EPFL

Experimental Museology +

Transforming visualisation for culture, heritage & art

2019

Experimental Museology +

The vision

eM+ is a new transdisciplinary initiative at the intersection of immersive visualisation technologies, visual analytics, aesthetics and cultural (big) data. eM+ engages in research from scientific, artistic and humanistic perspectives and promotes post-cinematic multisensory engagement using experimental platforms. The Lab features eight unique visualisation systems combined with powerful sonic architectures that are benchmarks in the realms of virtual, augmented, mixed realities. These cluster-based 3D systems have been deployed in major exhibitions and installations throughout the world.

The Lab works on cultural and archival materials from many countries including Asia, Australasia and Europe. eM+ also creates high fidelity data in-the-field through a range of state-of-the-art techniques (such as motion capture, ambisonics, photogrammetry, linear and laser scanning, panoramic video and stereographic panoramas). Our work transforms this burgeoning world of cultural data into advanced ultra-high resolution visualisation through advanced computer science (i.e. interactive graphics, machine vision, deep learning) and human-computer interaction (HCI).

eM+ builds on 20 years of research and development at pioneering laboratories iCinema Research Centre for Cinematic Research (iCinema) Sydney, The Applied Laboratory for Interactive Visualisation and Embodiment (ALiVE) Hong Kong, and the Expanded Perception and Interaction (EPICentre) Sydney.

Opposite *Pure Land AR*, 2016

eM+

1.0

Research themes

Experimental museography

Creating the experimental frameworks of 'embodied museography' and 'engagement science' for galleries, libraries, archives and museums (GLAMs) using virtual, augmented, mixed reality technologies combined with powerful sonic architectures, this research engages in the representation of scientific and artistic complexities, promoting multisensory engagement and expanding experience in a post-cinematic world. Experimental museography advances theoretical frameworks of new museology re-defining the boundaries of public/ museological space. Themes also include design-driven evaluation methodologies for examining qualitative experiences.

Image science, visual computing & data curation

The application of new documentation technologies to objects, places and people, pioneering solutions for the acquisition of high resolution and high fidelity data. This research theme includes data curation models (ontologies, open linked data, annotation), data fusion, data science and image science.

Interactive archives & emergent narratives

Speculative, applied and theoretical research focused on new modes of knowledge creation from digital cultural archives through immersive visualisation and interactive narrative. Themes include: visual analytics, computer vision, deep mapping, data-aesthetics and pan-aesthetics, audification, data and interaction design, networking, open linked data, crowd-sourcing and participatory media.

Embodied knowledge

Research into the analysis of features based on the form and style of physical movement in 3D space. Creating archival, analytic and representational frameworks for intangible heritage and embodied knowledge systems (from ritual and tradition through to performance and sport). Themes include: automated annotation, motion-over-time analysis, computer vision and preservation protocols (including metadata).

Immersive visualisation

Applied design frameworks for interactive omnidirectional and omnispatial data visualisation for small and big data from the arts and sciences Themes include: VR, AR, MR, data sonification, networking (e.g. 'internet of big machines'), gamification and advanced computer graphics.

Immersive pedagogy

Integrating immersive modes of learning into higher education is a fundamental strategy for next-generation learners. Interactive systems have been shown to facilitate reflection, interrogation and interaction with hypothetical simulated worlds, enabling students to develop high-level skills in cognitive association, creative thinking, problem-solving and innovation. Research in this theme includes the structuring of immersive learning paradigms involving co-evolving patterns of discovery.

2.0

Visualisation systems

2.1 Panorama+

10 m diameter x 4.8 m high
Effective resolution: 18000 x 2160 pixels
Audio: 16 + 1 channels

Description

The panorama screen is based on UNSW iCinema Research Centre's landmark 360-degree stereoscopic, interactive visualisation environment – AVIE (Advanced Visualisation and Interaction Environment). Its standard configuration is a cylindrical projection screen, four metres high and ten metres in diameter, a twelve channel stereoscopic projection system, and a 12.2 surround sound audio system. AVIE's immersive mixed reality capability articulates an embodied interactive relationship between viewers and the surrounding projected information spaces. The EPFL panorama screen is designed to quadruple the resolution to an effective resolution of 22000 pixels by 1750 pixels in 3D.

Opposite top *Pacifying the South China Sea Pirates,* 2013
Opposite bottom *mARChive,* 2015


1955
1959
1962
1966
1969
1973
1976

Top *T'visionarium*, 2009
Opposite *Metabolic Network Visualisation,* 2016

Exhibition history

The first AVIE was launched at UNSW in September 2006. Four subsequent systems were deployed to NSW Mines Rescue Stations in 2007-08 for Virtual Reality training in the coal mining industry. Other subsequent systems have been installed at Melbourne Museum, UNSW School of Mining Engineering, University of Technology Sydney, ZKM Germany, HIVE Norway, two at City University Hong Kong. and one each in Shenyang, Chengdu and Shanghai. Two additional touring AVIE's have been installed at Smithsonian Institute Washington, SFU Vancouver, as well as in Rome, Spain, Amsterdam, France and Hong Kong.

