Deep Fakes

Art and Its Double

EPFL Pavilions

Amplifier for Art, Science and Society

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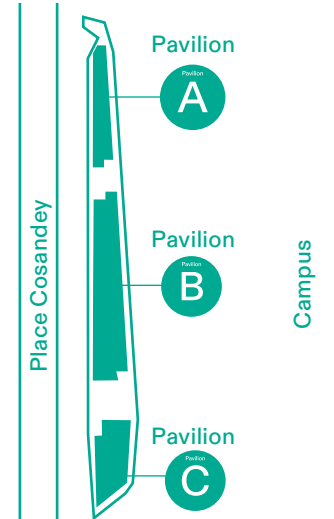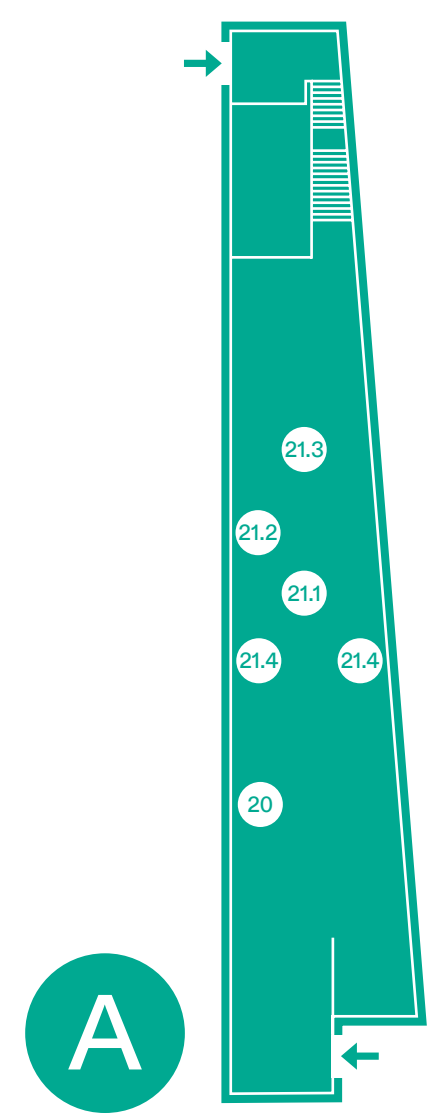Pavilion
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Deep Fakes: Art and Its Double

Few fields of knowledge denounce copies as 'fake' more than those of art history. Few are as concerned with the authenticit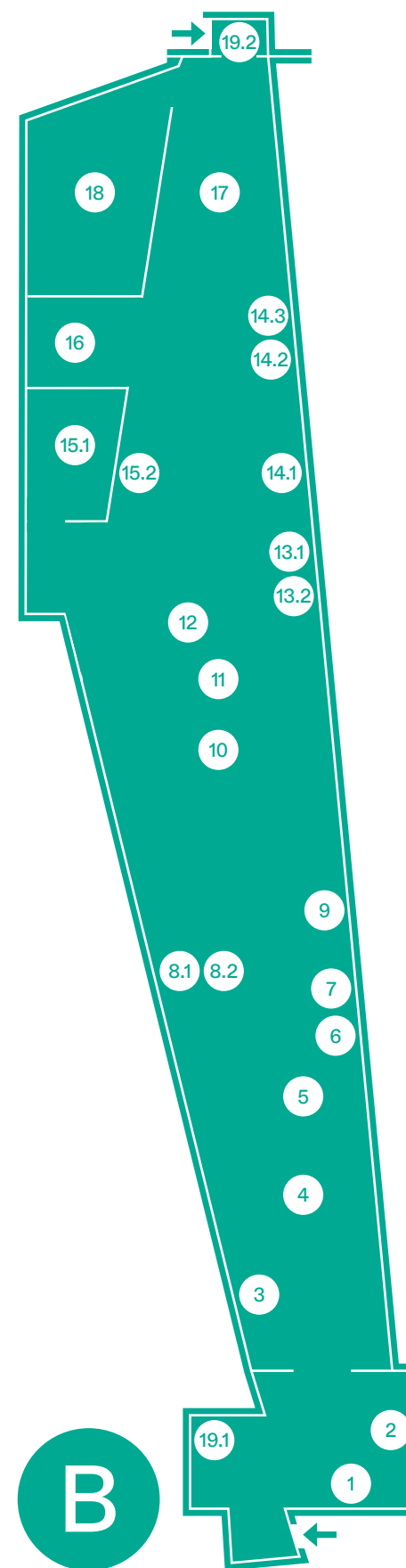y and provenance of objects as those of curating and collecting. In response, *Deep Fakes: Art and Its Double* poses crucial questions about the potency of digital replicas to absorb audiences in enduring emotional encounters with universal art treasures.

This exhibition opposes the use of 'deepfakes' for manipulation and misinformation, to explore very different perspectives, reimagining objects through advanced computational techniques. Decades of computer science and engineering at EPFL have revolutionized the tenets of verisimilitude and representation. Today's 'perfect pixels' coalesce in imaging techniques designed to replicate cultural artefacts with ultimate fidelity. Simultaneously, as algorithms and computer vision re-perform and reprocess the digitally visible, they are exposing the optical unconscious of art[1] calling us to reexamine, once again, objecthood itself.[2]

Remediated through participatory interfaces, such as mixed, augmented and virtual realities, *Deep Fakes: Art and Its Double* creates new performative platforms for the complex archetypes that emerge out of computational practices as they intersect with art heritage. Through 21 installations across Pavilions A and B, the exhibition is equally focused on affirming and activating visitors' sensory experiences, while also grappling with the critical implications of the digital materialities that objects possess in post-original form. The installations re-present seminal objects of pan-Asian art and architecture from Cambodia, China, India, Malaysia, Japan, Sri Lanka, and Thailand. The Middle East is represented by important sites in Egypt and Syria. The United States of America and significant European heritage sites in Armenia, Germany, and Italy complete an encyclopaedic offering made tangible through state-of-the art imaging and interactive immersion.

Cultural deep fakes have manifold significance. The ongoing global pandemic has starkly focused the use of the digital as a mechanism for shared cultural futures

and the digital object has taken on new and powerful potencies. Cultural deep fakes are technologically empowered to offer forensic insights into invisible dimensions, generating unforeseen hypotheses and connections. These art-science phenomena also propagate powerful auras which rise to the surface entangled with the affective qualities of their originating sources. Such augmented replicas are able to draw us into unparalleled tactility with the textures, patinas, forms and 3D geometries of their counterparts. With its propensity for peripheral vision, machine learning has amplified the possible futures for curatorial and artistic practices, antagonizing outdated notions of authority, authenticity and access. Harnessing artificial intelligence approaches for art reproduction, cultural deep fakes are generating perpetually new archival artefacts, concurrently formed and formless.

Digital facsimiles also decolonize matter as they defy hegemonic narratives, helping to liberate things from their colonial entrapments, confronting authoritative discourses, historical sedimentation, and uncontested social relations. In cases of heritage at risk due to warfare, iconoclasm and climatic catastrophe, digital copies have enabled communities to become more resilient to loss.[3] They can also provide reservoirs of cultural memory and instruments for those on the margins to 'speak back' to their oppressors.

Critical discourse is germane to the worlds of architecture, art and heritage. Vital issues include how the encryption of digital counterparts in place of originals is exploding systems and codes of ownership, custodianship, and repatriation. Meanwhile the accumulation and exploitation of digital patrimonial and cultural capital by technological elites, unnervingly re-enacts colonial constructs. Synchronously, new forms of cryptographic control such as non-fungible tokens are being enabled for networked circulation of art. Promoting the blockchain as a potential dominion of arbitrary value is the hallmark of the intensification of late capitalism's newest investment for its enmeshed cultural objects, rather than their 'depropriation' through the commons.[4]

Deep Fakes: Art and Its Double is a cumulative narrative that embarks on these cross-cutting themes, traversing the simulacrum, mirrorworlds, digitaltwins,

cryptocurrency and machine intelligence, while engaging the issues of mimesis, reenactment, memory and decolonization. The exhibition's installations cycle us through some of the antitheses of the real and the fake around which the history of art has been circumscribed. Just as postmodernism challenged the assumed meaning of things, cultural deep fakes have become a central pivot for a new significance of objects. Recognizing their importance opens the way to redefine the dominant techno-cultural logic of our contemporary era.

'... the image of the counterfeit functions as a complex figure, a kind of pretzel in which true and false chase each other's tails. Glass and gold, pure and impure, begin to reflect on one another, as in a hall of mirrors.'
    Rosalind Krauss[5]

1   Rosalind Krauss (1993), *The Optical Unconscious.* Cambridge, Massachusetts: MIT Press.
2   Michael Fried (1998), *Art and Objecthood: Essays and Reviews.* Chicago: University of Chicago Press.
3   *Age Old Cities: A Virtual Journey from Palmyra to Mosul* (2018), Aurelie Clemente-Ruiz et al. Institute du Monde Arabe (IMA), exhibition catalogue, Paris, 10 October 2018–10 February 2019.
4   Marcus Boon (2014), 'Depropriation: The Real Pirate's Dilemma', Eckstein, L., and Schwarz, A. (eds). *Postcolonial Piracy: Media Distribution and Cultural Production in the Global South.* London: Bloomsbury Academic, pp. 135–148
5   Rosalind Krauss (1999), *The Picasso Papers.* Cambridge, Massachusetts: MIT Press, p.11.

1 *Reclining Pan* 2018

Stereolithography, selective laser sintering, polyamide, polyurethane, pigments, aluminium base. 145.7 × 151.7 × 83.7 cm. Courtesy the artist, Tanya Leighton Gallery, Berlin, evn collection, Maria Enzersdorf, Austria

Oliver Laric

Reclining Pan is a hybrid sculpture of stereolithographic printing with varied laser sintering and pigment colouring, in which Pan, the ancient Greek satyr, infamous for his lascivious promiscuity, reclines on a rocky base. As artist in residence at St. Louis Art Museum, USA, Oliver Laric was instantly drawn to create a doppelganger of the *Reclining Pan*, a circa 1535 CE sculpture attributed to Italian Renaissance artist Francesco da Sangallo.

Derived from a 3D scan of the original produced by the museum, Laric's iteration plays on the endless repetition of classical motifs and myths throughout art history. Pan's origins in Arcadia can be traced through the mimesis of his image in thousands of regenerations since the Etruscan art of 6th century BCE, and in the manifold Roman replicas of Greek marble originals.

Da Sangallo's work is post-original itself, being a copy carved from the remnants of an ancient Roman relief, formerly a fountain; its water spout still protruding from the gourd resting on Pan's lowered arm.

Half-man and half-goat, Pan also mirrors the material and aesthetic hybridization of Laric's 3D-printed object, which is a composite of many printed moulds, each with subtly variegated colours, textures and surfaces, some more transparent, others iridescent.

Laric's work is not so much an intervention as a simulation of a continuum in the ranks of the countless artists, including Peter Paul Rubens, who have copied this sculpture in print, sketch, paint and sculptural replica.

Oliver Laric's work displays a deep fascination with animal-human liminality and hybridity, seen in numerous prior works. The artist's use of 3D scanning and printing, which dates back to 2009, is a provocative gesture that questions the veracity of the post-original in a digital age.

Further refuting the premise of art's singularity and private ownership, Laric has made many of the 3D scans used in his work available to the public through his website threedscans.com where anyone can download and generate their own post-original on a 3D printer.

