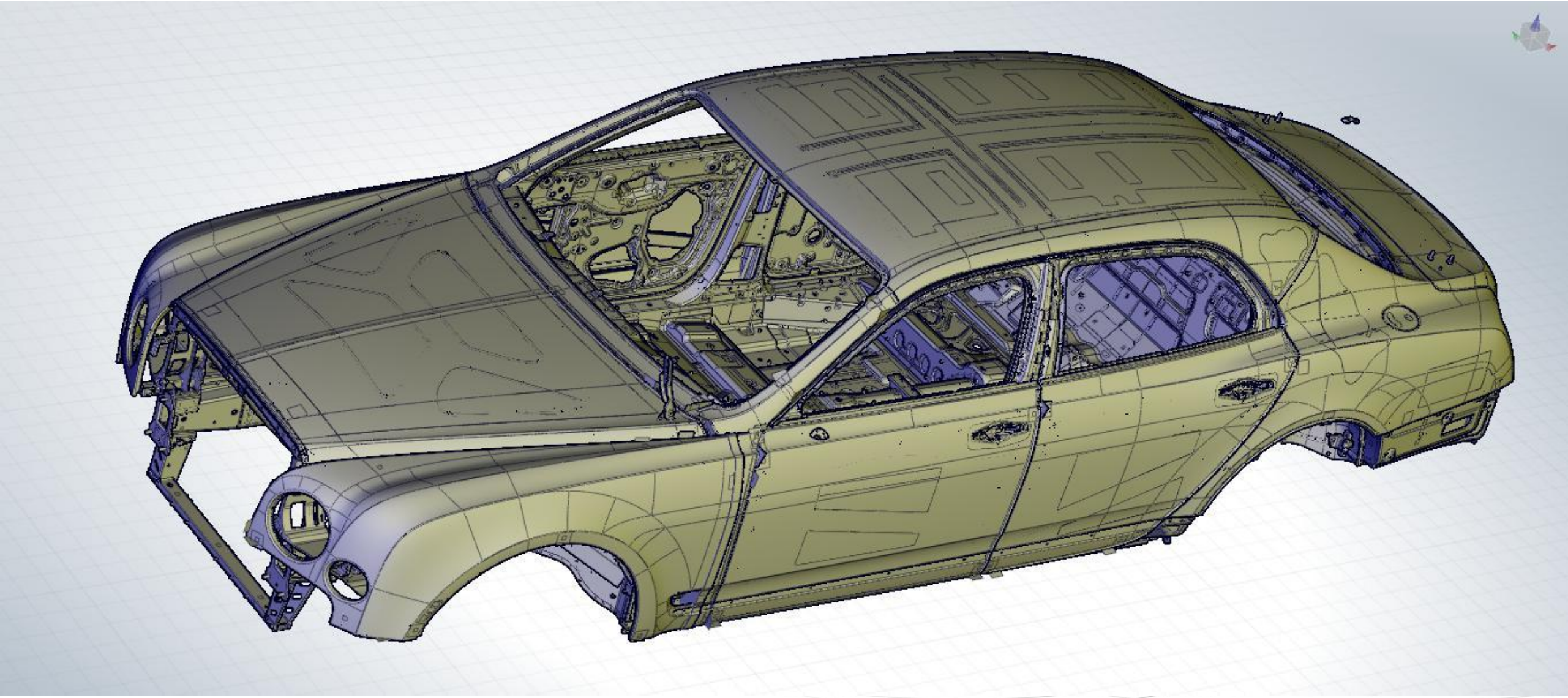

3D Digital Model of BIW

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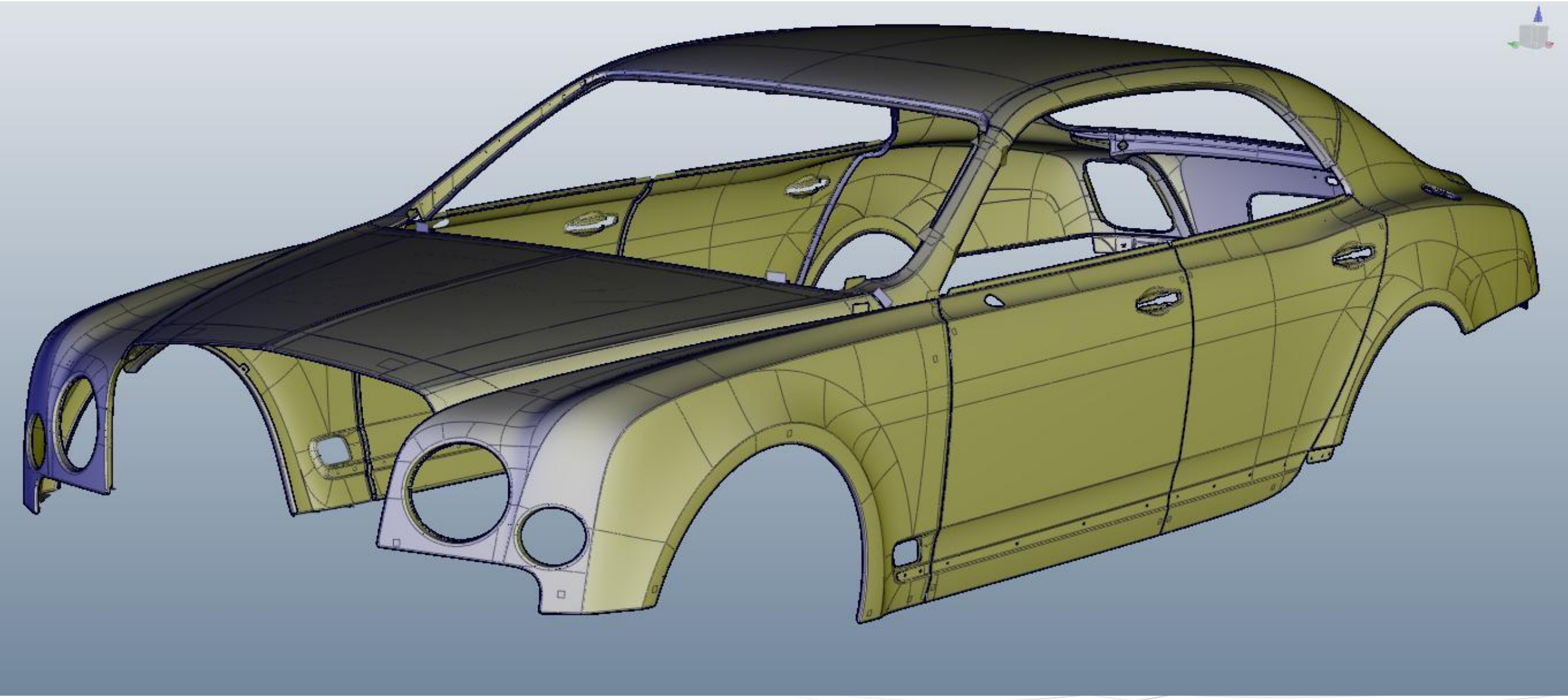