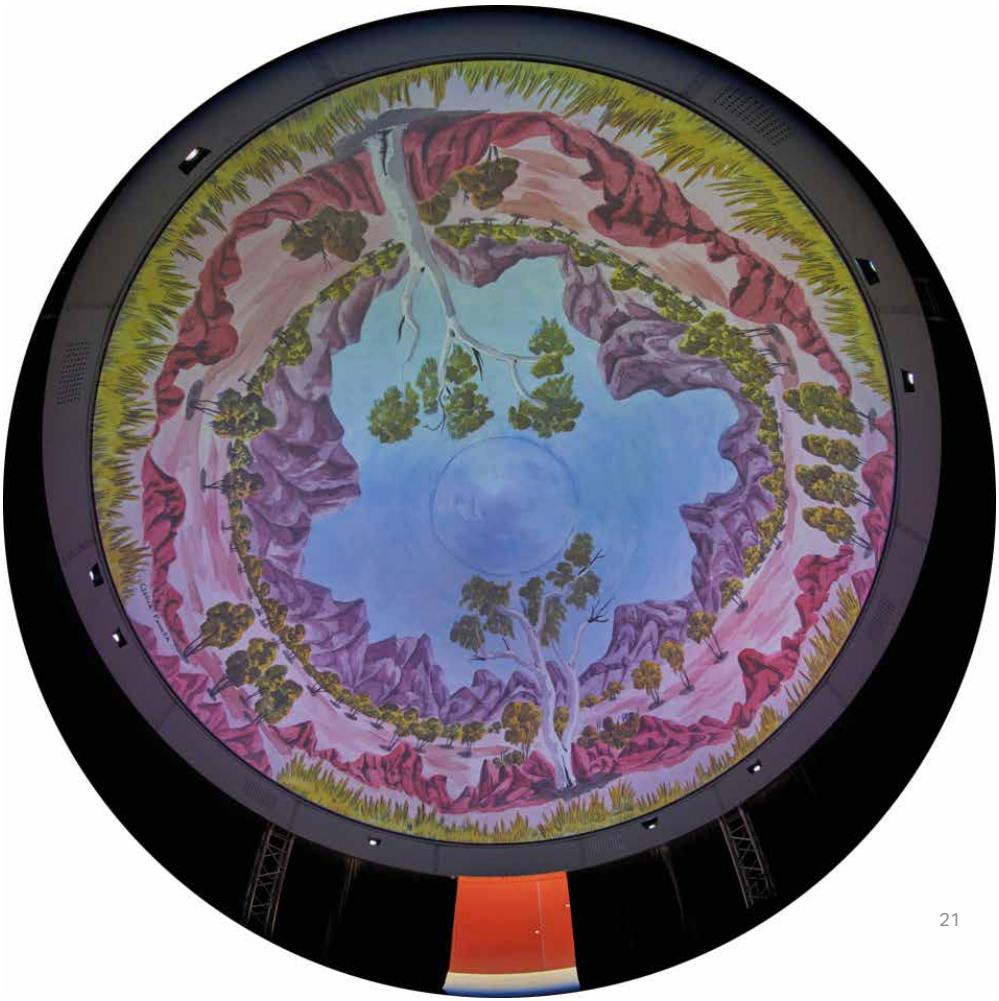
2.2 Cupola

45 m diameter x 6 m high
Effective resolution: 4096 x 4096
7000 pixels at spring line
Audio: 5.1

Opposite *Looking up Country!* 2016
Bottom *Travelling Kungkarangkalpa*, 2017

Description

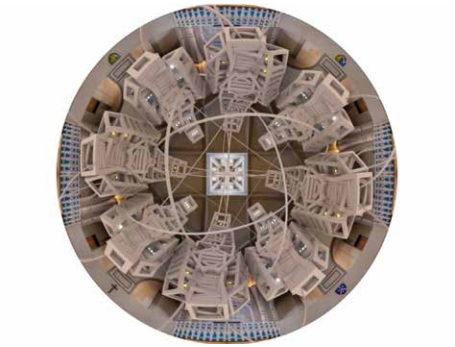
The cupola is a two-projector negative pressure system at 4k, with 5.1 surround sound that can also be used for stereo content. It generally operates horizontally, although it can be tilted to 45 or even 90 degrees. The 4k projector solution uses a cove projection configuration.

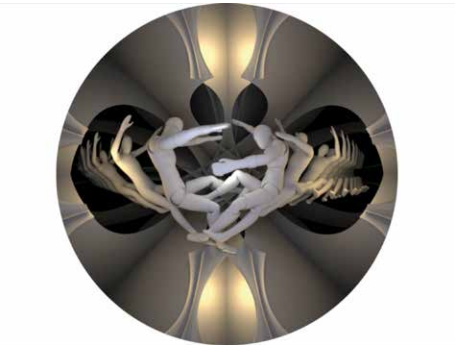


Exhibition history

Aesthetic formulations embodied in previous works by Sarah Kenderdine and Jeffrey Shaw provided the conception for this system, including *Heavens Gate* (1986) and *Cupola* (2004). DomeLab was conceived and designed by Kenderdine for UNSW in 2015 on behalf of eleven organisations, and is configured to tour nationally and internationally. DomeLab was launched at UNSW Michael Crouch Innovation Centre in 2015. It has since been exhibited in 2015 at *Look Up Mumbai*, showcasing the stunning heterogeneous dome architecture of Mumbai, this display attracted over 2000 visitors per day.

