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Research Infrastructure**

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**D9.5  
Virtual Director Implementation and Commissioning  
*Final***

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## D9.5 Virtual Director Implementation and Commissioning

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## D9.5 Virtual Director Implementation and Commissioning

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## List of Acronyms and Abbreviations

ACF	Advanced Computing Facility
API	Application Programming Interface
CaSToRC	Computation-based Science and Technology Research Centre of the Cyl
CPU	Central Processing Unit
CUDA	Compute Unified Device Architecture (NVIDIA)
Cyl	The Cyprus Institute
CyNet	The Cyprus NREN
DEISA	Distributed European Infrastructure for Supercomputing Applications. EU project by leading national HPC centres.
EC	European Community
ESFRI	European Strategy Forum on Research Infrastructures; created roadmap for pan-European Research Infrastructure.
FZJ	Forschungszentrum Jülich (Germany)
HPC	High Performance Computing; Computing at a high performance level at any given time; often used synonym with Supercomputing
HPCC	HPC Challenge benchmark, <a href="http://icl.cs.utk.edu/hpcc/">http://icl.cs.utk.edu/hpcc/</a>
HPL	High Performance LINPACK
HWA	HardWare accelerator
IB	InfiniBand
IBA	IB Architecture
IBM	Formerly known as International Business Machines
IEEE	Institute of Electrical and Electronic Engineers
I/O	Input/Output
ISC	International Supercomputing Conference; European equivalent to the US based SC0x conference. Held annually in Germany.
JSC	Jülich Supercomputing Centre (FZJ, Germany)
LinkSCEEM	Linking Scientific Computing in Europe and the Eastern Mediterranean
LinkSCEEM-2	Linking Scientific Computing in Europe and the Eastern Mediterranean – Phase 2
NDA	Non-Disclosure Agreement. Typically signed between vendors and customers working together on products prior to their general availability or announcement.
NoC	Network-on-a-Chip
NFS	Network File System
NIC	Network Interface Controller
OpenCL	Open Computing Language
OpenGL	Open Graphic Library
Open MP	Open Multi-Processing
OS	Operating System
pNFS	Parallel Network File System
POSIX	Portable OS Interface for Unix
PRACE	Partnership for Advanced Computing in Europe; Project Acronym
PRACE-1P	Partnership for Advanced Computing in Europe – First Implementation Phase
PRACE	Partnership for Advanced Computing in Europe – Research Infrastructure
SDK	Software Development Kit
SSD	Solid State Disk or Drive
TB	Tera (= 240 ~ 1012) Bytes (= 8 bits), also TByte
TFlop/s	Tera (= 1012) Floating-point operations (usually in 64-bit, i.e. DP) per second, also TF/s
UNICORE	Uniform Interface to Computing Resources. Software for seamless access to distributed resources.
VO	Virtual Organization
VRC	Virtual Research Community

## D9.5 Virtual Director Implementation and Commissioning

### Executive Summary

The report is describing briefly the work done to achieve the Deliverable D9.5 with title “Virtual Director Implementation and Commissioning”. In particular in the next sections will be described the hardware and software used, the general development and implementation, the training activities, the remote virtual collaboration and the documentation and training. Together with this report the software developed are part of the deliverable D9.5.

### 1 Equipment and Software

Equipment: A 3D back-projection system constituted by 2 JVC RS-25 full HD resolution projectors, 3D rack and circular polarizing filters, large projection screen, Linux workstation and SpacePilot™ 6-degree-of-freedom input device. Software: Virtual Director™, open-sourced PartiView and NCSA vMaya renderer.

### 2 General Development and Implementation

Beginning in November 2011, NCSA and CyI staff discussed file format specifications, user requirements, and workflow preferences through periodic telephone and video Skype sessions. In addition, Ropertos Georgiou visited NCSA in December 2011. Staff identified modifications to enable the visualization of Digital Cultural Heritage (DCH) datasets using software modifications as described below.

Virtual Director™ was adapted and enabled to work with open-sourced PartiView for use with DCH point clouds and NCSA vMaya renderer for use with Digital Cultural Heritage DCH geometric datasets and mesh models. The SpacePilot™ 6-degree-of-freedom (6 DOF) control device has been configured as part of the virtual environment interface focused on DCH applications. This development includes the ability for users to load DCH objects into the Virtual Director™ environment and to interactively display, navigate, and record/store camera paths within a configured DCH scene. The camera movement enables a user to ‘zoom’ close to objects within a scene and to choreograph/store camera locations and scene files from the interactive sessions. This capability will enable users to scientifically explore DCH data and design virtual tours of the scene. Cyprus has provided all of the cultural heritage datasets and models to allow this collaborative work. CyI staff have discussed with NCSA the required modifications to be implemented and been active in reviewing changes.