3D Digital Model – Surface Patches

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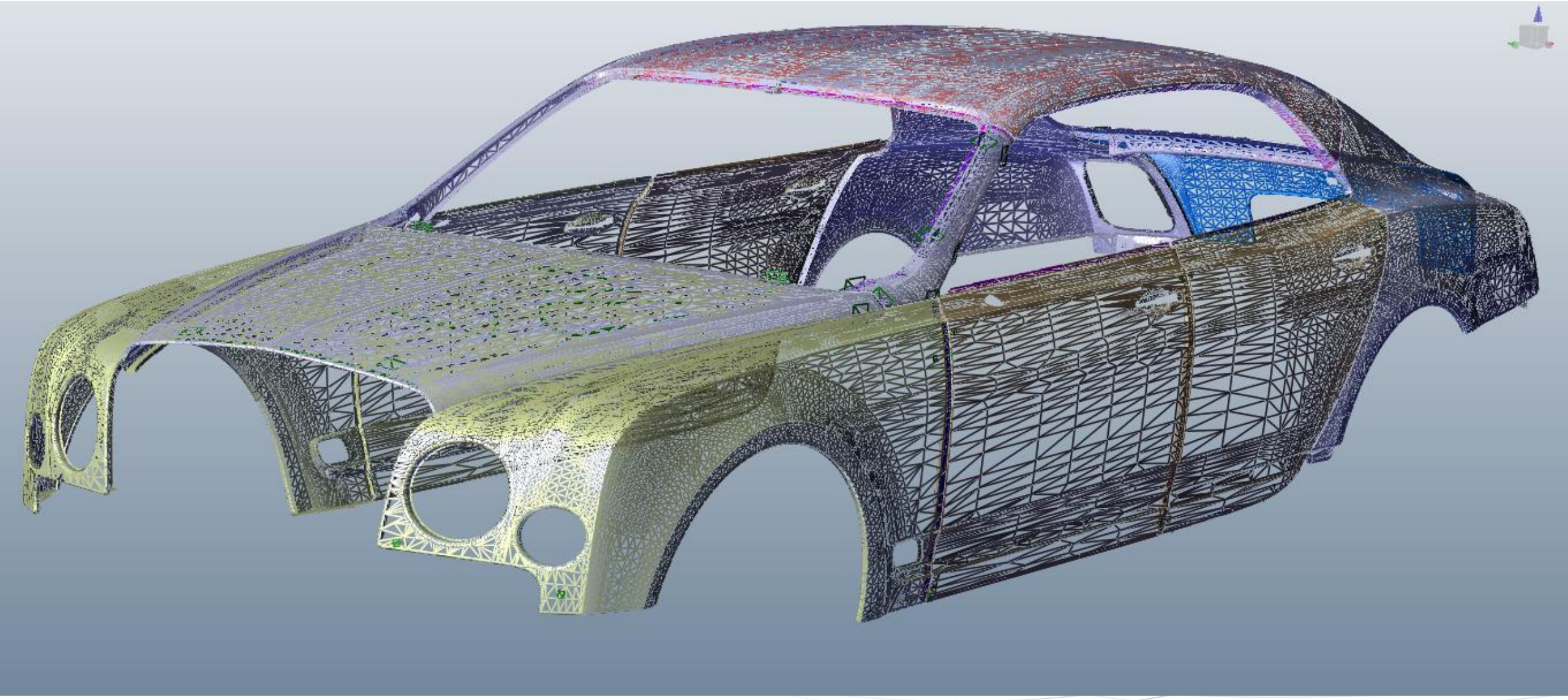