Other exhibitions include, *Inside the Ethereal Eye* at the 2016 Melbourne Festival, and miscellaneous installations at UNSW Art & Design EPICentre (2016-19). In 2017, DomeLab was included in the National Museum of Australia's *Seven Sisters Songlines* exhibition, featuring two works for the dome, of which *Travelling Kungkarangkalpa* was honoured with the award for most outstanding exhibition of the year at the 2018 Museums and Galleries National Awards ceremony.



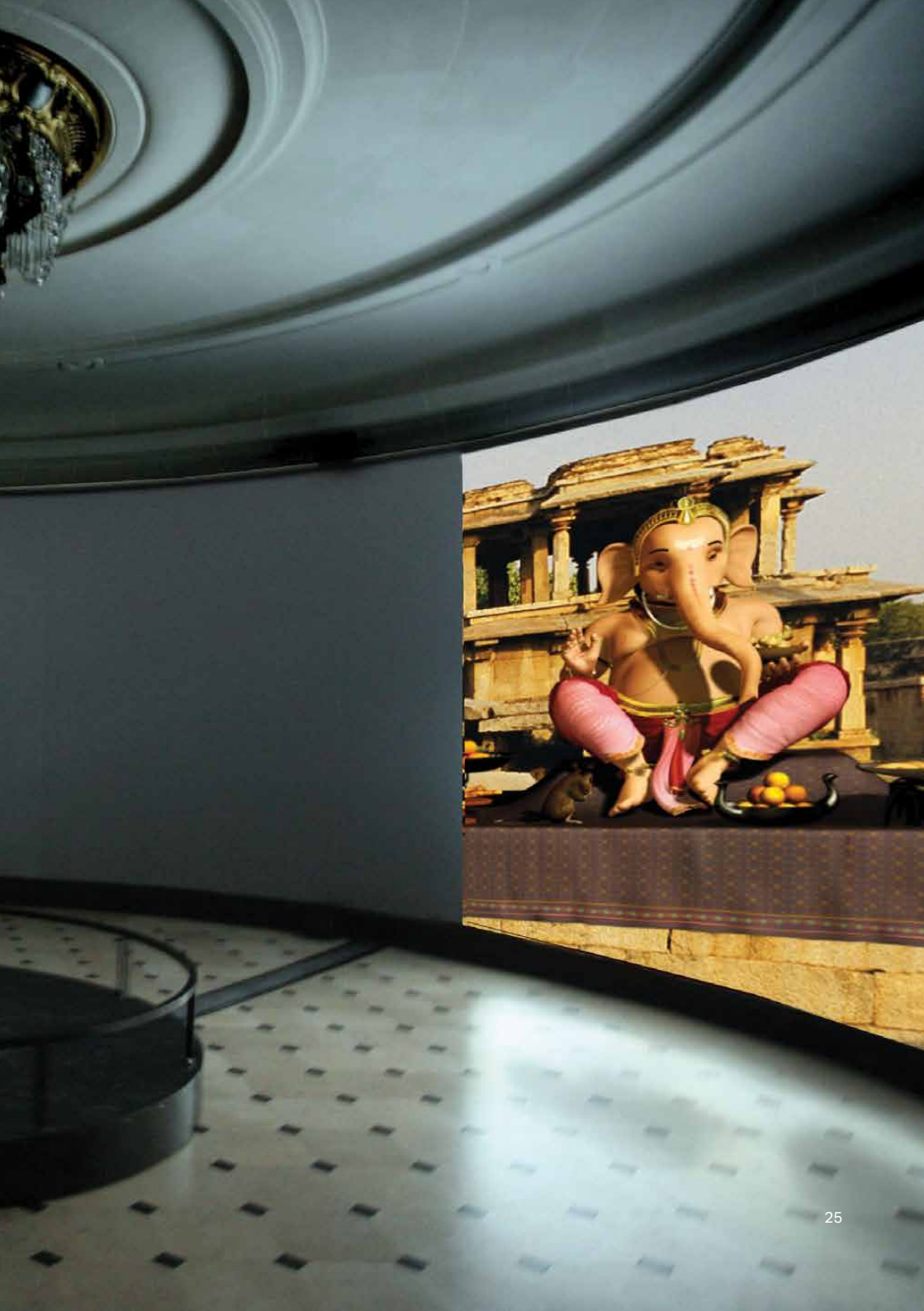


Right, top to bottom *Inside the Ethereal Eye*, 2016
Opposite *Look Up Mumbai*, 2015

2.3

Place

9 m diameter x 3.5 m high
Resolution: 4000 x 1750 pixels
(rotating in 360 degrees)
Audio: 8 channels



Description

PLACE has a motorised platform that allows viewers to rotate a projected image within a circular screen while exploring a virtual 3D environment. Two projectors mounted on this platform place a stereoscopic image onto one portion of the screen, which as it rotates reveals the complete 360-degree scene. The user interface on the platform allows viewers to control their forward, backward and rotational movements in the virtual scene, as well as the rotation of the platform and of the projected image. The system enables kinesthetic navigation through virtual worlds, and is especially effective for representing cultural landscapes.