Interactive installation. Application software: Gideon May (1994), Leoson Cheong (2020). Collection of the artist
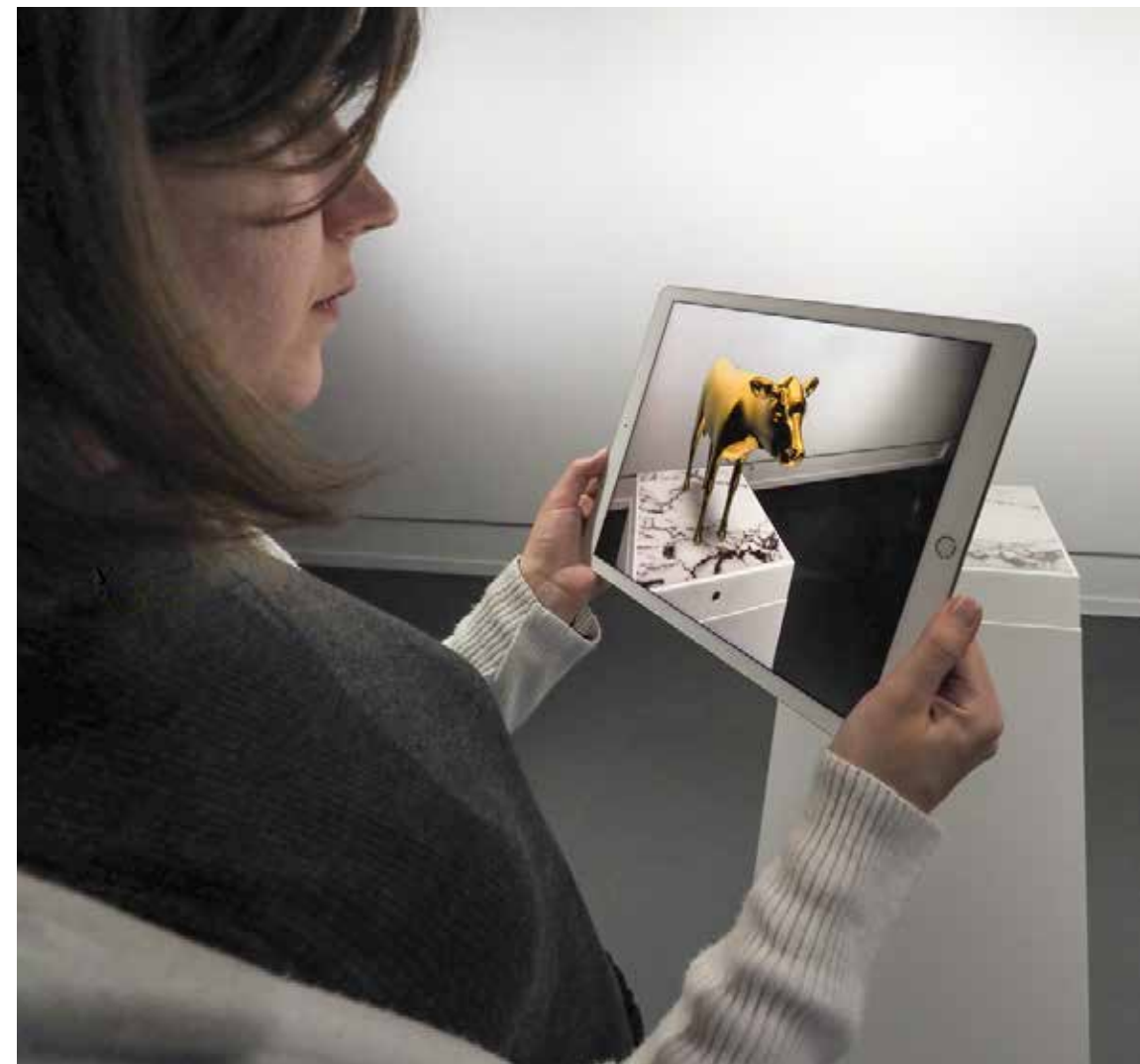
Jeffrey Shaw

Images: Jeffrey Shaw

The Golden Calf is an iteration of Jeffrey Shaw's pioneering augmented reality installation from 1994. A white pedestal stands alone in the space, seemingly devoid of any object. After taking up a small tablet, the participant hovers the monitor over the plinth, and a virtual image of the pedestal appears on the screen. In this mirrorworld known as augmented reality, or AR, yet another apparition is evoked, that of a golden calf. By moving the monitor around the real pedestal the viewer can examine this calf from above, below, and all around. Because the tablet carries a motion tracking system, the computer can recognize its spatial position and orientation with great accuracy.

The monitor functions in this way as a kind of dual window: as it reveals a virtual animal, it also augments and is situated within the real space. The calf itself is shiny, like the body of an idolatrous object that is no longer a real entity but is instead the immaterial subject of a mediated process of revelation. Representation is and always was the twofold domain of our embodied and disembodied yearnings, and in this conjunction we experience a form of euphoria due to our dislocation from the present world.

As *The Golden Calf* makes the viewer a co-creator, it exemplifies Shaw's commitment to dialogue and co-operation with the public. As such, it realizes one of the artist's persistent preoccupations: the desire to overcome the barriers set by traditional representational conventions that separate the artwork from the viewer. Deeper still, in moving the screen around the pedestal, the viewer engages in a ceremonial dance before a simulated, false image.

Jeffrey Shaw's creative use of digital media technologies lies at the forefront of virtual and augmented reality, immersive visualization environments, navigable cinematic systems and interactive narrative. *The Golden Calf* is one of Shaw's landmark art works in the domain of participatory, interactive and computer-controlled forms of media art, of which he is considered a pioneer. Widely exhibited work, such as *The Legible City* (1989), *The Virtual Museum* (1991), *Place-A User's Manual* (1995), *conFiguring the CAVE* (1997), and *T_VISIONARIUM* (2004–2009), transform computer images by projecting them in real time into a setting that shapeshifts in relation to the motion and viewpoint of the spectator. Shaw has received numerous awards for his critically acclaimed work, including the prestigious Ars Electronica Golden Nica for Visionary Pioneer of Media Art in 2015.

Convention for promoting universally reproductions of works of art for the benefit of museums of all countries

1867

Facsimile of original printed copy (1921). Original dimensions: 33 × 21.2 cm. Collection Victoria and Albert Museum, London, United Kingdom. V&A: MSL / 1921 / 1153. Reproduced courtesy V&A Museum

Drawn up in 1867 by Henry Cole, the first director of London's Victoria and Albert Museum, this treaty was conceived in response to the rise of new technologies of reproduction in the mid-19th century. Longstanding antiquarian fascination with world architecture and sculpture alongside the expansion of trade routes and travel had already popularized the copying of famous works of art. By the end of the 1860s, the V&A Museum was involved in a myriad of efforts to preserve and disseminate copies of works of art by adopting the newest replication technologies of the time. The art of replication in plaster casts, which had already been used for hundreds of years for taking moulds of an archaeological find or object, was perfected for the making of surrogate objects. Alternatively, electrotyping provided a novel way to generate a 3D copy of an object by electroplating a thin shell of metal onto a mould of the original.

Copies were offered for study and to tell a complete story of the history of art and design, such as in the V&A's own Cast Courts, which opened in 1873. These mimetic galleries even made it more acceptable to display a substitute in place of a real, when the work could not be acquired otherwise. During this period, the V&A Museum was also producing photographic records of artefacts, not merely for potential acquisition but moreover as standalone works of art in their own right.

The Convention was the first of its kind to establish an international agreement on the conditions and shared benefits of duplicating works of art, without any collateral damage to originals. The final accord was signed by nine ruling royal figures across Europe. Although this charter advocates for the dissemination of images of objects or places to audiences that might not otherwise be able to see them, the adoption of technologies of reproduction was pivotal to the renewed annexation of the colonized cultural heritage of others, as is reflected back to us once again in the mirrorworld of Google Arts and Culture. Undertaken by some of the most powerful nations and institutions in the West, the production and custody of cultural deep fakes was authorised for the first time in the Convention.

Photo: Stefan Altenburger
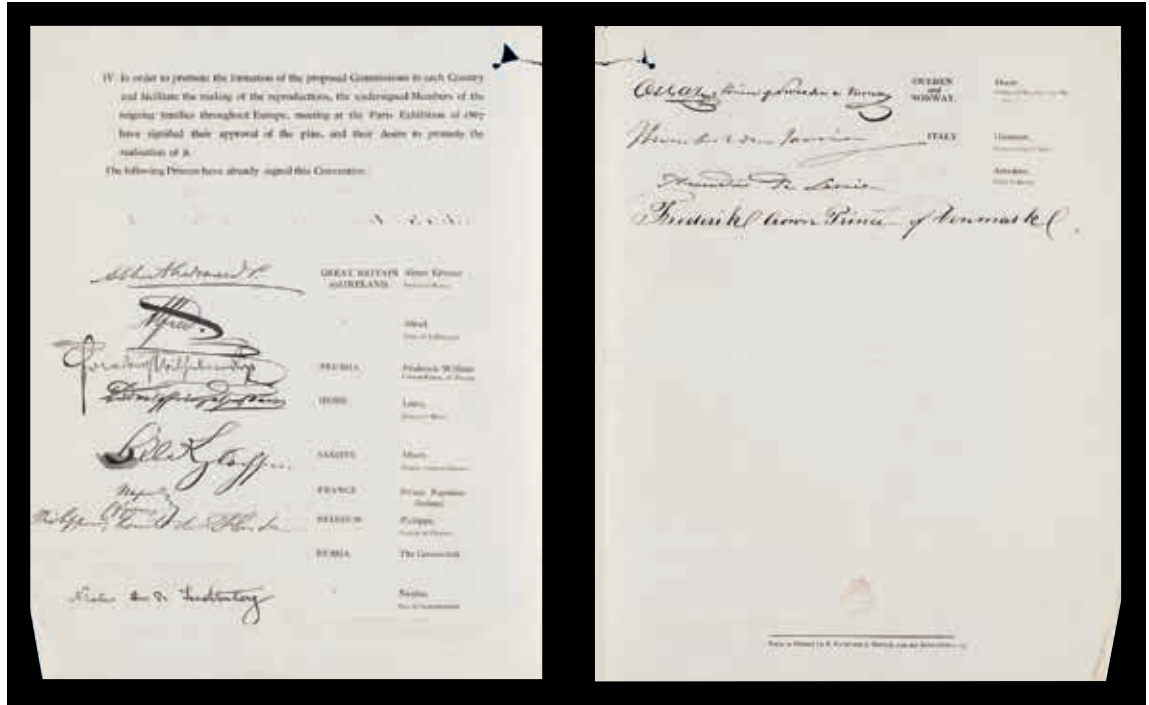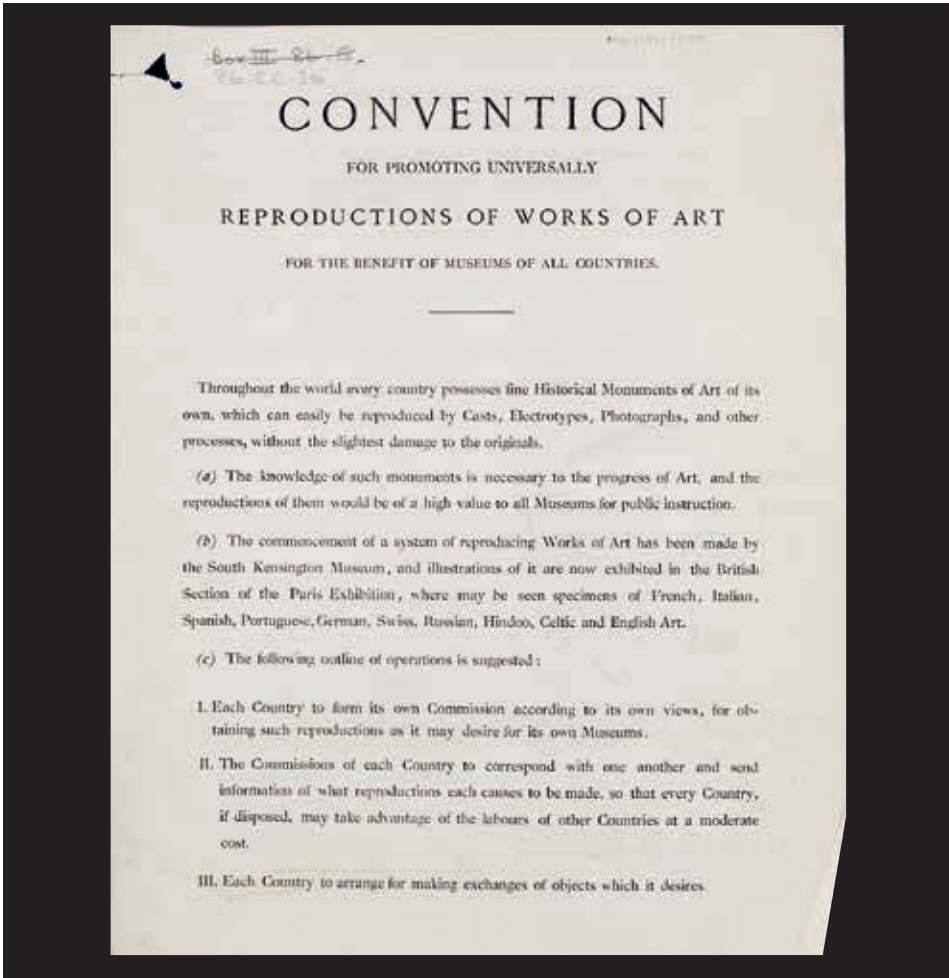
Replica / Real / Replica

ScanLAB Projects

Images: ScanLAB Projects

Replica / Real / Replica is a virtual 3D model that takes us on a tour through the London house-cum-museum built by 19th-century architect Sir John Soane. The journey traverses the five floors of meticulously restored rooms of the museum. Each room is filled with original and duplicate fragments of antiquity, such as the 3,500 year-old sarcophagus of Egyptian King Seti I.