In particular, the tasks that have been performed are briefly described:

- The real time presentation pipeline has been extended to read 3D models that are stored in formats that are commonly used for cultural heritage data, or already in use at Cyprus (such formats include PLY, COLLADA, and Blender’s file format). This development makes it less incumbent upon users at Cyprus to reformat their data for the Virtual Director™ environment pipeline. Virtual Director and vMaya binaries and updates have been provided and can be made available to University of Illinois project collaboration partners.
- Displaying Cultural Heritage datasets in real time: many DCH datasets are large files, acquired by scanning devices that record spatial information at very high resolution (e.g., laser scanning of a archaeological object), or represent spatially large areas (e.g., a

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town or city). The performance of the vMaya rendering software was improved to enable the efficient display and navigation of large DCH datasets.

- DCH users specified new DCH data workflows and NCSA identified modifications from within Virtual Director™, PartiView, and vMaya. NCSA delivered a template scene file that enables flight, navigation (virtually moving user viewpoint around objects and within the virtual DCH scene), and hiding/showing objects within a scene. CyI staff provided DCH datasets, and NCSA developed software and macros to automate some functionality.
- Virtual Director™ was configured to make use of the new Cyprus SpacePilot™. This general-purpose device was adapted for the specific purpose at hand. A customized and tested set of commands were mapped to the SpacePilot™. Figure 6 shows how the SpacePilot™ device's buttons are currently mapped based upon iterations of testing and training with CyI staff. Functionality assigned to perform software operations such as flying, creating camera paths, and storing paths are shown in Figure 6. This new version of SpacePilot™ mapping was tested and delivered to Cyprus with documentation. Training on this SpacePilot™ functionality is described below.

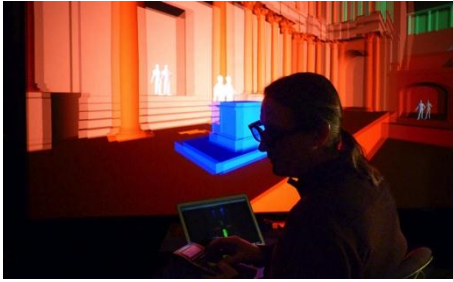
### **3 Description of Training Activities**

Ropertos Georgiou spent a couple of weeks (December 2011) at NCSA and was trained in using Virtual Director™ software and the SpacePilot™ 6-DOF input device. During this time he provided DCH end-user feedback and discussed possible modifications of the software environment and interface design. Since December, NCSA provided on-going training during the five remote collaboration instances. As new features were added, CyI staff were introduced to these features and provided with initial documentation. During these remote collaborative instances of initial training through to February 23, 2012, CyI users and NCSA developers refined workflow macros to help streamline training and use of software.

### **4 Description of the Remote Virtual Collaboration Instances**

Four collaborative instances of Virtual Director™ between two remote sites using Digital Cultural Heritage (DCH) data took place. This remote collaboration enables users at two remote sites (Cyprus and NCSA) to remotely and interactively collaborate within a shared DCH object/scene. Each user can virtually navigate through DCH data, retain their individual viewpoint during flight and positioning objects using SpacePilot™. Users are enabled to load and position DCH objects while sharing a common virtual scene. During the interactive remote session, users retain their independent Avatar viewpoints, observing the location of other Avatars in the virtual scene. DCH object positions can be moved during the interactive session. Interactive positioning of DCH objects using the SpacePilot™ 6-DOF input device was enabled as well as level-of-detail 'zooming' into the DCH objects (the capability for the user to fly very close to the object for detailed viewing). See Figure 1 and Figure 2.

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**Figure 1: Bob at NCSA collaborating with Alessandro and Ropertos from Cyprus Institute in remote collaborative training session.**



**Figure 2: Interactive training collaboration with the DCH "Paphos Theater" reconstruction model created by Ropertos Georgiou of the Cyprus Institute STARC. Ropertos is flying (see white smiling face avatar) and seeing from his independent point of view.**