Exhibition history

The earliest version of the PLACE platform was developed in 1995, which featured regularly in international exhibitions up until 1998 as *PLACE: A Users Manual* by Jeffrey Shaw. In 2006 *PLACE-Hampi* by Kenderdine and Shaw was exhibited at the Lille Rotonde de l'Opera for Lille3000/Bombaysers de Lille, France; then in 2007–08 at i.Future Festival at Singapore Science Centre, Singapore; the PanoramaFestival, ZKM, Karlsruhe, Germany and *From Spark to Pixel. Art + New Media* at Martin-Gropius-Bau, Berlin, Germany. In 2008, the work travelled to the eArts Festival: *eLandscapes*, Shanghai Science and Technology Museum, China, and was installed in 2008-10 as *Ancient Hampi* at the Melbourne Immigration Museum, Australia, and in 2010 it featured in the ALiVE Inaugural Exhibition at Hong Kong Science Park, China. *PLACE-Hampi* then toured in 2014 to the Chronus Art Center in Shanghai, China for the *Jeffrey Shaw and Hu Jieming Twofold Exhibition*, and in 2015 as part of *Hidden Pasts, Digital Futures: A Festival of Immersive Arts* at Simon Fraser University in Vancouver, Canada. Another iteration, *PLACE-Turkey* was created for *Made-Isik* in 2010 at Borusan Music House, Istanbul, Turkey, where it remains in their collection. Since 2012, *PLACE-Hampi* has been permanently installed at Kaladham, Vidyanagara Museum, Karnataka, India.

Opposite top *PLACE-Turkey,* 2010
Opposite bottom *PLACE-Hampi*, 2006

2.4 Re-Actor

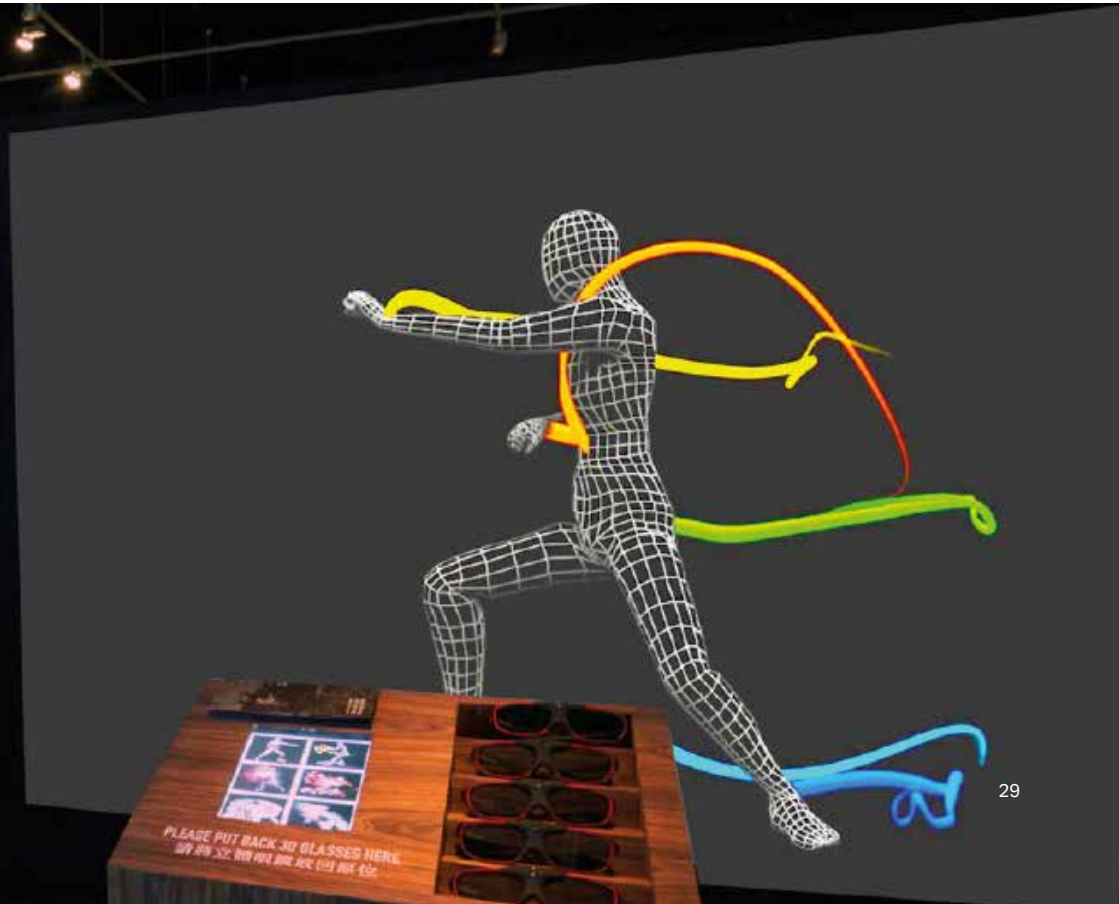
5 m diameter hexagon
Resolution: 1920 x 1200 pixels per screen (x6)
Audio: 12 channels

Bottom *Kung Fu Visualisation*, 2018

Description

Re-Actor originates from *The Virtual Room,* first developed at Museum Victoria by VROOM Inc. It is a hexagonal container with six walls made of active stereoscopic back projection screens. Inside the walls are twelve projectors, two for each screen in passive stereo mode. Viewers standing outside the hexagon can move around to see inside virtual 3D scenes from six distinct points of view. These virtual scenes can either be computer generated, or real world recordings made with six stereo video cameras. Various interaction and tracking devices can be added to this system.

Re-Actor (2008) was conceived and produced by Sarah Kenderdine and Jeffrey Shaw. Engineered by Huib Nelissen. Developed with the support of Museum Victoria, the UNSW iCinema Research Centre and EPIDEMIC Paris.