The drifting journey unfolds within a point cloud; a doppelganger of the real, seamlessly merging the 3D scans of scale models with LiDAR scans of the physical locations. Two of the most iconic collections housed in Soane's building provide the starting point to venture further afield. First, via Seti's original Sarcophagus in the Soane's sepulchral chamber, we travel to the real and replica Tombs of King Seti I in the Valley of the Kings and its duplicate created by Factum Foundation. Then, we are transported to the infamous human casts set inside the ruins of Pompeii departing from Soane's elaborate cork replica of the ruined Roman city in the museum's model room.

Replica / Real / Replica also visits Egypt and Italy in forensic digital detail via their LiDAR doppelgangers. Within these models we find two of the most notorious facsimiles in the world: we discover the data used to create the Factum Foundation's near-perfect replica of Kings Seti I's Tomb, and we confront the unexpected interiors of the Pompeii casts, which are believed to be copies since the originals were supposed to have been destroyed in raids undertaken by Allied powers during WWII.

ScanLAB's long-running collaboration with the John Soane Museum provides the groundwork for this latest work *Replica / Real / Replica*. Through objects featured in the collection, ScanLAB have created an interconnected journey that bridges the museum and the iconic locations that ScanLAB have been fortunate to observe through the eyes of their scanning machines as part of TV and research projects. ScanLAB were also lucky to explore seminal datasets collected by our contemporaries at the Factum Foundation and the Polytechnic University of Turin. Together, these datasets form a digital doppelganger that merges distant locations, vastly different scales, and sources ranging from the highly authentic to the incredible intentional fakes.
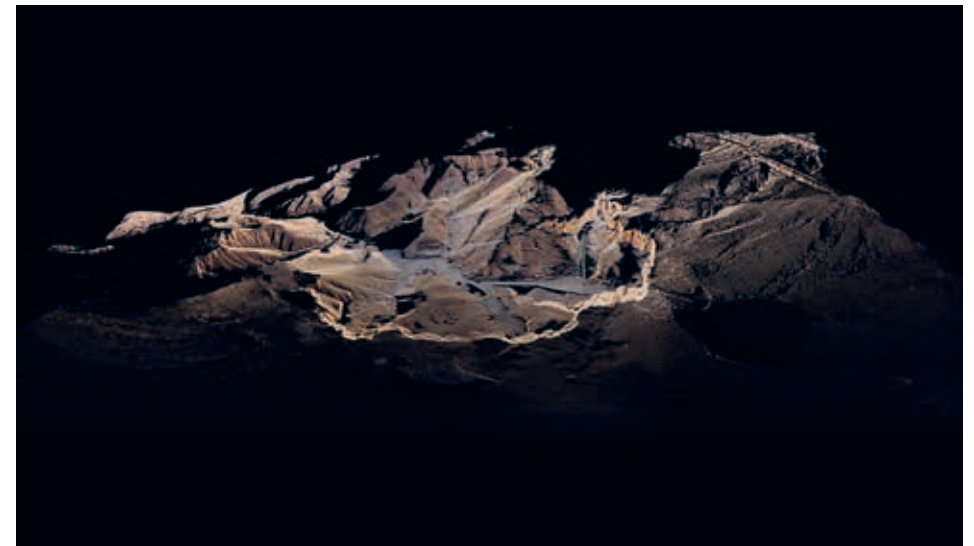
5 *Double Truth* 2021

Sarah Kenderdine

Images: Sarah Kenderdine

'Double truth' is a theory that as separate sources of knowledge religion and philosophy might arrive at contradictory truths without mutual detriment. 'Two truths' in Buddhism are the truths of the mundane and of the absolute. Sculpture itself also has a double truth, as one of the oldest and most contested forms of representation, concurrently referenced as the most traditional and the most innovative of the visual arts. Sculpture is both noun and verb, and it also exists at once as a singular frontal view and in multiple perspectives.

Double Truth is an interactive 3D sculpture platform in the round for viewing revered Buddhist sculptures drawn from *The Atlas of Maritime Buddhism* research project and worldwide exhibition series. Many of these Buddha and bodhisattva representations have never been seen before outside their country of origin. The exceptional fidelity of this sublime art treasury of statuaries was created through specialised processes of photogrammetry, assembled from thousands of photographs.

By rotating the human-scale viewing platform, the participant generates a dynamic temporal sequence that reveals each of the 15 sacred sculptures one-by-one. The reverse rotation of the platform meanwhile produces unexpected materialities, as the icons melt, fragment and refold through a series of computer graphics transformations and parametric visualizations. Their acoustic realm is also augmented through the sonification of each sculpture with rare ethno-musical archival recordings.

Led by Sarah Kenderdine, EPFL Laboratory for Experimental Museology (eM+) is a new transdisciplinary initiative at the intersection of immersive visualization technologies, visual analytics, aesthetics and cultural (big) data. eM+ engages in research from scientific, artistic and humanistic perspectives and promotes post-cinematic multi-sensory engagement using experimental platforms.

The Atlas of Maritime Buddhism research project encompasses hundreds of sites and artefacts across Cambodia, China, India, Indonesia, Myanmar, Sri Lanka and Thailand, and is the world's largest archive of fully immersive, high-resolution panoramic and panoptic 3D images. This deep mapping archive is not only vast in scale and content, it also provides the digital framework for a profoundly new exploratory experience for museum visitors that enables them to delve into deep levels of sensory memory across place and time.

3D photogrammetric robotic scanner, replica object, monitor. Variable dimensions. Conception, design & build: CultLab3D, Fraunhofer Institute for Computer Graphics Research IGD, Darmstadt, Germany. Rapid Compact: Darmstadt Graphics Group GmbH (DGG). Camera system: Phase One A/S Frederiksberg, Denmark. 3D replica printing: Stratasys, Ltd. Rehovot, Israel. Informatic displays: Ars Electronica Solutions GmbH & Co KG Linz, Austria. Samurai mask: Collection of Samurai Art Museum, Berlin, Germany. Presented in collaboration with EPFL Laboratory for Experimental Museology

CultLab3D

CultArm3D is the world's first autonomous 3D scanner with a robotic photogrammetry head that produces repeatable high quality 3D object documentation for cultural heritage artefacts. It combines photogrammetry and intelligent view planning with colourfaithful capture of arbitrary objects, especially those that exhibit challenging surface materials.

In *Deep Fakes: Art and Its Double,* *CultArm3D* performs an infinite loop in a four-part installation. Firstly, it is in the process of operating on a 3D printed facsimile of an original Japanese Edoperiod Samurai mask. Secondly, the live scanning of the 3D printed model is simultaneously rendered visible on a built-in monitor. Thirdly, the resulting 3D rendition of the completed scan can be seen on a large screen behind *CultArm3D*. Fourth, and finally, there is the original mask on loan from the Samurai Art Museum in Berlin.

When the virtuality continuum concept was first introduced in 1994, it was understood as a sliding scale ranging from authentic reality to utterly virtual virtuality, with the area in between being defined as mixed reality. Present-day technologies now allow us to surf the virtuality continuum up and down, making it almost impossible for the human eye to discern virtual from real content. The technologies of today also enable us to add multimedia provenance information and thus enhance our perception and understanding of reality, in a computer-mediated reality. Furthermore, recent advances in additive manufacturing allow

us to use the captured, colour-faithful 3D information about the shape and texture of real objects to physically replicate their function and original appearance and thus preserve the fragile originals.

The presence of *CultArm3D* in this exhibition gives audiences the chance to appreciate for the first time the full potential of these advances in the production of digital simulacra. To see this machine in action, replicating not only the original but its own digital-twin live before our eyes, is to witness the expansion of ubiquitous, educational and scientific horizons for such work with heritage objects.

Images: © Fraunhofer IGD, 2021

The golden necklace from the tomb of the Celtic Prince of the Glauberg Archaeological State Museum of Hesse, Germany.

CultArm3D is the culmination of many years of intensive research, prototyping and development in the development of innovative 3D scanning technologies. This has taken place in the CultLab3D research lab at the Competence Center Cultural Heritage Digitization of the Fraunhofer Institute for Computer Graphics Research IGD, Darmstadt, Germany.

The project is also a significant collaboration with three leading industry partners. Phase One of Denmark have manufactured the world-class camera system specialized for cultural heritage photography, mounted on the CultArm3D. The Darmstadt Graphics Group, a spinoff of Fraunhofer IGD, has created Rapid Compact to automatically decimate large model data into

web usable 3D formats for virtual and augmented reality. While, Israeli 3D printing company Stratasys joined the project to generate the colourfaithful 3D replica using the Cuttlefish printer driver of Fraunhofer IGD on their Polyjet 3D printers.

Full mask of a kite (鳶総面)

1615–1868 CE

Edo-period Japan. Iron, lacquer, silk, leather.
Unsigned. 35×18.9×13.2 cm. Collection
Samurai Art Museum, Berlin, Germany

Author unknown

Images: © Fraunhofer IGD, 2021

Photograph Courtesy Samurai Museum, Berlin.

This full-face mask *(sōmen)*, made of finely forged and patinated iron *(tetsu sabiji)*, has a slightly hooked-shaped beak of a Japanese kite (tobi). The nose and upper lip part are riveted and the mask features a kirigane (decorative metal application) in the shape of an omodaka (Japan arrowhead marsh plant) on the cheeks. The frowning expression and accentuated nose are ably captured by the crisp embossing. The interior of the mask has an additional gold leaf application (kinpaku) above a black lacquer ground *(kuro urushi nuri)*. The throat guard *(tare)* is attached to the mask with a decorated doeskin leather panel *(egawa kōmori tsuke)* and consists of four black-lacquered scale rows, laced in blue kebiki odoshi (close lacing).

Armour masks covering of the sōmen type were rarely used in actual warfare, although some full masks made during the Muromachi period (1336–1573) survive that may have served this purpose. A full mask had the disadvantage of limiting the wearer's vision and restricting their breathing. Lighter masks covering the cheeks or the half masks with their removable nose were far more practical during the time of the civil war *(sengoku jidai)*. Full masks became fashionable during the Edo period when they were worn for aesthetic, symbolic and / or status use.

8.1 *Landscapes of Four Seasons with Sun and Moon*

Late-15th century / 2021

Digital scan of late-15th century CE Japanese National Treasure Landscapes of Four Seasons with Sun and Moon (2021). Two screens of six panels, each 147 × 313.5 cm, printed at 1:1 scale of the original as a 2.5D (3D surface texture) on Japanese paper. Scanned by the Advanced Imaging Technology Research Center (AITReC), Ari Ide-Ektessabi. Courtesy Kongo-ji Temple, Osaka, Japan. Co-produced by AITReC and EPFL Pavilions

Author unknown

These two standing screens are a Japanese National Treasure known as *Jitsugetsu-zu sansui-zu byobu* or the *Landscapes of Four Seasons with Sun and Moon*. This work is considered *preeminent* in the history of Japanese art and cosmology. The coupling of the Sun and the Moon has long been associated in Japanese culture with the 'Onmyodo' – the Way of Yin and Yang, and the complete space-time universe. And they are thought to have been displayed on an altar during the performance of esoteric Buddhist rites in Osaka's Kongo-ji Temple, established in the mid-8th century CE. The temple remains the custodian of these sublime ritual treasures.

The screens portray the classical Japanese understanding of the yearly seasonal cycle: the Sun watches over spring and summer on the right screen, while the Moon watches over autumn and winter on the left. A vast ocean occupies the centre of the composition, and the seasonal landscape seem to swirl around it.