3D Digital Model – Triangular Faces

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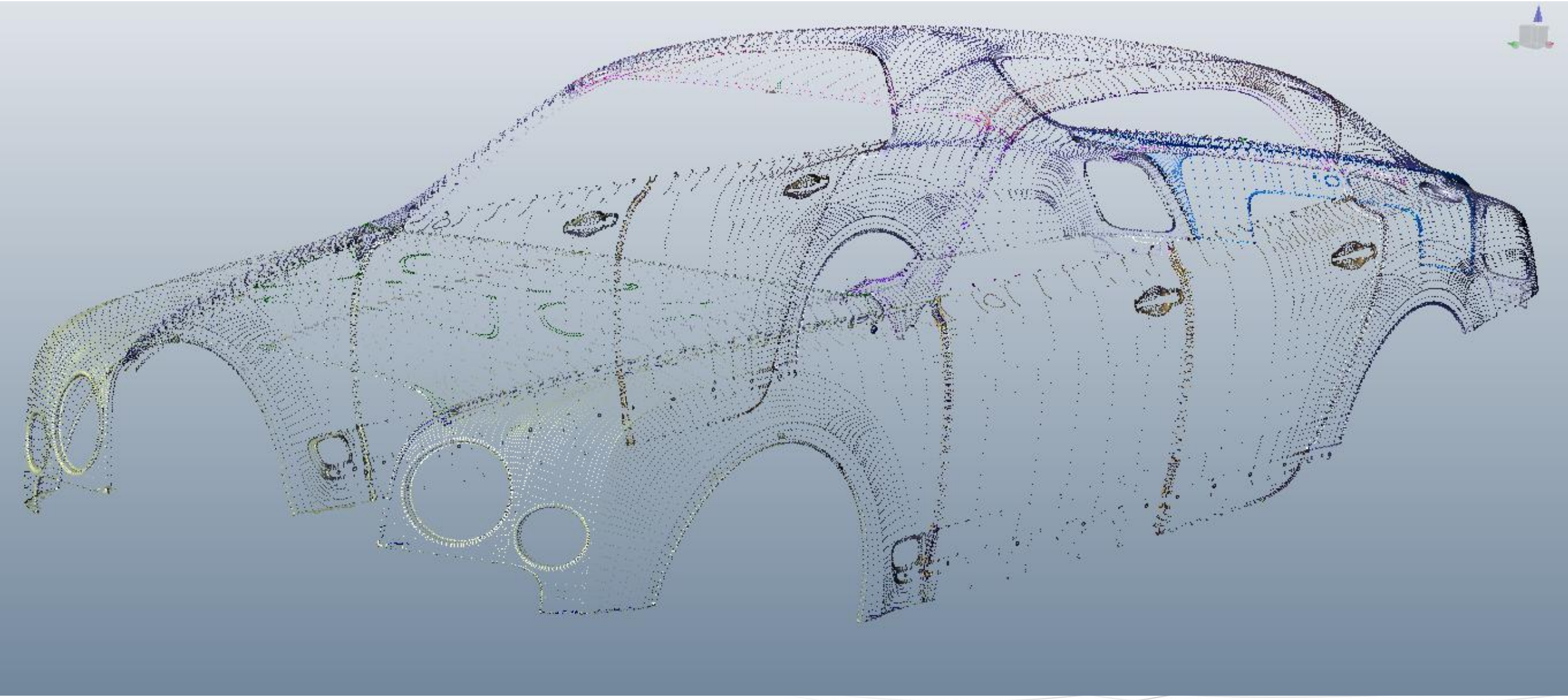

3D Digital Model – Vertices

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Priorities for Bentley Motors

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Objectives

- Improve the quality of the design solution
- Reduce time and cost of new vehicle design
- Replace physical mock-ups with virtual prototypes

Surface and Build

- Virtual surface validation

Ergonomics

- Ergonomic Validation – vision/reflections
- Lighting Development – illumination

Demonstration Project

- Vehicle CAD data of Mulsanne — **Bentley Motors**
- Virtual Reality technologies — **VEC**
- Optical behaviour — **Optis**

Common technology challenges include

- Immersion and auditor tracking
- Physics based real-time visualisation
- Realistic exterior environments
- Augmented physical reality
- Actual visibility of variation