Exhibition history

The Virtual Room was installed at Melbourne Museum between 2003-2010 and included in 15 exhibitions at the Museum in addition to touring through Japan and Australia. Re-Actor premiered in 2012 at *Un Volcan Numérique*, Le Volcan at Le Havre, France, and has since exhibited in France, Germany, China, Canada and Hong Kong. A number of works have been commissioned for Re-Actor including: *UNMAKEABLELOVE* (2008) by Sarah Kenderdine and Jeffrey Shaw; *Double District* (2008) by Saburo Teshigawara with Kenderdine and Shaw; and *Fragmentation* (2011), an adaptation of three scenes excerpted from the show *LIPSYNCH,* directed by Robert Lepage with Kenderdine and Shaw. *The Kung Fu Visualisation* has toured widely in Re-Actor, including *300 Years of Hakka Kung Fu*, Hong Kong Heritage Museum, China (2016); *Kung Fu Motion*, Melbourne Immigration Museum, Australia (2017); *Kung Fu Motion,* ArtLab, EPFL, Lausanne, Switzerland (2018).

Opposite top *Kung Fu Visualisation*, 2018
Opposite bottom *UNMAKEABLELOVE*, 2008
Below *The Virtual Room*, 2003

2.5 0.5 Cave

5 m wide x 4 m deep x 5 m high
Resolution: 2560 x 1600 pixels per screen (x2)
Audio: 5.1

Description

0.5 CAVE is a structural modification of the original CAVE. Instead of projecting onto three walls and the floor, this new version projects on a single wall and the floor, yet in a much wider aspect ratio than the original work. One rationale for this modification was the need to create a simplified touring model of this installation. It also offers a major benefit in its the open-viewing configuration for a much larger public to engage with the work. The system allows for stereo projection across the wall and floor, making it an ideal immersive space for a range of content, including point-cloud data, as illustrated opposite.

Exhibition history

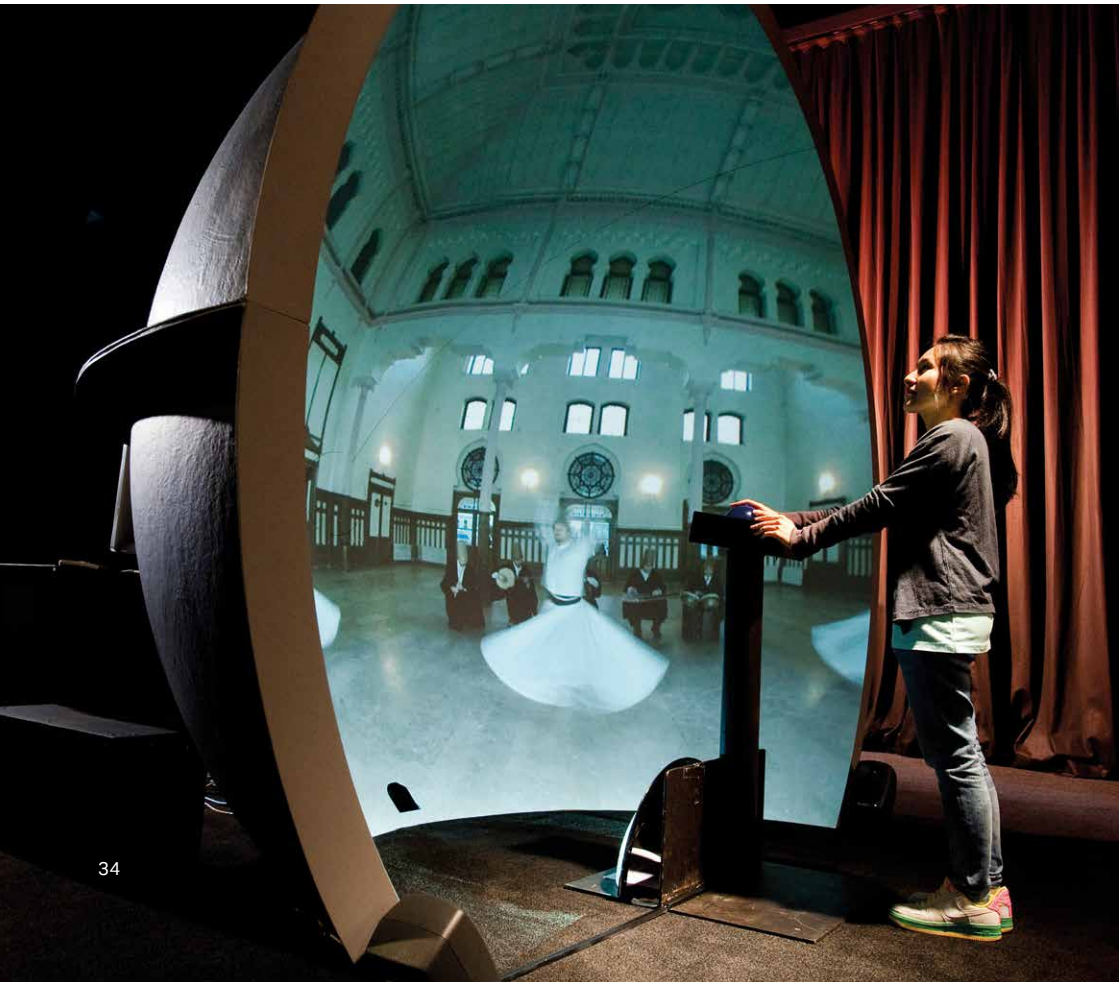
Developed at the Applied Laboratory for Interactive Visualization and Embodiment, CityU of Hong Kong and upgraded at eM+ in 2019, 0.5CAVE was created to display *reconFIGURING the CAVE* in a structural modification of the original 1997 Tokyo installation of this work.