The replicas on display in *Deep Fakes: Art and Its Double* are a 1:1 scale facsimile of these sacred Buddhist objects. The colour palette in the digital double is as rich as the original art work. The Sun shines in gold while the Moon glows in silver against the vivid green of the rolling mountains. The contrast between these pigments lends a sense of space and depth to the composition. Gold and silver leaf, silver paint, and silver powder play important roles in giving life to the surging waves found in the centre of the composition. The free-flowing forms of the waves give the scene a feeling of depth, and gesture to the degree of freedom the artist enjoyed during the painting process.

The origin and author of the *Landscapes of Four Seasons with Sun and Moon* screens a mystery, as they lack any signature, and there is no known record of their commission or completion. The screens are thought to date from the late Muromachi period (1336–1573), though their stylistic features indicate a closer relationship to early Momoyama period (1558–1600) painting.

8.2 *Zooming the Cosmic Landscape*

2021

Interactive application of late-15th century CE Japanese National Treasure Landscapes of Four Seasons with Sun and Moon. (2021). 49-inch touch screen. Digital scan: Foundation for Advanced Imaging Technology Research, Japan. Courtesy Kongo-ji Temple, Osaka, Japan. Co-produced by AITReC and EPFL Pavilions

The infinitely decorated surface of the Japanese National Treasure *Landscapes of Four Seasons with Sun and Moon* is also presented to the audiences of *Deep Fakes: Art and Its Double* as an ultra-high-resolution, 1200 dpi digital scan. Presented on an interactive monitor, allowing for intimate inspection of textures, patinas and geometry of these cultural treasures in RGB and infrared light.

◀ *Jitsugetsu-zu sansui-zu byobu*. Images: Advanced Imaging Technology Research Center (AITReC), Ari Ide-Ektessabi.
▶ Photographs: Sarah Kenderdine
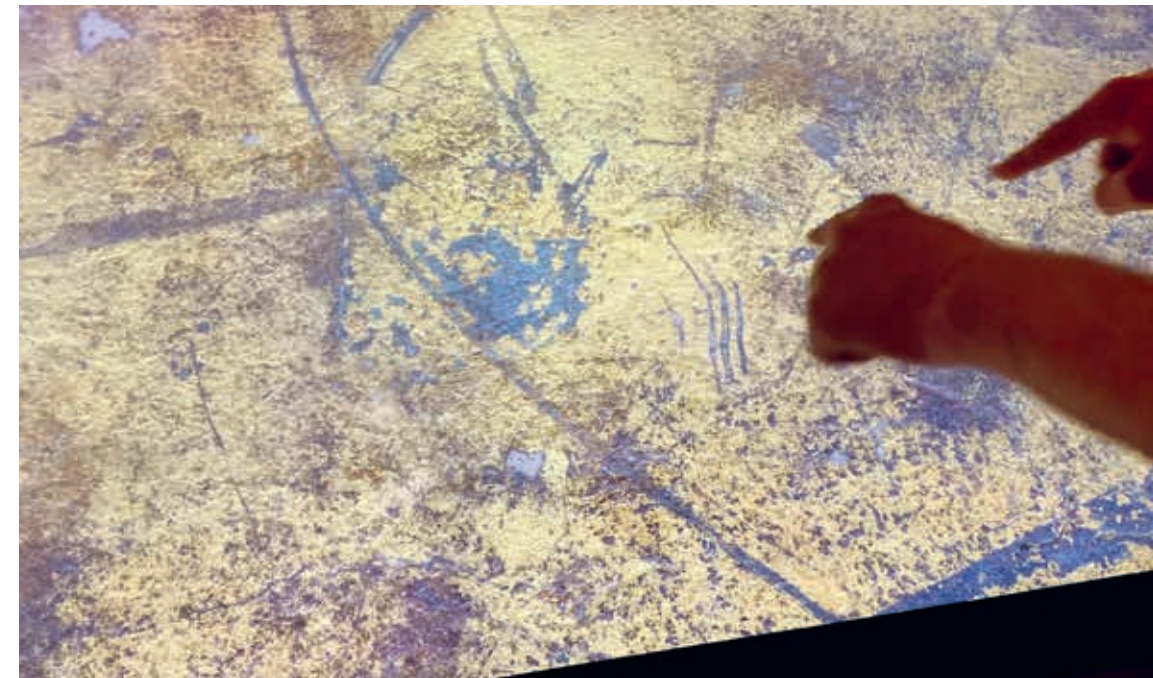
The Advanced Imaging Technology Research Center (AITReC) led by Ari Ide-Ektessabi, facilitates non-invasive analytical imaging scanning technique for ultra-high resolution RGB and near-infrared data capture. The images have high spatial resolution which can achieve mesoscopic resolution (typically 0.1 mm–10 mm). Since the images are being scanned line-by-line instead of being recorded frame-by-frame, this enables accurate colour and spectral recording of the material response from visible and near infrared irradiation. The multi-spectral images were used to reconstruct colour information and spectral reflectance.

Clouds of the ancient world

2021

Drone-based photogrammetric reconstruction, 6DOF interactive installation. Point cloud data: Iconem. Point cloud renderer: Consensive. Interactive application produced by EPFL Pavilions

Iconem

Images: ICONEM

Clouds of the ancient world is a drone-based exploration of eight ancient sites modelled in 3D photogrammetric point cloud, including the Bamiyan Valley in Afghanistan, Aleppo and Palmyra in Syria, Egypt's Giza, Meroe of Sudan, Leptis Magna in Libya, and Geghard and Hagpat in Armenia. These places are keystones of early civilization and ancient culture, and are all listed as UNESCO world heritage sites. Among them, Bamiyan, Aleppo and Palmyra have paid a heavy price for recent cultural wars and civil conflicts. Visitors simultaneously navigate through the space and time of these reconstructed point clouds, to witness first-hand their integrity. The images were collected by Iconem in scientific partnerships with local custodians and UNESCO between 2016 and 2018.
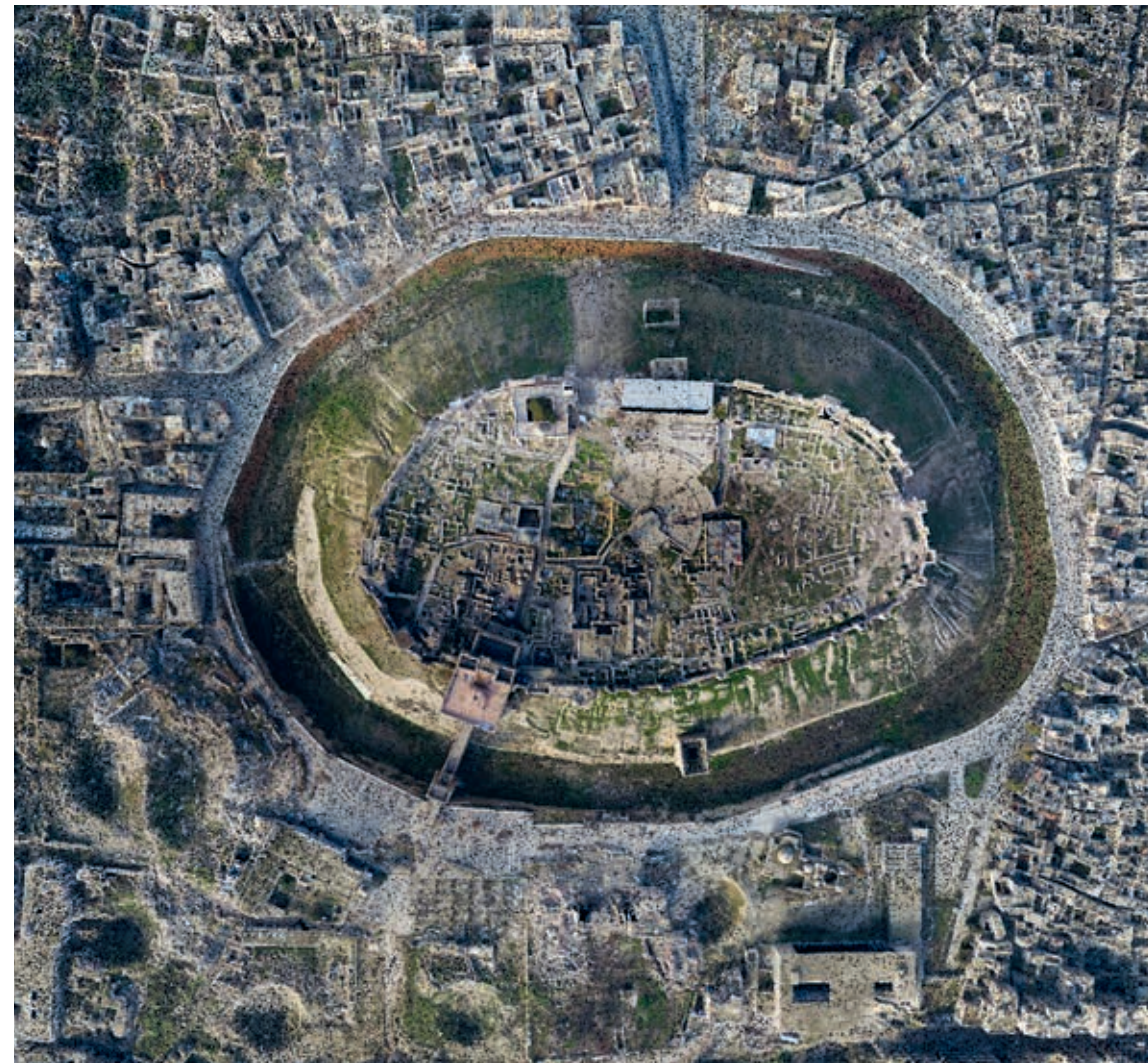
Founded in 2013, Iconem is an innovative company that specialises in the digitisation of endangered cultural heritage sites in 3D. Iconem's mission is to further conserve these endangered places by digitising them for exploration and study, today and tomorrow. Their expert team travels the globe, combining the large-scale scanning capacity of drones and the photorealistic quality of 3D to create digital replicas of the most treasured places, record them for future generations, and champion them today.

Pure Land Augmented Reality Edition

2012 / 2021

Sarah Kenderdine and Jeffrey Shaw

Photographs: Sarah Kenderdine

Dunhaung is home to one of the world's great repositories of Buddhist art: the UNESCO World Heritage site of the Mogao Grottoes, known as the 'Caves of the thousand Buddhas'. Hewn into a desert rock face by Buddhist monks, the Grottoes consist of almost 750 caves, 492 of which contain over 45,000 square metres of mural paintings and 2000 painted sculptures; its size and breadth considered incomparable in the Chinese Buddhist world. During the Tang Dynasty it was an important site for trade and cultural exchange on the Silk Road. Today, however, the site is under serious threat from the rising number of visitors and increasing humidity inside the caves, and most of them are now closed to the public.

Pure Land is an augmented reality re-creation of Cave 220 (618–704 CE) from the Mogao Grottoes built from high-resolution archaeological data-sets produced by the Dunhuang Academy – custodians of the Mogao Grottoes. Cave 220 is an important early Tang-era Buddhist shrine whose murals portray scenes from the 'Pure Land' Buddhist tradition.

In this installation, the walls of the exhibition room are the same scale as the real cave, and are covered with one-to-one scale prints of Cave 220's wireframe-looking polygonal mesh, which provides viewers with visual cues as to what to explore. Inside the virtual model, the high-resolution photographs of the cave's paintings and sculptures are digitally rendered onto this polygonal mesh to create the composite 3D re-presentations that are then presented to the visitors on the tablets as they navigate the exhibition space.

Since 2003, Sarah Kenderdine and Jeffrey Shaw have collaborated on a series of interactive artworks on cultural heritage, including *PLACE-Hampi* (2006), *Look Up Mumbai* (2010), *The Atlas of Maritime Buddhism* (2021), and the five works that make up the *Pure Land* series (2012–2015). *Pure Land AR* acts on the borderline between the indexically real and the phantasmally virtual – between re-embodiment and dis-embodiment. *Pure Land AR* thus weaves a set of subtle paradoxes into its web of virtualization and actualization, and these paradoxes feed the kinaesthetic excitement that is clearly evident as visitors engage as if they hold a 'window on the world'.