Demonstration Project

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VIRTUAL REALITY AT VEC

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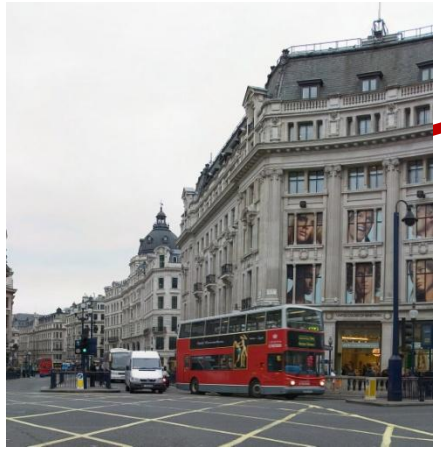
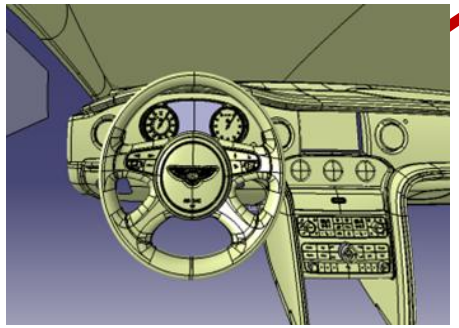
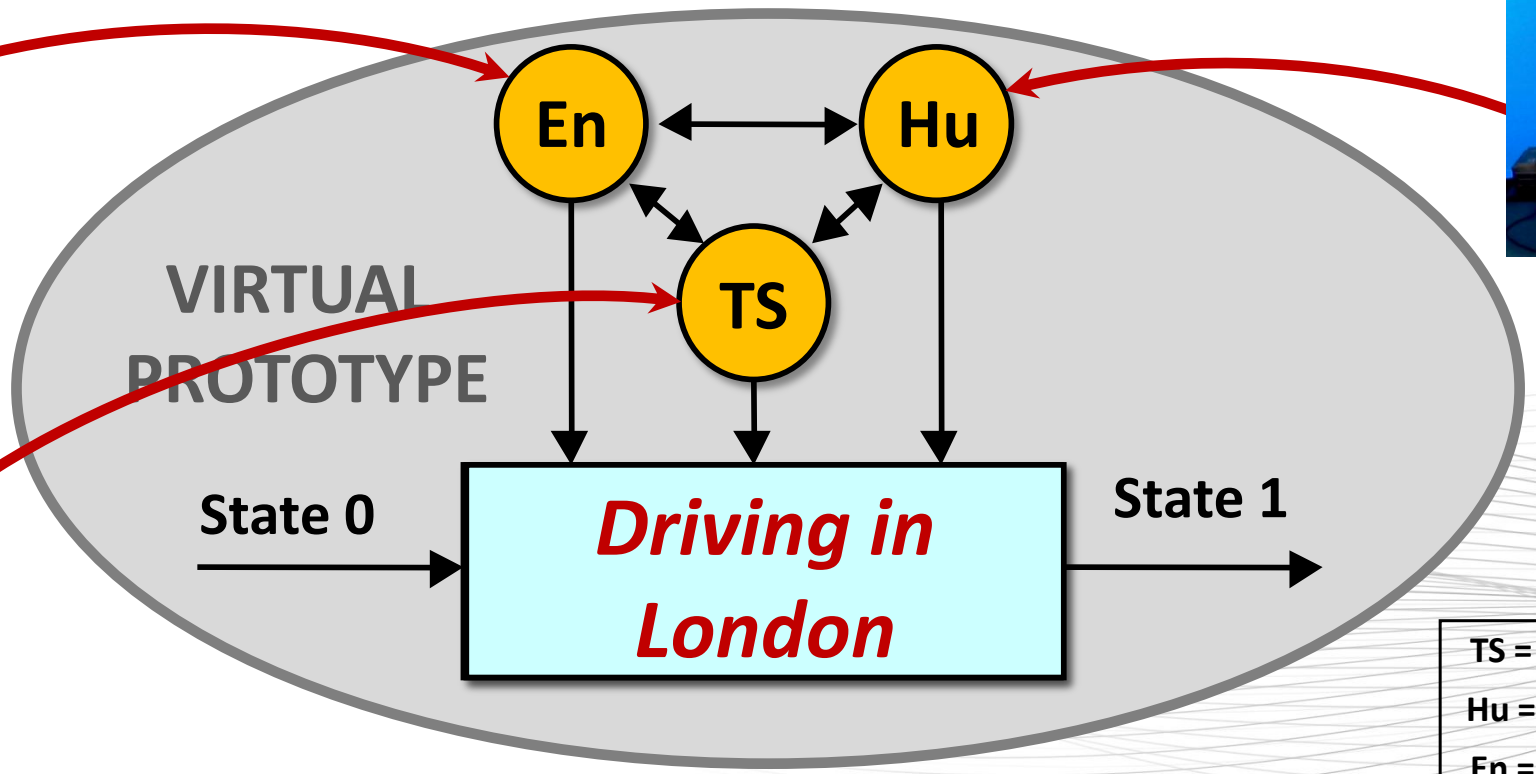
A product model embedded within a synthetic environment with human interaction is a VIRTUAL PROTOTYPE