Opposite *reconFIGURING the CAVE*, 2001

2.6 iDome

3 m diameter fibreglass hemisphere
Resolution: 2500 x 1800 pixels and 4000 x 4000 pixels
Audio: 5.1

Opposite *iJiao,* 2011
Bottom *PLACE-Turkey*, 2010



Description

iDome is a novel hemispherical projection system that provides a fully immersive visualisation experience for a small group of viewers. First developed at the UNSW iCinema Research Centre, Sydney, its standard configuration entails a single projector and a spherical mirror that reflects the image onto a vertically standing 3-metre diameter dome. The resulting immersive three-dimensional viewing experience is well suited for the interactive visualisation of digital datasets, virtual worlds, spherical movies and panoramic photographs.

Exhibition history

iDomes have been supplied for numerous exhibitions and projects, including: Imperial College, London, UK; Nanyang Technological University, Singapore; City University Hong Kong, China. In Australia for the Powerhouse Museum, Back of Bourke Exhibition Centre, Bourke, NSW, University of NSW (two sites), NSW Mines Rescue Station (four sites each with 3 x 4 metre iDomes), University of Queensland and University of Wollongong. And in Western Australia for Scitech, Curtin University, Edith Cowan University, and University of Western Australia.

2.7 Linear Navigator

12m long, motorised 55" LCD touch screen
Resolution: 3840 x 2160 pixels

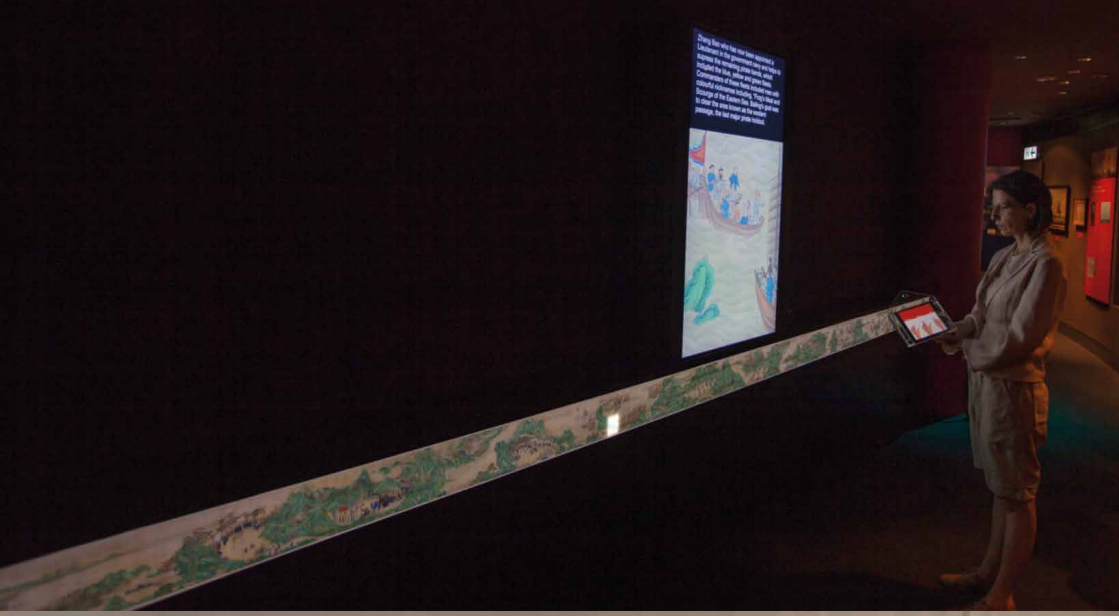
Description

The Linear Navigator system interactively positions virtual information in the physical space of a gallery or museum. Its physical construction entails a set of rails mounted on the wall, along which a motorised LCD 4k monitor can travel to various positions, such as along a timeline or a temporal sequence. Wherever the monitor stops the user is able interact with the content via a touchscreen or activate a movie.

Exhibition history

Linear Navigator has been widely exhibited, uncluding *300 Years of Hakka Kung Fu* (2016) Hong Kong Heritage Museum, China; *Academic 3*, City University of Hong Kong, China (2017), and *Kung Fu Motion* at EPFL ArtLab, Lausanne, Switzerland (2018).

Opposite top *Pacifying the South China Sea,* 2013
Opposite bottom *Discovering Castiglione,* 2015



2.8 Panoramic Navigator

3.5 metre diametre 360-degree screen
Resolution: 1920 x 1200 pixels
Audio: 4 channels

Above & right *WILD Panoramic Navigator,* 2010
Opposite *Panoramic Navigator of Jiao Festival*, 2016

Description

Coming in two distinct forms, the panoramic experience enables to viewer to explore a 360-degree worldview. In the first version, a rotatable touch screen is coupled to a video camera, enabling the viewer to look around the real-world environment via its live camera image. Using the touch screen the viewer can then access additional multimedia information attached to specific objects in the environment. In its second version, the viewer can rotate a projector within a 360 degree screen, to reveal panoramic movies that are projected on its surface.