The Confucian Body: Rite of Archery

2021

Remaking Confucian Rites Project

The Confucian Body: Rite of Archery is a triptych of videos documenting the reenactment of an ancient Chinese archery ceremony, suppressed during the Chinese Cultural Revolution. Produced as part of the ongoing research project titled Remaking Confucian Rites, the present Provincial Archery Competition reconstruction is based on the renewed philological study of the *Yili* (Book of Etiquette and Rites), a performance manual that describes rituals recorded by disciples of Confucius in the 5th century BCE. Steeped in decades of ritual reenactment scholarship, novel techniques of reenactment are being used to revive this embodied knowledge today.

The Remaking Confucian Rites project has reenacted and filmed three complete *Yili* rites since 2013 – the 'capping', 'marriage' and 'archery' ceremonies – staged in Hong Kong, Taiwan, and China. The Rites of the Provincial Archery Competition has entailed an even more elaborate realization, led by Tsinghua University's Professor Peng.

The reenactment of the Provincial Archery event has resulted in major new innovations in the domain of digital reconstruction. To ensure the transmission of this lost art and intangible heritage practice, a wide range of digitization and video recording technologies are also being used, including 4k-8k videography with multiple points of view, static, mobile and dolly shots, close up, medium and long shots, aerial views, and high-speed videography. State-of-the art 3D imaging is also employed, from panoramic 3D and 360-degree photography, as well as spherical 360-degree videography. Such immersive visualizations are more apt to convey the bodily practices inherent to ritual archery practices.

Since 2012, the Remaking Confucian Rites project has been forging the fundamental means to reconstruct and build new archives for the embodied knowledge systems of Confucian Rites, through the coupling of reenactment with advanced digital documentation forms, in conjunction with novel interactive and immersive media art experiences for their affective transmission. The approaches arising from this work are building a foundation for the renewed scholarship and societal practice of the Archery Rites, as well as a cohesive framework to address the challenges facing the wider revival of intangible cultural heritage in China today.

Production stills from *The Confucian Body: Rite of Archery*. Images: Remaking Confucian Rites project.

The Next Rembrandt

UV-ink 3D print on canvas, framed. 89×74×3.5cm. Collection Wunderman Thompson, Amsterdam. For extended credits see imprint

Wunderman Thompson

One of the most notorious cultural deep fakes to date, the 3D printed painting *The Next Rembrandt* was entirely generated from Rembrandt data. More than 300 paintings by 17th-century Netherlands artist Rembrandt van Rijn were analysed using hi-res 3D scans and digital files, upscaled by a deep learning algorithm. Facial recognition and machine learning software was then designed to understand Rembrandt's style and use those learnings to generate new facial features. This process produced more than 165,000 painting fragments, which were then assembled based on the artist's use of geometric proportions. Finally, a height map was created to mimic Rembrandt's brushstrokes. The file was brought to life through an advanced 3D printer that printed 13 layers of paint based UV-ink, with 148 million pixels in the final 3D print.

Three-hundred and fifty years after his death, Rembrandt has been brought back to life to create one more self-portrait, after an artist who rendered more than 90 autobiographical images in his lifetime. These head and shoulder studies are considered the hallmark of Rembrandt's originality and inventiveness. Shattering the inviolability of the original is at the core of *The Next Rembrandt's* shock value. But Rembrandt was himself playing a game with the art market, for in his day there was great hunger for what were known as 'tronies'. The meme machine of the time, in these art works a model would act out a role or don an exaggerated expression. It was Rembrandt's replication of his own face as tronies that have lasted through the centuries.

When Dutch multinational banking group ING, an innovative bank and long-time supporter of Dutch arts and culture, wanted to stand out from its competitors, they challenged Wunderman Thompson Amsterdam to use technology and data bring back to life one of history's greatest painters. The result? *The Next Rembrandt*, which was unveiled on the 5th of April 2016, in front of a packed auditorium in Amsterdam, with experts, the press and the public invited to join the conversation about where data and technology can take us. And it got the world buzzing, with leading news channels and blogs reporting on the blurring of boundaries between technology and humanity. The work earned over 10 million Twitter impressions on launch day and has been featured in over 1,400 articles. The technology developed for this project is now used for restoration of damaged and partially lost masterpieces.

Photographer: Robert Harrison

Simulacrum

At the core of any critical theory of the original and its copy is the observation that the primary object is always accompanied by a swarm of simulacra, as well as the fakes and copies that threaten and distort it. The simulacrum is best known as a way to understand symbols and signs, and how they encapsulate contemporaneity. It was Jean Baudrillard who claimed in 1981 that current society had replaced all reality and meaning with these symbols and signs, and that human experience was a simulation of reality. The formation of the simulacrum comprises four stages for Baudrillard. In the first stage we regard a faithful copy, 'reflecting 'profound reality'. The second stage is where we take the sign to be an unfaithful copy, which 'masks and denatures' reality, making it an 'evil appearance … of the order of maleficence'. In the third stage, the sign pretends to be a faithful copy, but it is in fact a copy that has no originating counterpart. The fourth stage is pure simulacrum, in which the sign has no relationship to any reality whatsoever. Here, signs merely reflect other signs, so that cultural productions are no longer required to pretend to be real. Even though Baudrillard wrote on the simulacrum twenty years ago, the first and second stages could be used in the present to re-interpret the history of digital replication. Even more intriguingly, Baudrillard's third and fourth stages align with applications of artificial intelligence to art today. One question remains: do the post-human images of AI art leave us bereft of critical self-awareness and thus devoid of the ability to decipher them?

Jean Baudrillard (1983), *Simulations*. Los Angeles, California: Semiotext(e), pp. 1–30.

Mimesis

Mimesis is an age-old issue in Western aesthetics with a wide range of meanings, including imitation, *imitatio*, non-sensuous similarity, receptivity, re-presentation, mimicry, the act of expression, and the act of resembling. In Chinese aesthetics it carries the term *moxie* (copying and drawing) to denote at least two kinds of inter-related practices: *linmo* (studio learning of practical skills by making replicas of the well-recognized paintings of preceding masters), and *xiezhao* (the outdoor study of live objects or the in-situ drawing of natural scenes). Modernism in the West, particularly the Avant-garde, eschewed mimesis, and its attempt to subvert bourgeois culture, in favour of criticality or reflexivity. Mass culture, on the other hand, took up the labour of mimesis, producing affective experiences for popular consumption.

It was Aristotle who argued that we are mimetic animals and that we enjoy mimesis. Indeed, art is mimetic both in the sense that it imitates nature and also because it imitates our own nature. It externalizes the process whereby we come to understand the world. Recent scientific studies on reflexive mimesis show that the action of mirror neurons in the human mind allow us to sense that the experiences we observe taking place in others are not only happening within our own bodies but they also seem identical to our own. Reflexive mimesis makes us aware that, whatever new form of the human is to emerge, it will be based upon the deep claim of affect that ties us to one another. In art, reflexive mimesis is construed through the conscious experience of emotional participation on the part of the viewer. Contemporary visual culture has also begun to reflect the recent and wider socio-cultural interest in emotion and affect, reconfiguring the relationship of art to mimesis. If traditional arts engaged in mimesis before modernism eschewed it, recent art has reconnected the mimetic drive to its core significance for human culture.

Post-Original

The intensity of the search for an original depends on the fervour triggered by its copies. While an entity is only retroactively identified as an original, copies transport the original into new surroundings and contexts. The validity the original's aura is also contested, namely in the claim that a museum object removed from the real world cannot possess aura at all because it has lost the relationship to time and space. Digital objects, on the contrary, generate aura through their metadata and network relationships in time and space. Digital copies are part of the lifecycle of the originating object's cultural trajectory, which is often expressed as a tussle between shifting concepts of aura. Good quality digital facsimiles propagate and add layers of significance and meaning to the original, providing the object with a biography, proliferating its original aura, and even migrating this aura entirely to its digital counterpart.

As digital objects challenge conventions of interpretation, they exist at the threshold of new ways of seeing. Their artful materialities – intangible, reproducible and transmissible – are challenging institutionalized claims of uniqueness and authenticity. The value placed on authenticity and the rejection of copies is also far more culturally specific than most Western literature assumes. China is arguably the apotheosis of the ancient art of copying, where it is considered an act of veneration. This 1000-year-old tradition continues today in the contemporary perfection of replication, which in the context of global capitalism are often seen as 'knock-offs'. Nonetheless, when images filter through such a copy culture, forgery is meaningless. Without a cult of the original, in which there is some notion of a singular and un-repeatable performance, and without the conception of the artwork as a singular non-repeatable event, the counterfeit does not have a place.

Keping Wang (2010), 'The Platonic Mimesis and the Chinese Moxie', *International Yearbook of Aesthetics*, Volume 14, pp. 214–233.

Elizabeth Walden (2011), 'Reflexive mimesis in contemporary visual culture', *Emotion, Space and Society*, Volume 4, Issue 1, pp. 35–41

Marcus Boon (2010), *In Praise of Copying*. Boston: Harvard University Press.

Douglas Davis (1995), 'The Work of Art in the Age of Digital Reproduction (An Evolving Thesis: 1991–1995)', *Leonardo*, Volume 28, Number 5, Third Annual New York Digital Salon (1995), pp. 381–386.

Bruno Latour and Adam Lowe (2011), 'The Migration of the Aura, or How to Explore the Original through Its Facsimiles', *Switching Codes: Thinking Through Digital Technology in the Humanities and the Arts* (Eds), Bartscherer, T. and Coover, R. Chicago: Chicago University Press, pp. 275–298.

Sarah Kenderdine and Andrew Yip (2019), 'The proliferation of aura: Facsimiles, authenticity and digital objects', in Drotner, K., Dziekan, V., Parry, R. and Schrøder, K. (Eds.), *The Routledge Handbook to Museum Communication*. Abingdon: Routledge, pp. 274–289.

Mirrorworld

The mirrorworld is an invisible digital layer of networked data that is spatially anchored to relevant objects and places. In his 1993 book 'Mirror Worlds: Or the Day Software Puts the Universe in a Shoebox…' David Gelernter laid the framework for this unforeseen dimension, where information pours endlessly into a digital model designed to mimic reality's perpetual transformation. The mirrorworld traps the mirror image of an organization, or group of them, in a computer model, which is itself embedded in a model of the organization's environment. It is within this realm that digitaltwins exist as computational representations of realworld entities that each mirror a unique physical object, process, organization, person, or other abstraction. Data from multiple digitaltwins can be aggregated across the network or internet of things (IoT) for a composite view across a number of real-world entities, such as a power plant, a city, or a museum. Cultural collections are now creating their own digitaltwins through processes of scanning, photogrammetry, and 3D modelling. Then, when one of these artefacts is preserved or repaired, its digitaltwin is annotated accordingly. As this action is repeated through its entire lifecycle, it turns a networked entity into a quantized cognitive mirror image.

David Gelernter (1993), *Mirror Worlds: or the Day Software Puts the Universe in a Shoebox… How It Will Happen and What It Will Mean*. New York: Oxford University Press.
    Susan Hazan (2020), 'Through the Looking Glass. Cultural Heritage Custodians to Populate the Mirrorworld', IOP Conference Series: *Materials Science and Engineering*, Volume 949, International Conference *Florence Heri-tech: the Future of Heritage Science and Technologies*, 14–16 Oct. 2020.

Reenactment

Reenactment is a vital tool for sustaining and transmitting culture through replication and repetition. It encompasses profound bodily practices, which replace interpretation with action, experience and impact. With widespread appeal, from the restaging of battle scenes to historic martial arts, and from modern performance art to ancient rites of passage, reenactment reignites the complex temporalities and layers of behavioural cultures. As a sensual, corporeal and kinaesthetic tool, it has the potential to democratize knowledge with its inventive and social modes of historical representation. For scholars of embodied culture, reenactment is a powerful means to generate critical thinking that delves deeper into the past than conventional, predominantly textual, modes of history and heritage production. These novel means of knowledge production signal the rise of new forms of historiography.

As it offers non-specialist audiences authentic experiences and representations of the past, reenactment also challenges codes of authorship and presumptions about the veracity of history. Reenactment transcends orthodox Western mind-matter dualisms to produce new agencies, materialities, intercorporealities, kinetic empathy, sympathetic imagination, haptic communication, and dialogue. As an alternative to conventional heritage production and curatorship, reenactment presents a timely yet unexploited opportunity to create new knowledge by immersing subjects within the embodiment of the past. Today, as it is melded with technologies of corporeality and computational forms of cultural transcription, such as 4D motion modelling through to virtual reality, reenactment has begun to foster powerful avenues for transmission, emanating directly from the wellsprings of embodied cognition.