TS = Technical System

Hu = Human System

En = Active Environment

Virtual Prototypes

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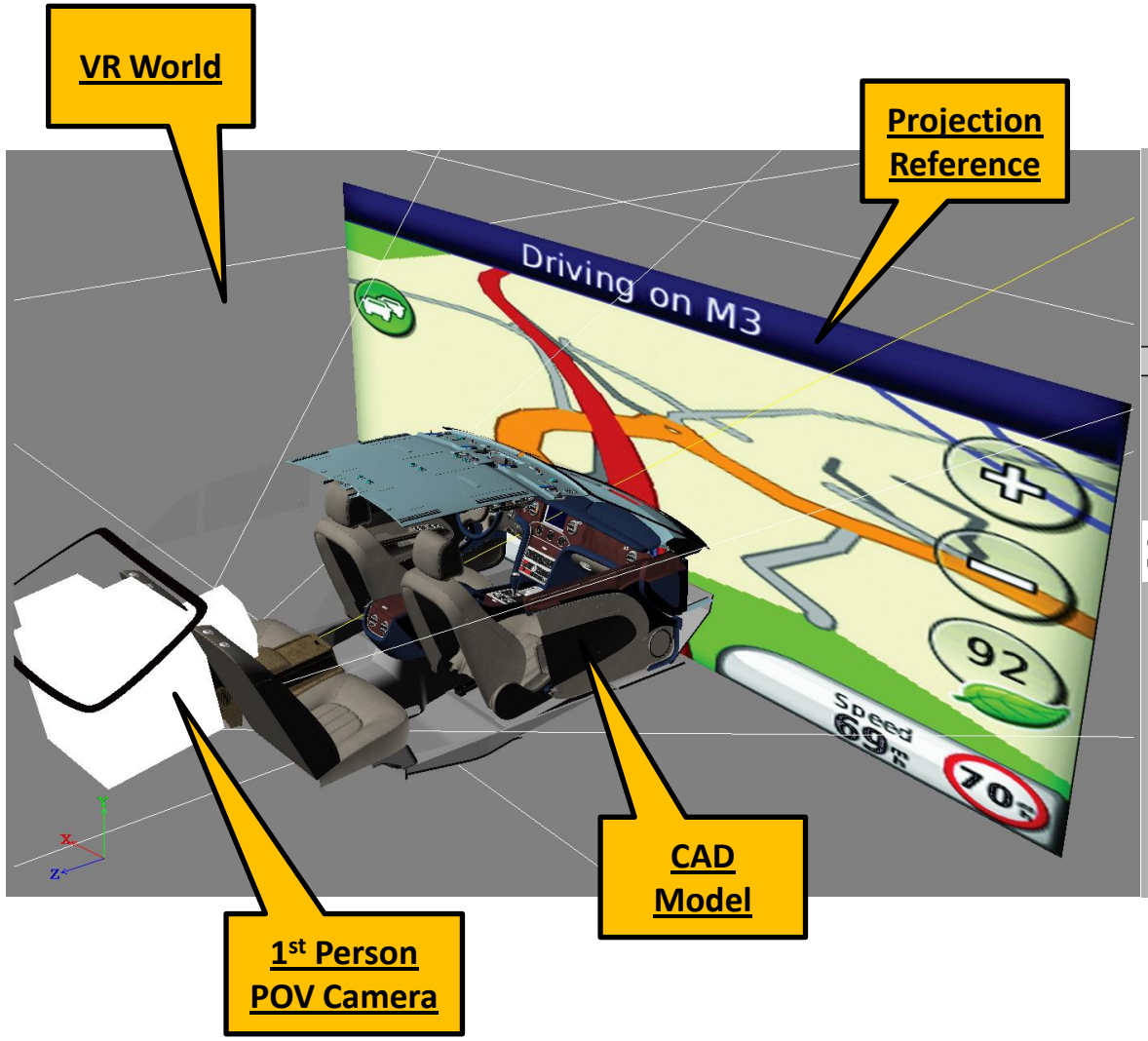

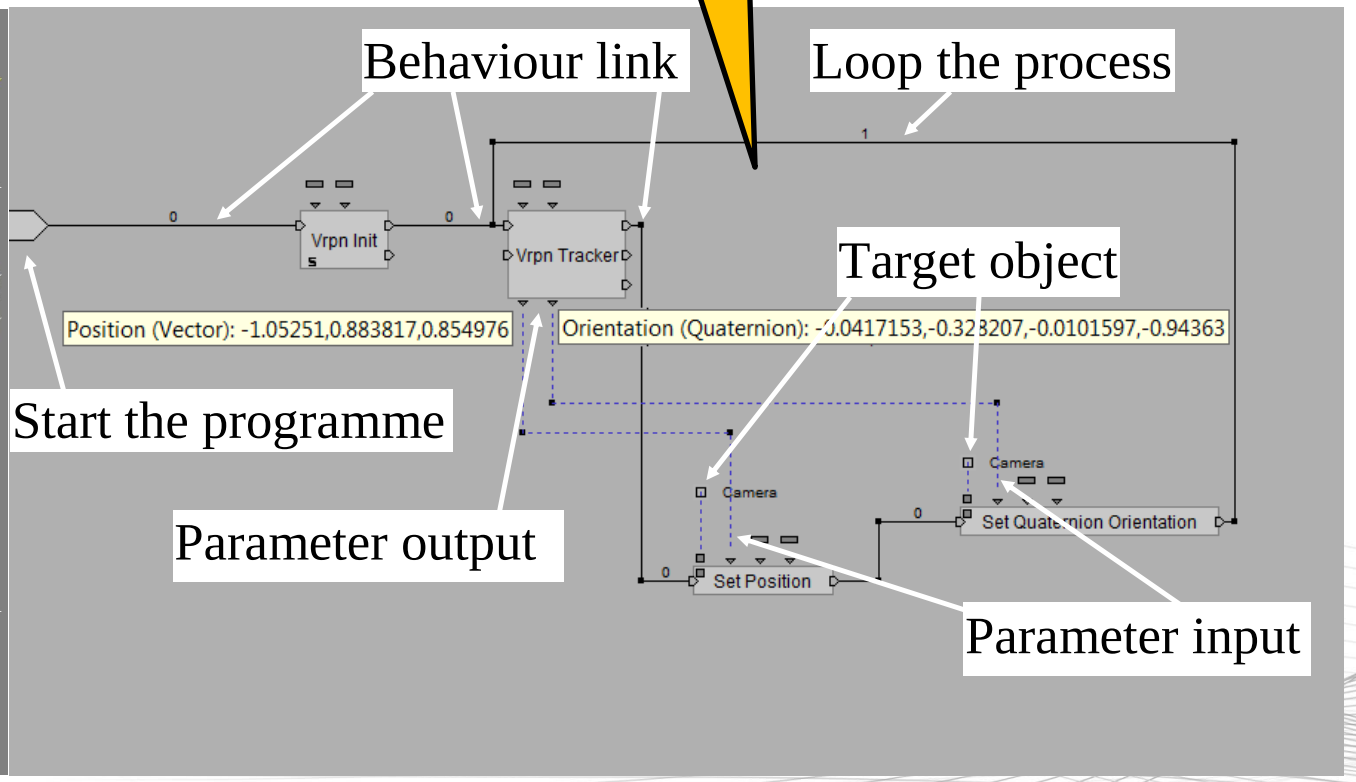

VR Development Toolkit - Virtools

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Will show the use of virtual prototypes in several scenarios