Exhibition history

The Panoramic Navigator has featured in *WILD: Amazing Animals in a Changing World*, Melbourne Museum, Australia (2010), and *Kung Fu Motion,* EPFL ArtLab, Lausanne, Switzerland (2018).

2.9 Augmented realities

2.9.1 Pure Land AR

5.8 m wide x 5.5 m deep x 3.5 m high
Resolution: 2048 x 1536 pixels
iPad 7″

Opposite *Pure Land AR*, 2016
Bottom *Pure Land AR*, 2016

Description

Pure Land AR employs iPad screens that visitors use as mobile viewing devices to explore the magnificent Buddhist wall paintings inside Cave 220, a cave dated to early Tang, from the Mogao Grottoes at Dunhuang in Gansu province, China. *Pure Land* is an innovative augmented reality installation in which the original paintings and sculptures of the caves are rendered virtually within the architecture of a simply constructed rectangular room, which shares same dimensions as those of Cave 220 itself. This novel technical rendering of *Pure Land* is facilitated via infrared cameras that accurately track the position and orientation of two iPads as they are handled by visitors. The cameras can detect these iPads because of small optical markers that are attached to their frames. Computers then create the appropriately rendered views of the actual Dunhuang cave, which are transmitted to the iPads via a Wi-Fi connection.

Exhibition history

Pure Land AR has received hundreds of thousands of visitors to its various installations worldwide. Previous major exhibitions include *Tang: treasures from the Silk Road capital,* Art Gallery of NSW, Sydney (2016); 9th Shanghai Biennial, China (2013), and ART HK 12, China (Hong Kong Art Fair, 2012). *Pure Land AR* also toured during 2016-17 through Malaysia and China.

Opposite top & bottom
Pure Land AR, 2016

2.9.2 Divine Comedy AR

12 marble slices, iPad Pro 12.9"
Resolution: 2048 x 1536 pixels

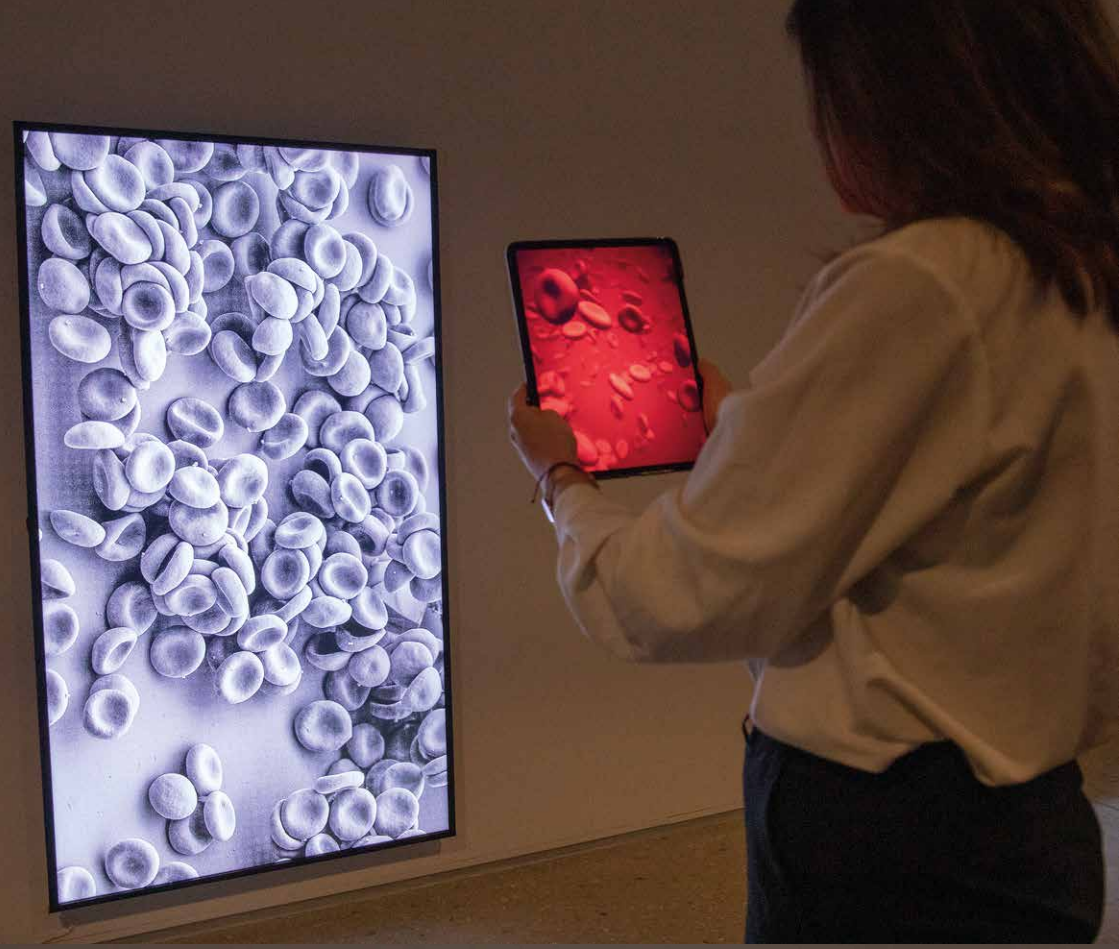
Description

Divine Comedy AR draws on a series of 'curiosities' arising from geology, ethnology and information technology. Marble is a rock produced from the metamorphism of limestone, after eons of heat and pressure. Its characteristic veins are due to the mineral impurities originally present in the limestone. This artwork's marble slabs are 'found objects' (objets trouvés) whose patterns fortuitously allow for QR codes to be embedded and recognised by the iPad's camera system. These image registration capabilities orient the 'augmented reality' artwork's virtual objects – glass cabinets containing animated male and female figures – in relation to the real-world scene of its arrangement as marble tiles on a wall.