Vanessa Agnew, Jonathan Lamb and Julianne Tomann (2020). (Eds.), *The Routledge Handbook of Reenactment Studies*. London: Routledge.
    Mads Daugbjerg, Rivka Syd Eisner and Britta Timm Knudsen (2014). 'Re-Enacting the Past: Vivifying Heritage "Again"'. *International Journal of Heritage Studies*, Volume 20, Number 7/8, pp. 681–87.

Algorithmic

Machine learning algorithms are computational systems nestled within the larger domain of artificial intelligence, or AI, that learn inductively from large bodies of data rather than acquiring knowledge deductively from programming. Their intelligence is grounded in the capacity to identify patterns in data that human beings have not discerned, opening up intriguing creative and curatorial possibilities. Today's euphoria around machine learning is reminiscent of the discourses of postmodernists like Gilles Deleuze, who saw the mechanical gaze of the camera as a way of overcoming the empirical limitations of human perception. This thinking also promised to transcend the conceptual boundaries of machinic vision, because a camera can record and convey slow motion, it can thus demonstrate the dynamic pluralism of time. Machine intelligence has provoked us to conceive of suitable concepts to match, such as speculative archaeology, in which the excavation of space and place is performed by machine intelligence and its peripheral vision. Machine learning has also amplified the possible futures for museological practices, antagonizing outdated notions of scarcity and authenticity to generate archives of abundance. In contrast, AI is the precursor of 'blackbox' deepfakes and fake news that mirror human biases and prejudices due to culturally limited training datasets. The paradigm shift in-the-making for AI systems will be that they discover by themselves the logical rules that shape their decision-making processes and then make these explicit for society.

Collectibles

Videogames blend culture and education, offering the potential to transcend the limits of textual monographs, digitized historical sources, and digital simulations. They also provide a new framework of critical enquiry, as well as narrative, social communication and cultural expression. Concepts and mechanisms derived from the digital gaming industry have stimulated curiosity in cultural content. Virtual worlds further provide the scholarly opportunity to transform complex data that are inherently visual into shared laboratories for scrutiny, argumentation, and debate. Commercial videogame companies employ historians, archaeologists and architects to recreate ancient civilizations and monuments, deeply enriching gamers' experiences and stimulating new forms of media consumption. Videogames are products of human creative practice and their widespread influence on society endow them with their cultural significance. As a result, they have found a place in museums as technological artefacts, artistic media, and historic objects. Nonetheless, the process of acquisition threatens to override the culture of game play itself.

Kate Crawford (2021), *Atlas of AI: Power, Politics, and the Planetary Costs of Artificial Intelligence*, New Haven, CT: Yale University Press.
    Brian Cantwell Smith (2020), 'Rethinking our Thinking about Thinking: Epistemology, Architecture, and World' in Lowe, A. (Ed.), *The Aura in the Age of Digital Materiality: Rethinking Preservation in the Shadow of an Uncertain Future*, Factum Foundation, pp.181–191.

Adam Chapman (2016), *Digital Games as History: How videogames represent the past and offer access to historical practice*. New York, NY: Routledge.
    Rose Evelith (2012), 'Video Games Are Officially Art, According to the MoMA', *Smithsonian magazine*, Dec. 3, 2012.
    Christopher Johanson (2016), 'Making Virtual Worlds' in Schreibman, S., Siemens, R. and Unsworth, J., (Eds) *A New Companion to Digital Humanities*, 1st ed. West Sussex: Wiley-Blackwell, pp. 110–126.

Decolonial

Presenting million images of artworks from around the world, networked based aggregators and portals such as Google Arts and Culture and Facebook, are undeniably biased toward 20th century Western art. Little evidence can be found to deny the claims that these collections constitute digital cultural neo-colonialism. Conversely, digital media can be used to create spaces or platforms for those who have been excluded from dominant narratives of literature, history, and culture. The use of digital tools for decolonial-ization is also confronting hegemonic narratives to liberate objects from their untroubled entrapments: ownership, historical sedimentation, and uncontest-ed social relations. In making reparations for the past while emancipating subaltern communities in the present, digital facsimiles of cultural heritage can be very potent, if not revolutionary objects. But post-colonial reconciliation heritage can be only succeed if it happens on the terms set by the once-colonized community, and moreover for their benefit. The law can also play a significant role in embedding ethical com-mitments to applied justice. This process must likewise curb the influence of constraining legal precepts and the vestiges of authority, such as authenticity and rights of access that maintain the power of institutions.

Inna Kizhner, Melissa Terras, Maxim Rumyantsev, Valentina Khokhlova, Elisaveta Demeshkova, Ivan Rudov and Julia Afanasieva (2021). 'Digital cultural colonialism: measur-ing bias in aggregated digitized content held in Google Arts and Culture', *Digital Scholarship in the Humanities*, 19 Dec. 2020.

Lucas Lixinski (2020). 'Digital Heritage Surrogates, Decoloniza-tion, and International Law: Restitution, Control, and the Creation of Value as Reparations and Emancipation', *Santander Art and Culture Law Review*, Volume 2, Number 6, pp. 65–86.

Simon Schaeffer (2020) 'Get Back. Artifices Of Return And Repli-cation', in Lowe, A. (Ed.), *The Aura in the Age of Digital Materiality: Rethinking Preservation in the Shadow of an Uncertain Future*. Madrid: Factum Foundation, pp. 93–99.

'Humans have always lived in a hybrid environment surrounded by artificial and natural objects. The arti-ficial and the natural are not two separate realms, nor are artificial objects simply instruments with which to conquer the natural; instead, they constitute a dynamic system that conditions human experience and existence. And precisely because the artificial is con-stantly developing toward greater concretization, it demands constant reflection on its singular historical condition.'

Yuk Hui (2016), *On the Existence of Digital Objects*. Minneapolis: University of Minnesota Press, p.1.

13.1 *Picasso / Pastiche*

2021

Triptych of original Pablo Picasso painting *Buste de Mousquetaire*, with a flipped 1:1 scale print reproduction, and a projected display of the 25,000 owners' names

Homme XVIIème sur Fond Brun / Buste de Mousquetaire is an original painting by Pablo Picasso from 1968, one of almost 300 variations on the musketeer theme.

Given that the musketeer motif appeared in the last period of Picasso's life, when apparently, he had nothing more to prove, the avatar gave free reign to the artist's lewd sense of humour. Inspired by swashbuckling, adventure and racy novels, Picasso generated hundreds of variations held in collections around the world, sometimes with busty women and eager sparkling-eyed men, or self-portraits in the guise of the 'painter and his model'. The musketeer was also a figure reminiscent of the world of childhood, magic, farces, and masquerades.

As the last of Picasso's myriad alter-egos, the series culminates the artist's penchant for the open theft of the art of others; not only of the character from Alexandre Dumas' famous novel, but also mimicking the selfportraits of Rembrandt and Velázquez, works that are also curiously represented elsewhere in *Deep Fakes: Art and Its Double*. In so doing, Picasso swam against the predominant late-1960s artistic tides of abstraction and minimalism, and critics received these late period works with dismay at the time.

In yet another mischievous proliferation, this is one of the rare examples in which Picasso played with a trompe-l'œil effect. Like the Joker playing card, when rotated 180 degrees, the picture contains a doppelganger musketeer.

Pablo Picasso, *Buste de Mousquetaire*, 1968, Collection QoQa, Geneva, Switzerland © Succession Picasso 2021, ProLitteris, Zurich.

In December 2017, faithful to the motto of the three musketeers, 'All for one and one for all', 25,000 Internet users joined forces to acquire this work, organised by the Swiss community platform QoQa. ch. The collective ownership of the painting marked the first acquisition of such an important work of modern art by a digital community. This brings to mind an historical Swiss precedent.

In 1967, the City of Basel held a referendum with its inhabitants to increase the amount of their taxes in order to acquire two more of Picasso's canvases. When the 'yes' won, the artist was so moved that he gifted yet another two works. Today, each of the 25,000 owner-contributors provide their opinion on the future of the painting: its movement, sale, exhibition and other public events.

13.2 *Buste de Mousquetaire 5D*

2018

ARTMYN for QoQa. Interactive installation of 5D scan on 55-inch monitor. Collection QoQa, Geneva, Switzerland © Succession Picasso 2021, ProLitteris, Zurich

ARTMYN for QoQa

In 2018, *Homme XVIIème sur Fond Brun / Buste de Mousquetaire* was scanned in 5D ultra high-resolution at 3.5 billion px / m². Displayed on a 55-inch interactive screen, we have access to high definition and ultra-close range vision of the unique properties of the painting, such as its topography, material reflectance and colorimetry. Such a vision not only forensically animates the work but also, paradoxically, enables the uniqueness of the original to be safeguarded, and thus prevent the threat of forgery – an irony that would amuse the arch-appropriator Picasso if here were here with us today, who notoriously once said: 'Good artists borrow, great artists steal.'
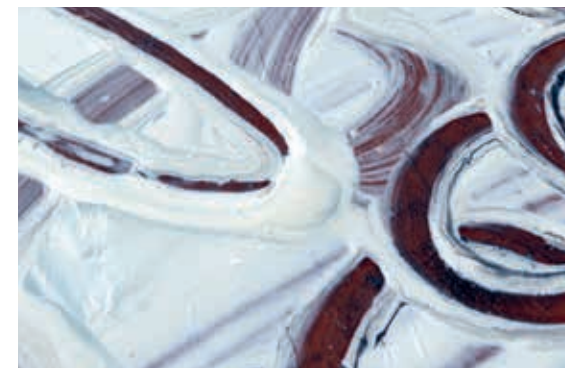

Image courtesy: ARTMYN

Image courtesy: QoQa

ARTMYN, an EPFL spin-off company provides 5D interactive images for art lovers, auction houses and digital encryption in ultra-high definition (more than a billion pixels depending on the artwork). This allows viewers to interact with the digitaltwin of the scanned artwork, interacting with the surface, zooming inside the texture, or relighting the artwork through changing the orientation of the illumination source. Scans include UltraViolet, Near Infrared and Visual Light.

14 *Henry VIII Trifold*

2021

A triptych centred on the mid-16th century *Portrait of Henry VIII* and its forensic analysis using ultra-high resolution XRF scanning