- Exterior A-surface audit - VEC
- Interior A-surface audit - VEC
- Interior illumination - OPTIS

All the VEC demonstrations require a person to interact with the virtual prototypes in real-time

Interaction is enhanced by immersion

Demonstration Projects

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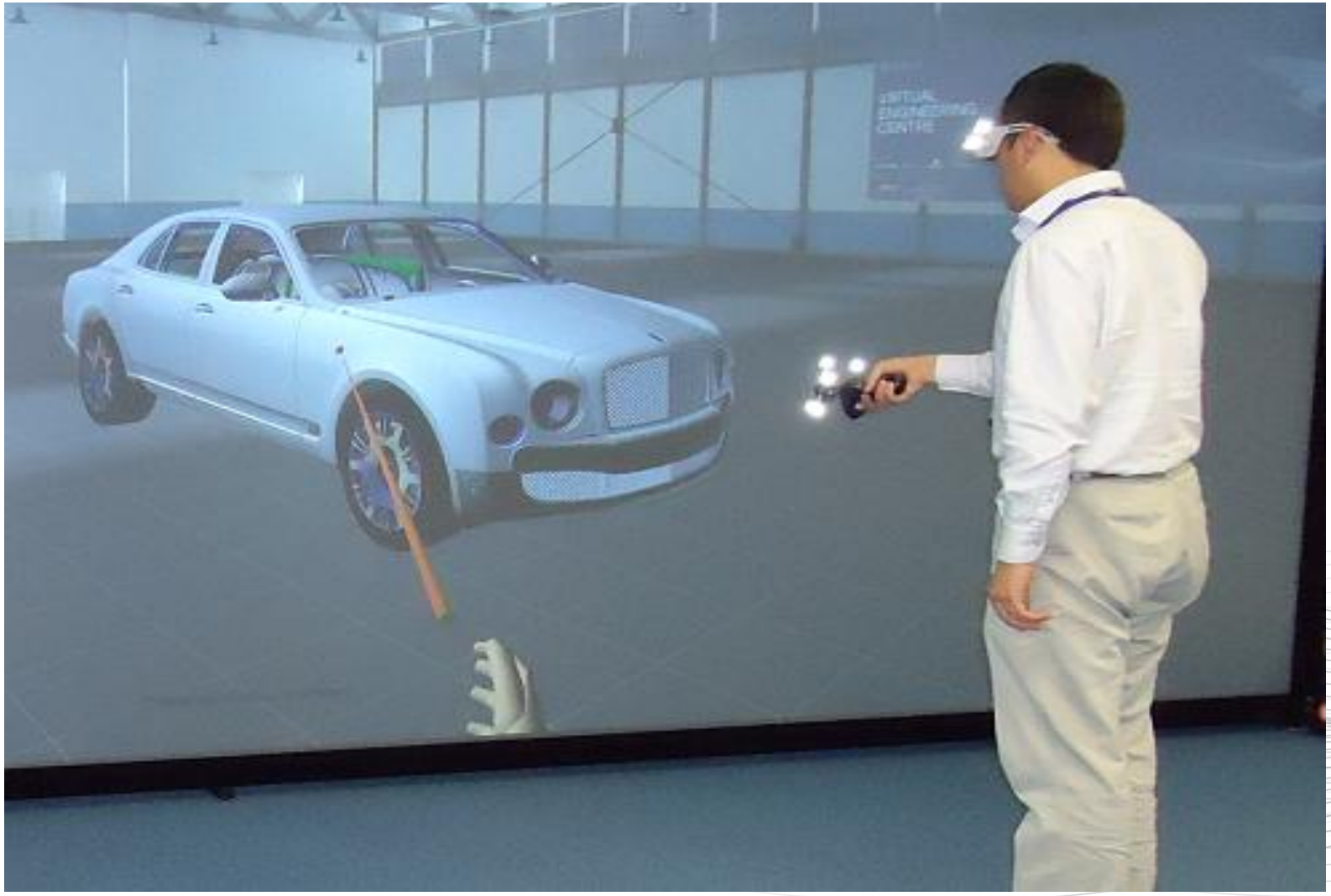