Exhibition history

'Cabinets of Curiosities', *Academic 3*, City University of Hong Kong, Hong Kong, China (2018).

Opposite top & bottom
Divine Comedy, 2018



2.9.3 Infinity Room 1

82" LCD panels, iPad Pro 12.9"
Resolution: 2048 x 1536 pixels

Description

In these four iPad AR installations, four images displayed on 82" LCD panels by Lausanne-based photographer Catherine Leutenegger were used as inspiration for entering inside the laboratories at EPFL. The augmented worlds consisted of zooming spherical gigapixel images, spherical video and real-time animations.

Exhibition history

Infinity Room 1, EPFL ArtLab, Lausanne, Switzerland, 2019.

Opposite top *Infinity Room 1*, 2019
Opposite bottom *Infinity Room 1*, 2019

2.10 Head-mounted displays

2.10.1 Pure Land UNWIRED

Oculus Rift, Kinect, gaming PC, backpack & stereo headphones

Description

Pure Land UNWIRED (2015) is the third in a series of virtual and augmented reality installations that explore sensorial and experiential exhibition technologies and 3D imaging data. The *Pure Land* projects are based on the UNESCO World Heritage site of the Mogao Grottoes, Gansu Province, north-western China. These research and immersive applications are focused on Cave 220, known for the importance of its early Tang murals. *Pure Land UNWIRED* integrates a wireless solution that allows full-body immersion in virtual reality while walking around inside Cave 220 at 1:1 scale. The VR platform combines a head-mounted display (Oculus Rift) with a depth-based camera (Kinect2) to capture movement of body and limbs within a space that is similar to the size Cave itself. A tablet computer, carried in a backpack, runs VR software (Unity) with custom integration.

Exhibition history

REAL 2015, Fort Mason Center, San Francisco, United States; and DH2015 Global Digital Humanities, Perth, Australia (2015).

Opposite *Pure Land UNWIRED,* 2015


GearVR

2.10.2 IN_SIDE VIEW

VR Gear
Tongue switch

Description

IN_SIDE VIEW is an installation in which the viewer, seated in a chair, is able to explore a series of stereoscopic panoramic photos using a Samsung Gear VR head mounted display. Turning the chair rotates these panoramic scenes, which offer a conjunction of photos of Angkor Wat showing foliage amalgamated with stone, and the interior of a Sydney hardware store after it had been ravaged by fire. The viewer controls these scene changes using a tongue-operated switch held in their mouth.

Exhibition history

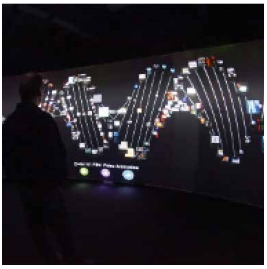
DIGITAL SYNESTHESIA, Angewandte Innovation Laboratory, University of Applied Arts Vienna, Austria (2016); and *Academic 3*, City University of Hong Kong, China (2016).

Opposite top & bottom *IN_SIDE VIEW,* 2016

KUNG FU MOTION EPFL
2018

KUNG FU MOTION
2017

LINGAN HUNG KUEN ACROSS THE CENTURY
2017



SCANLINES
2018

IN_SIDE VIEW
2016

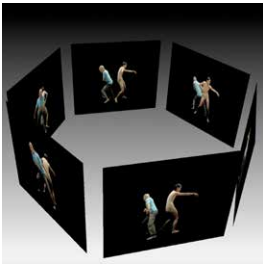
CAVE DOME
2015

MARCHIVE
2014

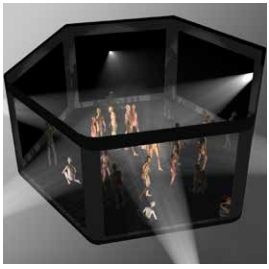
PLACE - HAMPI MUSEUM KALADHAM
2012

PURE LAND AR
2012

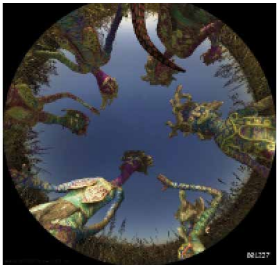
HAMPI-LIVE
2010



DOUBLE DISTRICT
2008



UNMAKEABLELOVE
2008



TRAVELLING KUNGKARANGKALPA
2017

ZOOMING SYDNEY
2017

LOOKING UP COUNTRY
2018

REBUILDING THE TONG-AN SHIPS NEW MEDIA ART EXHIBITION
2015

PURE LAND UNWIRED
2015

LOOK UP MUMBAI
2015

ECLOUD WWI
2012

PURE LAND: INSIDE THE MOGAO GROTTOES AT DUNHUANG
2012

LIIAO
2011

EYE OF NAGAUR
2008

PLACE - HAMPI
2008

CONVERSATIONS@THE STUDIO
2005

eM+

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