Henry VIII Trifold is a three part installation consisting of a striking 16th-century painting of the notorious Tudor monarch Henry VIII, alongside two monitors with ultra-high resolution images of the original work.
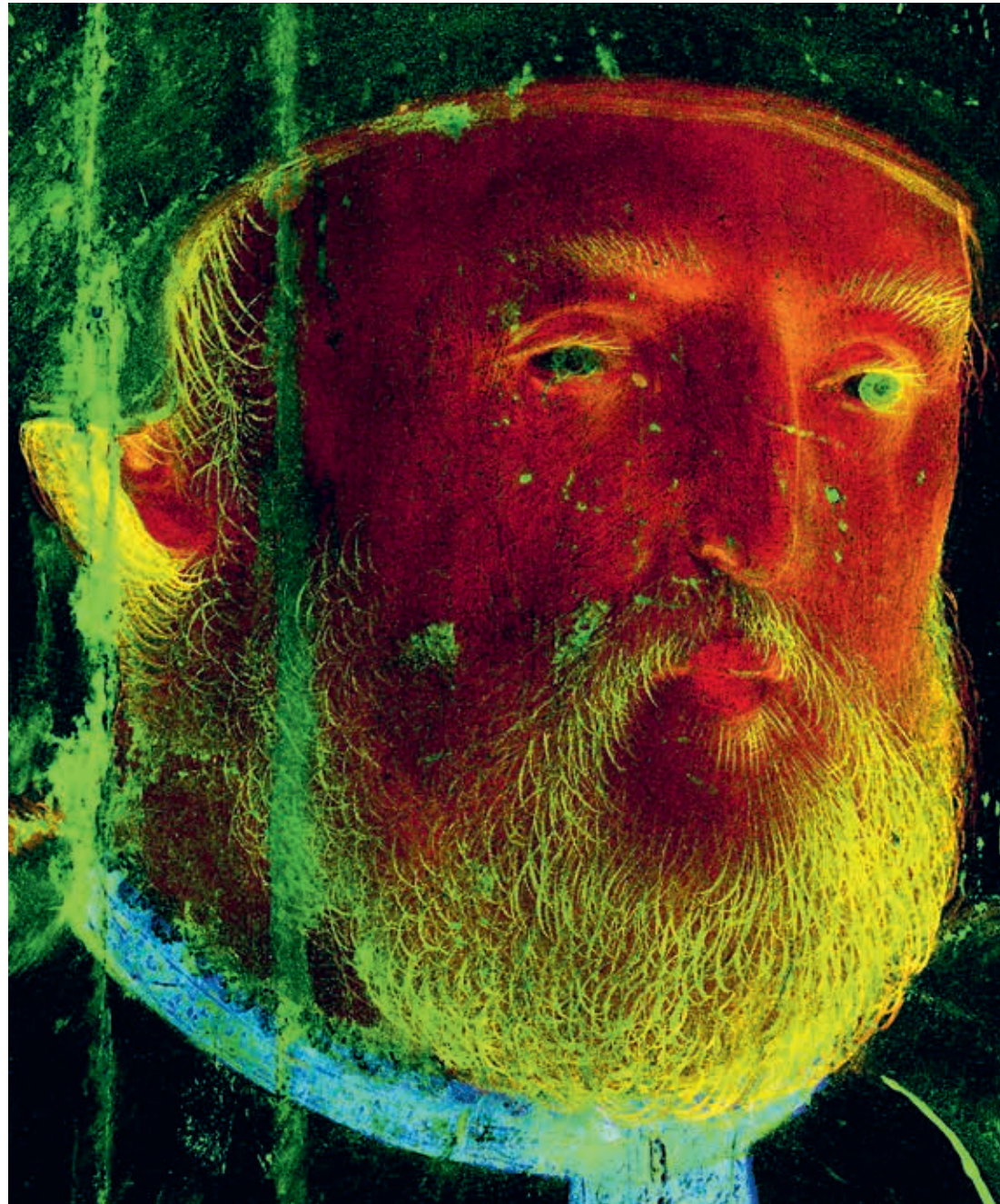
Portrait of Henry VIII, detail of high-definition X-ray fluorescence mapping composite scans of heavy elements: mercury (Hg), iron (Fe) and gold (Au). Image: Australian Synchrotron & Art Gallery of New South Wales.

14.1 *Henry VIII Trifold (I): Portrait of Henry VIII*

1535–1540 CE

Oil on oak panel. 54.5×38 cm. Collection Art Gallery of New South Wales, Australia. Purchased 1961

Attributed to an anonymous Anglo-Flemish workshop

Portrait of Henry VIII, prior to restoration. Photograph: courtesy Art Gallery of New South Wales.

In 1961, the early Tudor portrait of England's King Henry VIII was acquired by the Art Gallery of New South Wales, Australia. Painted in oil on oak panel and dated between 1535 and 1540, the authorship of this work has been attributed for many decades to an anonymous Anglo-Flemish workshop. It was also unclear whether the work was made by a single workshop or different workshops or artists. Little associated documentation on Anglo-Flemish workshops and artistic practice prior to 1540 has survived, and so the paintings themselves are the key source to unlock these questions. Similar to many other representative works in *Deep Fakes: Art and Its Double*, this portrait is one of countless renditions of Henry VIII.

14.2 *Henry VIII Trifold (II)* **2021**

Video of X-ray fluorescence (XRF) mapping of trace metals. XRF scans by the Australian Synchrotron in collaboration with the Art Gallery of New South Wales. Produced by EPFL Pavilions

14.3 *Henry VIII Trifold (III)* **2021**

Interactive installation. High-resolution RGB scan (1200dpi), LuxLab, UNSW, Sydney. Produced by EPFL Pavilions in collaboration with the Art Gallery of New South Wales

Sarah Kenderdine and Andrew Yip

Portrait of Henry VIII, detail of high-definition X-ray fluorescence mapping, scan of mercury element (Hg). Image: Australian Synchrotron & Art Gallery of New South Wales.

Detail of *Portrait of Henry VII*, scanned at 1200dpi. Image: LuxLab, UNSW Sydney.

In 2014, prior to planned conservation treatment, a full technical study was undertaken of the *Portrait of Henry VIII*. This included high resolution RGB photography, comparative analysis of differing fluorescence between varnish and paint layers, and dendrochronology, or tree-ring dating, of the oak panel. The first of many objectives underpinning this unique exercise was to investigate the art work's uncertain authorship. The second related reason was to compare Sydney's *Henry VIII* with four similar early Tudor portraits of the King held in British collections, in partnership with a research project led by London's National Portrait Gallery.

The *Portrait of Henry VIII* was then examined for the first time using high-definition X-ray fluorescence mapping technologies, realised at the Australian Synchrotron particle accelerator. Intense beams of light were harnessed to scrutinise the art work's substrata material composition. The elementally heavy pigments detected include: copper (Cu), chromium (Cr), lead (Pb), mercury (Hg), iron (Fe), and gold (Au). Each element analysed was used to create discreet image maps of oil paints, such as white (lead), chrome green (copper), and vermillion (mercury). The XRF mapping of the panel has also allowed revelations of previously obscured features, alongside insights into the process of making the painting and consequent new clues as to its true authorship.

In 2014, the *Portrait of Henry VIII* was also linear-scanned at 1200 DPI. The resulting images can be digitally projected and magnified to many times the size of the original object, as the touchscreen display in *Henry VIII Trifold* evidences. At higher levels of magnification, cracks, areas of loss, brush marks and traces of paint become more apparent, normally being invisible to the human eye.

This forensic vision revealed that the superficially crude work had in fact been made with delicacy and precision.

For instance, the simultaneous scrutiny of Henry VIII's right eye in both the scan and XRF map shows the presence of a tiny, one millimetre stroke of copper-based blue, presumed to contain the pigment azurite. Importantly, it is the only use of blue pigment found on the painting. Furthermore, the National Portrait Gallery's *Henry VIII* also features an azurite stroke in the eye, suggesting that the two works share at least one author or studio in common.

89 seconds Atomized

2018

Live-stream video installation. 9:44 minutes x 2,304 atoms. Collection of the artists

Eve Sussman | Rufus Corporation and Snark.art

In 2004, Rufus Corporation, Eve Sussman's ad hoc company of collaborators, premiered *89 seconds at Alcázar*. Installed in a pitch-black room as a life size projection with multi-channel audio, the piece reimagines the movement, gestures, sounds and psychology, leading up to and following the iconic moment depicted in Diego Velázquez's *Las Meninas*. Conceived as a looping choreography (with choreographer Claudia de Serpa Soares) there is no clear beginning or end as the scene seamlessly unfolds and reassembles itself, playing with the conceits that have been the endless subject of debate: were Philip IV and Mariana in the room? Is the image on the back wall a painting or a mirror? What was Velázquez looking at?

In 2018, when Snark.art approached Sussman about creating a blockchain project she imagined appropriating her own artwork, shattering her final artist's proof into thousands of pieces that could be shared and re-assembled. Each piece of *89 seconds Atomized* is a 20 × 20 pixel video (an 'atom') of the video art work *89 seconds at Alcázar*. An experiment in collective ownership and interaction, blockchain mechanics allow each atom owner to borrow atoms from the entire community to view *89 seconds Atomized*. The degree to which the image is re-assembled is dependent on the participation of the community of 89SA collectors. A re-thinking of the unfolding and reassembling in the original artwork, *89 seconds Atomized* dives into the picture plane further dissecting the picture's conceptual loop.

Eve Sussman is a Brooklyn-based artist and filmmaker. In the course of her career, her work has pushed the boundaries of cinematic experience, compelling viewers to actively participate in the invention of the story. Her algorithmically generated film, *whiteonwhite:algorithmicnoir* edits live, never repeating the same way twice. Snark.art is a blockchain laboratory exploring creative and commercial possibilities in art, founded in Williamsburg, Brooklyn in early 2018 by Andrey Alekhin and Misha Libman. In that same year, Snark.art approached Sussman about creating a blockchain project, a collaboration that resulted in *89 seconds Atomized*.
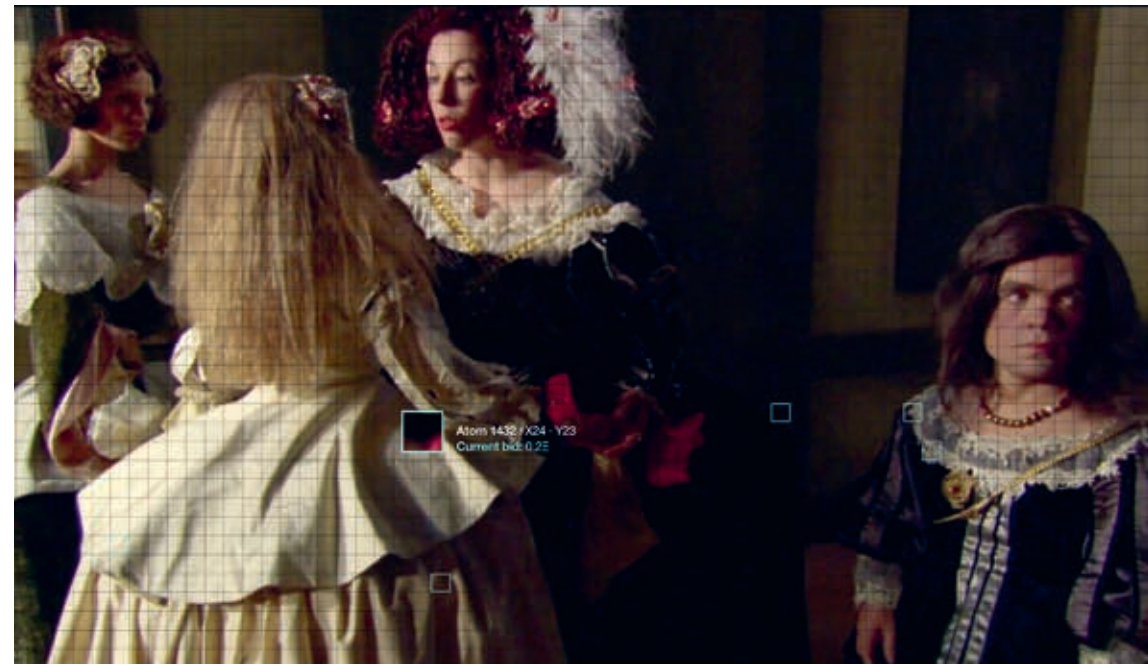
Images courtesy the artists
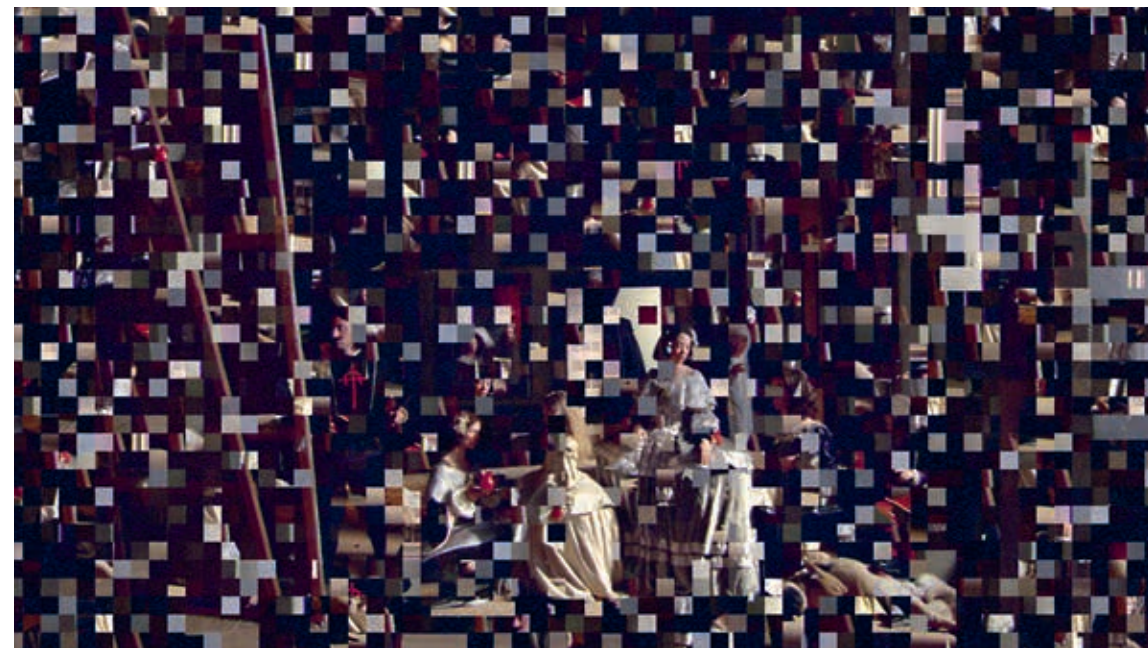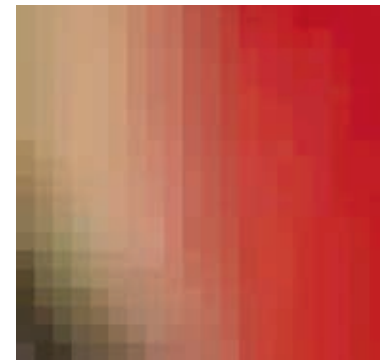
15.2 *Las Meninas by Diego Velázquez in the Museo del Prado Madrid Spain*

2006

Digital photograph
59.5 × 80 cm

Alex Segre

The camera gazes at people looking at art and equates it to a form of visual eavesdropping. It captures audience dynamics: witnessing revelation, speech in action, social interactions, body language, expressions, and fashion. In the lens of the camera, the subject and object oscillate. The subjectivity of the art experience demonstrates how differently people respond to a work of art, even though the material work itself remains unchanged. But the subjective experience of art is always historically situated and, for this reason, its interpretation is always changing. Artworks are prisms that give rise to new realities every time they are viewed.