Exterior A-surface Audit

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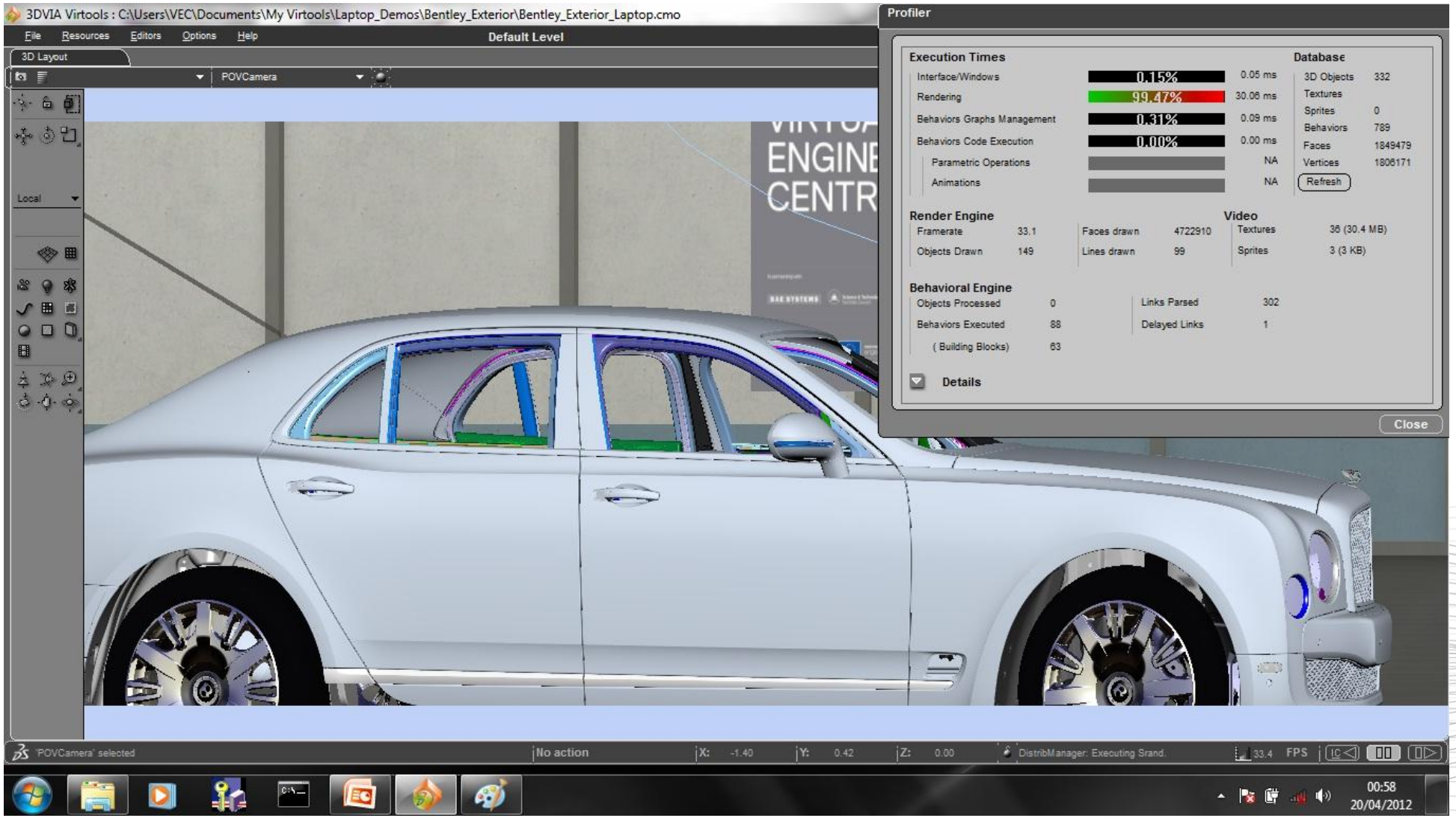

Faces Drawn
4,722,910

Frame Rate
33.1/sec

Exterior A-surface Audit

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OPTIS

Off-line Rendering of High Fidelity Image
CAD + Material Properties + Lighting Properties

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Exterior A-surface Audit

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Real-time Stereo Rendering + Tracked POV + 3DOF

Raw CAD

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Interior A-surface Audit

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Real-time Stereo Rendering + Tracked POV + 3DOF

CAD + Material Properties

Interior A-surface Audit

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Real-time **Optis Rendering** + Tracked POV + 3DOF
CAD + Material Properties + **Variable Lighting Levels**

Interior A-surface Audit

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Real-time Stereo Rendering + Tracked POV + **6DOF**
CAD + Material Properties + **HMD**

Interior A-surface Audit

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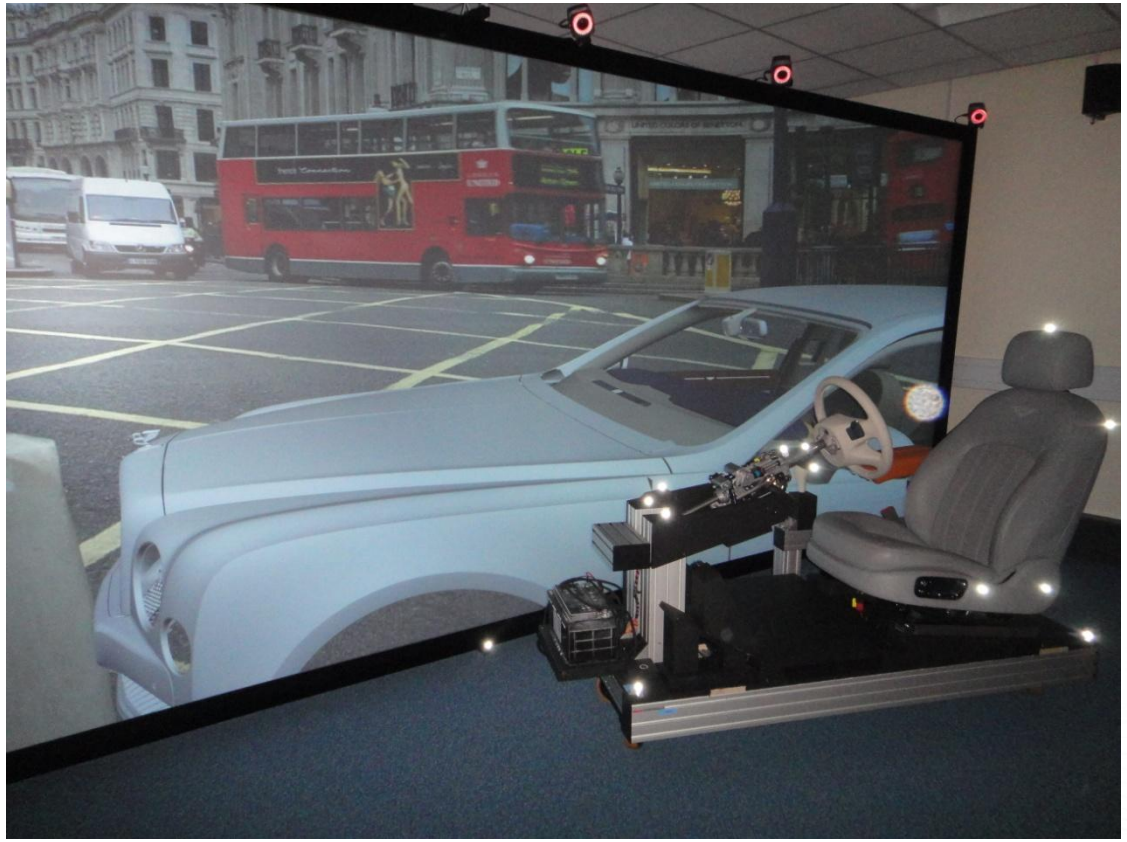
Real-time Stereo Rendering + Tracked POV + 3DOF
CAD + Material Properties + **Real World Integration**