### 5 Specific Documentation to Workflow and Interface for DCH Users

- Adapted Virtual Director™ to work well with SpacePilot™ 3-D controller by modifying and calibrating device drivers and adapting controller to Virtual Director™ software functions. NCSA tested locally and synchronized with CyI SpacePilot™ controller testing between CyI and NCSA SpacePilot™ to debug and calibrate.
- NCSA worked with CyI staff to refine networked collaboration capabilities including: camera path creation/sharing, recording and creating movies from an interactive session, remote avatar display and netcasting of Virtual Director™ commands.
- Set up direct visualization path for laser-scanned PLY models (e.g. mosaics) as colored point clouds, using NCSA's PartiView within Virtual Director. This required modification of software for these formats.
- Created interactive rendering of DCH scenes in stereo with NCSA's vMaya with a variety of DCH datasets provided by CyI including mesh geometry from LIDAR data and geometric reconstruction models.
- Added new software capability to allow interactive modification of DCH datasets in real time during an remote session. This capability includes placement of three-dimensional objects with a six-degree-of-freedom input device, and interactive modification of scene lighting conditions. An object in the scene can be selected by command line using the filename.
- Lighting: a vMaya light source was added to scene files (see Figure 3). Minor's light attached to camera to move with viewpoint through flight. Ability to adjust intensity and color of light source. In some files, have two light sources.



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- Provided color-coded visual feedback on screen of Virtual Director™ operation per discussion with CyI staff.
- Enabled capability to display textures on object models using COLLADA format (see Figure 3).

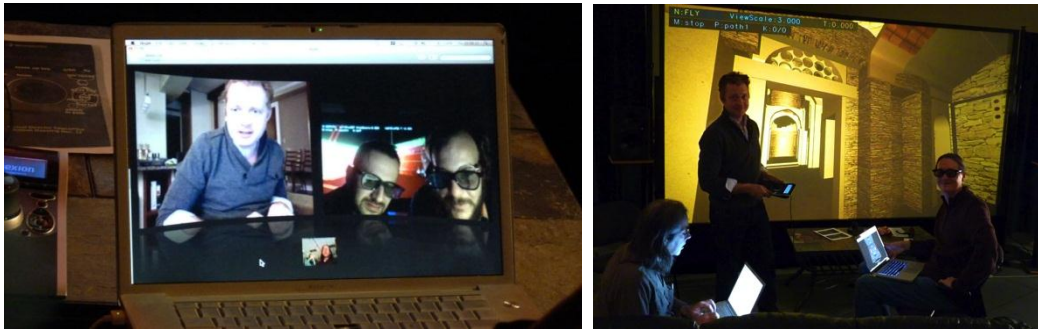


Figure 3: Ropertos, Alessandro, Alex, Stuart and Bob using Skype for audio communication during a remote collaboration. Virtual Director™ with vMaya showing DCH model's provided by Cyprus Institute.

### Additional Software development:

#### **Developed interactive Graphical User Interface (GUI) html web interface for collaboratively moving objects within a scene**

NCSA staff attempted to simplify user interface as a test for CyI staff to explore better methods for moving DCH objects within a scene. This model was presented on Feb 23, 2012 and discussed as a potential. This GUI was not required for implementation, but it was explored as an option for better software control.

Developed and demonstrated a new GUI Feb. 23, 2012 (see Figure 5 and Figure 6)

- Created server side of web-based control interface (for moving objects, etc.)
- Created image maps & rollover images in Photoshop out of the base images provided by Bob
- Using Dreamweaver, created an interactive web application using the rollover images created in Photoshop
  - Created Cascading Style Sheets (CSS) for the various page elements
  - Created a DIV structure for the interactive images
  - Added rollover functionality with sound effects when activated
  - Created form components to provide text command input and display
- Modified html documents to call correct scripts and debug interface

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Figure 4: Customized SpacePilot™ button mapping for Virtual Director commands and direct input for a variety of functions including flight through data, recording and editing camera paths through data.



Figure 5: NCSA created and tested a web graphical user interface prototype for nudging selected DCH objects in the stereoscopic virtual scene and for also sending these commands to session collaborators. Figure 6: There are settings for modifying the amount of translation and rotation for each click or touch on a tablet and a history of commands being sent.

### Plans for near future:

- Debug SpacePilot™ toggle between camera and object mode.
- Print out of log files for user feedback.
- Explore software modification for 'relative' motion of objects.
- Synchronize movement of objects visually among remote users.

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- Provide up-to-date documentation and user training (see below).

### **6 Documentation and Training**

- Currently compiling additional documentation and training material that includes:
  1. Directory structures
  2. Macros for user workflow (e.g. selecting objects, changing lights, saving delta of object movement to log file)
  3. Refining configuration files for users
- Provided on-going training during Virtual Director™ remote collaborative sessions. Included as part of this training, instructed CyI staff on file conversion for stereo movies for the CyI 3-D display setup.