VIRTUAL ENGINEERING CENTRE

Dr Antony Robotham - Executive Director
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Supported by:
Northwest
REGIONAL DEVELOPMENT AGENCY
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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.
Original VR Workgroup

LAN
100 Mbps

Computer Network
3 x DELL T5500 64-bit
1 x DELL T3500 32-bit
100 Mbps Ethernet connection
Various software applications

License Server
DELL T7800 64-bit
- DS Virtools
- PTC Division

CATIA V6 Server
DELL PowerEdge

“Virtual Touch” System
Haption Virtuose Haptic Device
6 x Degrees of Freedom
Force feedback
VRPN communication protocol

Projection System
NVIDIA Quadro 5800 Graphics
2 x WUXGA Active Stereo projectors
6.0m x 2.1m screen
3390 x 1200 resolution single image
3.6 million pixels in total

Head Mounted Display
NVIS nVisor SX111 HMD
NVIDIA Quadro 4800 Graphics
2 x 1280 x 1024 eye displays
102° Horizontal Field of View
Passive Stereo - 50° Binocular HFOV
Magnetic/Infrared Tracking

Tracking System
12 x Vicon Bonita Infrared Cameras
100 Mbps Ethernet connection
Vicon “Tracker” software
VRPN communication protocol

Magnetic/Infrared Tracking
Upgrades to VR Workgroup

LAN 1 Gbps

HPC Link

10 Gbps via Fibre Optic

Projection System Computer
- DELL T7500 64-bit computer
- 2 x NVIDIA Quadro 6000 Graphics
- 2 x Hex Core Processors (12 cores)
- 48 GB RAM
- 256 GB SSD
- 2 TB Disk Storage
- Windows 7 Pro 64-bit OS
- 10 Gbps Ethernet connection

Head Mounted Display
- 2 x NVIS nVisor ST50 HMD
- 1280 x 1024 “see-thru” displays
- 44° Horizontal Field of View
- Vicon Infrared Tracking

Virtual Hand
- 2 x CyberGloveIII MoCap gloves
- 22 sensors
- Wireless comms
- Vicon Infrared Tracking
Virtual Reality Technologies at VEC

Projection Screen
- 6.0m x 2.1m screen
- 3390 x 1200 resolution blended image
- 3.6 million pixels in total
- 10-bits per pixel
- 120 Hz refresh rate
- 4.3Gb/s data stream

Tracking System
- 12 x Vicon Bonita Infrared Cameras

1st Person POV with Head Tracking
- Shutter Glasses with Tracking Markers

Interaction
- Wireless Controller
Case Study with Bentley Motors
Design Development

Sketch  Sketch Development  Clay Models  Digital Design  Production
3D Digital Model of BIW
3D Digital Model – Surface Patches
3D Digital Model – Triangular Faces
3D Digital Model – Vertices
Priorities for Bentley Motors

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
- Virtual Reality technologies
- Optical behaviour

Bentley Motors
VEC
Optis

Common technology challenges include

- Immersion and auditor tracking
- Physics based real-time visualisation
- Realistic exterior environments
- Augmented physical reality
- Actual visibility of variation
VIRTUAL REALITY AT VEC
A product model embedded within a synthetic environment with human interaction is a **VIRTUAL PROTOTYPE**
VR Development Toolkit - Virtools

VR World

Projection Reference

Control Script

Behaviour link

Loop the process

Target object

Parameter output

Parameter input

1st Person POV Camera

CAD Model
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
Exterior A-surface Audit
Exterior A-surface Audit

Faces Drawn
4,722,910

Frame Rate
33.1/sec
Off-line Rendering of High Fidelity Image
CAD + Material Properties + Lighting Properties

Exterior A-surface Audit
Real-time Stereo Rendering + Tracked POV + 3DOF

Raw CAD

Interior A-surface Audit
Real-time Stereo Rendering + Tracked POV + 3DOF
CAD + Material Properties

Interior A-surface Audit
Real-time Optis Rendering + Tracked POV + 3DOF
CAD + Material Properties + Variable Lighting Levels

Interior A-surface Audit
Real-time Stereo Rendering + Tracked POV + 6DOF
CAD + Material Properties + HMD

Interior A-surface Audit
Interior A-surface Audit

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

Interior A-surface Audit
Interior A-surface Audit

Faces Drawn
1,449,564

Frame Rate
136.1/sec
CONCLUSIONS
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
Observations

- 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
Thanks!!