Interior A-surface Audit

VIRTUAL ENGINEERING CENTRE

Real-time Stereo Rendering + Tracked POV + 3DOF
CAD + Material Properties + **Real World Integration**

Interior A-surface Audit

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Faces Drawn
1,449,564

Frame Rate
136.1/sec

Interior A-surface Audit

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CONCLUSIONS

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Attributes of VR system

- 1:1 scale visualisation
- True 1st Person perspective
- Interactive features
- Real-time response vs Fidelity of Rendering
- Integration of Real-World and VR-World (Augmented Reality)
- Data Capture

Functionality Demonstrated

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- **Hi-fidelity models require lengthy preparation**
- **Superfluous model data impedes the real-time experience**
- **Interaction requires intuitive and unobtrusive controls**
- **Immersion requires high refresh rates and accurate tracking**
- **Real-time hi-fidelity physics based simulations require HPC**

Observations

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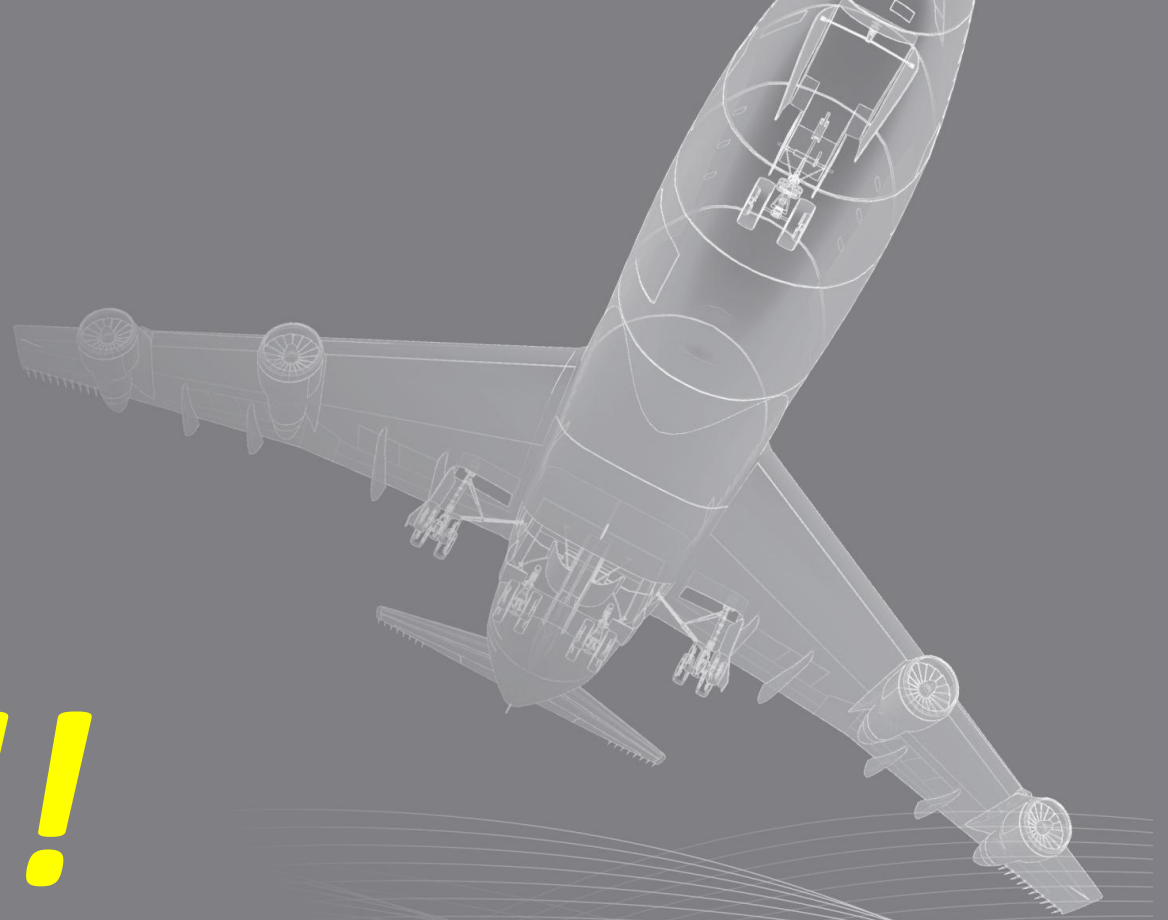

Thanks!!

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