This photo is one of thousands of similar images that depict visitors gazing upon the 17th-century painting *Las Meninas* (1656) by Diego Velázquez at the Prado Museum, Spain. The painting's complex and enigmatic composition provokes profound questions about reality and illusion, as it creates an uncertain relationship between the viewer and the figures depicted. These complexities have led to *Las Meninas* becoming one of the most extensively copied and analysed works in Western art.

Photograph: Alex Segre

2020

Bernd Lintermann and Florian Hertweck

Images: Bernd Lintermann

TRUST AI is an interactive media art work with a holographic representation of a human face that is operated by artificial intelligence, also known as AI. Entering into dialogue with this face, we cannot perceive our counterpart's motive. But the machine gradually hijacks our face, taking over our identity and speaking back to us. Today, media content is not only filtered by algorithms, but it is also produced by them. An intelligent learning machine can also assemble seemingly banal things into surprisingly precise conclusions about our personality. Today's so-called 'deepfakes', in which faces are authentically simulated in videos, are perceived by us as authentic images of reality, even though they are based on synthetic or procedural media, and their functionality in computing processes.

In *TRUST* AI the face shows us how these processes can influence our lives with the data they have collected. But how complex is the machine with which we communicate? Which processes are really running in the background? And to what extent does this 'face' have access to my data?

In a dialogical interplay between visitors and a machine, *TRUST* AI addresses the role of digital change and its dilemmas for us humans and society, such as privacy, truth, democracy and trust. It shows us the power of procedural media to determine how the individual perceives society and how society perceives the individual today. As we sense that deepfakes are not an illusion but the mirror of surveillance capitalism, in *TRUST* AI we experience an intense feeling of insecurity analogous to our wider concerns about digital change in society.
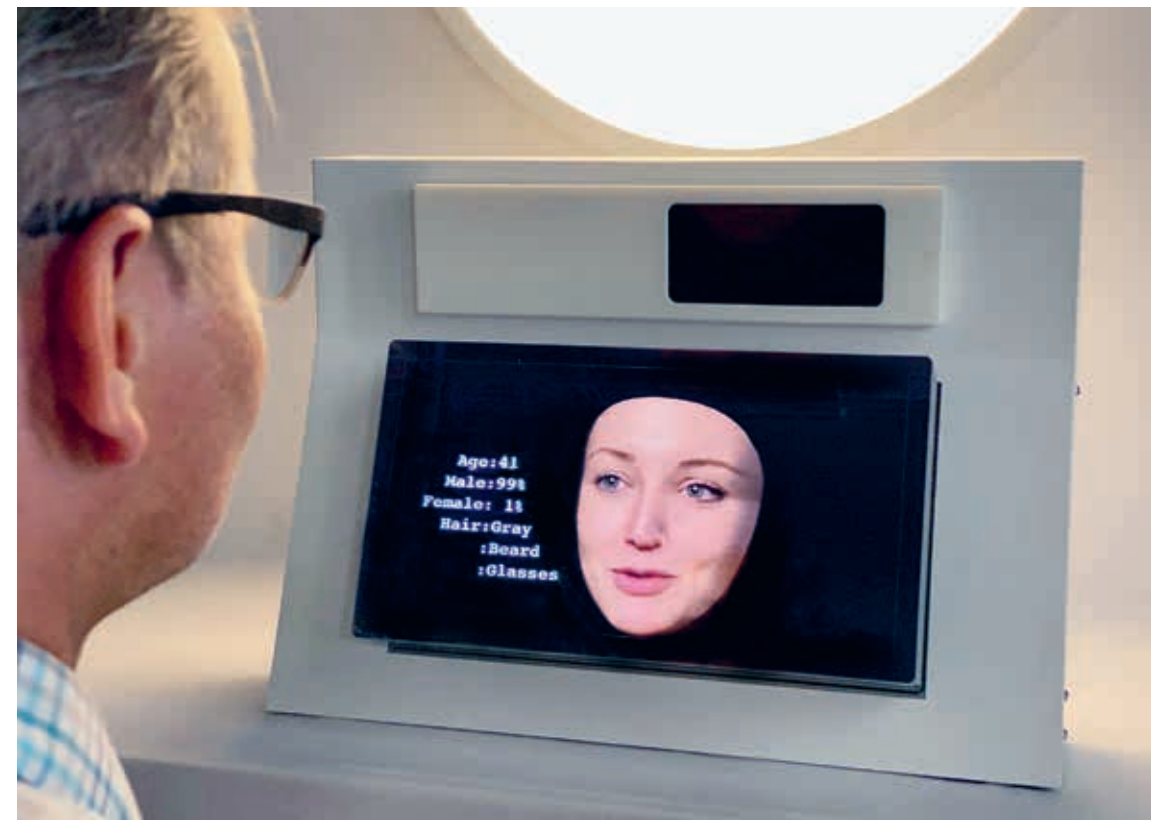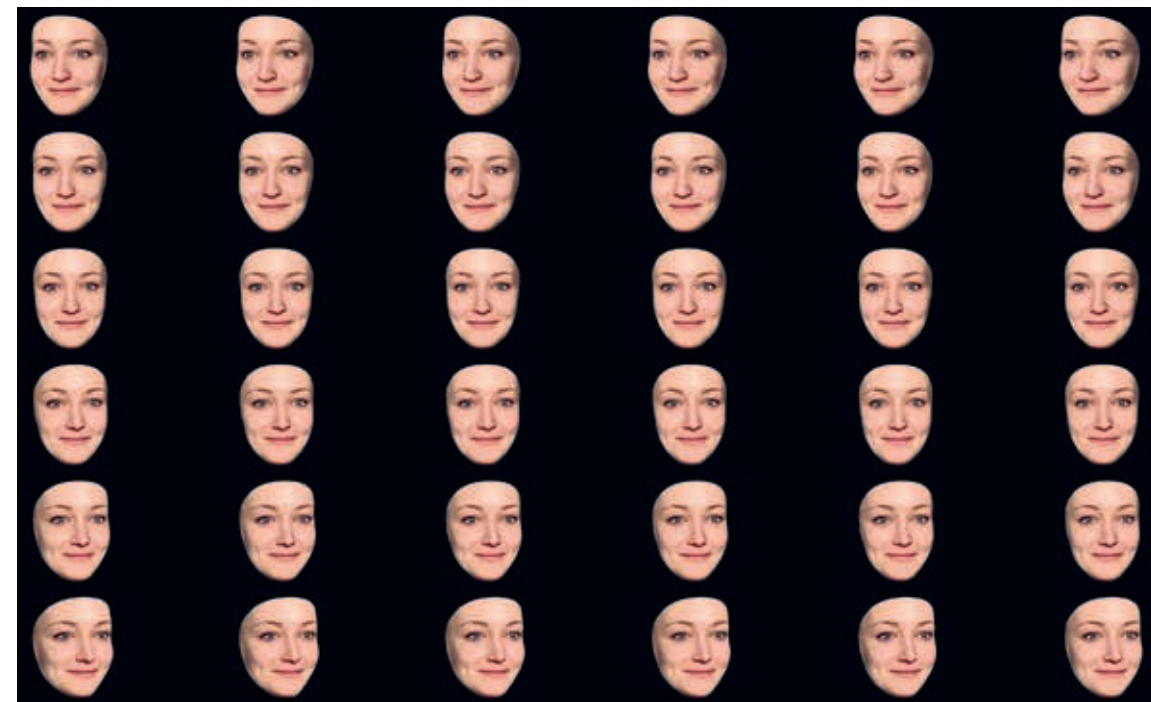
Bernd Lintermann and Florian Hertwec collaborated for the first time in 2016 to realise a mobile device-based augmented reality enactment in the city of Karlsruhe, titled 'Karlsruhe Maptory, A Digital Enactment in the City'.

They reunited to produce *TRUST* AI at the ZKM | Hertz-Lab in response to worrying developments in the area of deepfakes. Bernd Lintermann works as an artist and scientist at the ZKM | Hertz-Lab in the field of real time computer graphics with a strong focus on interactive and generative systems. Florian Hertweck is a freelance director, actor and musician, and Professor for stage acting at the Film University Babelsberg *Konrad Wolf*.

Christian Mio Loclair

Photos: Marco Petracci

If an aesthetic object is created without any human leitmotif or purpose, do we witness an accidental product of nature or do we perceive new forms of artificial intentions?

Helin is a sculpture and video project probing individual human and artistic intent with a highly autonomous technology such as machine learning. Created from an initial dataset of 120,000 3D scans of historical busts to train a custom network architecture to generate a composite model. To remove bias from the dataset and establish a universal view towards human expression, *Helin's* production included the incorporation of material across all accessible epochs and cultures from online sources such as *scan the world*.

In yet another process, each sculpture was re-oriented to face the z-axis, re-meshed to create a uniform topology, and normalized in 3D space. Furthermore, different 3D noise functions and subdivisions were used to create new arrangements and permutations of the original historical busts. This compound data is frozen in the form of a Carrara marble sculpture, carved by a robotic arm, challenging the status of art in the absence of a human author. As *Helin* translates assembled intelligence into a natural and tangible artefact, it offers insight into the historical and spatial data of human expressions. It embodies an organic data mirror emerging from collective historical heritage.

Christian Mio Loclair practices at the interface of artistic and scientific research. Using custom algorithms, data and digital devices, Loclair creates sculptures, video works and installations that aim to convey the aesthetics and frictions of both human and digital identity. In his work, Loclair explores the human body, organic movement and codified nature with opposing digital processes, data-driven algorithms and machine learning. His artworks focus on the novel aesthetic identities that derive from the interplay of mathematical and poetic research, examining both creative and societal potentials of artificial intelligence as well as the oppositional myth of human versus machine.

The Abbey St Michel, Bamberg

Bauhaus-Universität Weimar, ArcTron 3D and Consensive, with Digital Projection

The Abbey St Michel, Bamberg is a unique interactive tour of the former St Michel Benedictine monastery situated within the UNESCO World Heritage Site of Bamberg City, Germany. The extraordinary German Renaissance style interior of the church has been digitized with laser scanning and photogrammetry. The mimetic perspective rendering of this magnificent building is peopled with stunning 3D models of the abbey's legendary saints and sacred relics, including the abbey's namesake, the archangel Michael.

Image: ArcTron 3D

Guided through the space, these models reveal a series of compelling stories, such as that of Bamberg Abbey's founders, King Heinrich II and Queen Kunigunde. Empress of the Holy Roman Empire by marriage to Holy Roman Emperor Saint Henry II, Kunigunde was canonized by Pope Innocent III on 29 March 1200, 53 years after the canonization of her husband in July 1147. Both are buried in the ornate tomb at Bamberg Abbey.

The Abbey St Michel, Bamberg is a world premiere for the use of the new Digital Projection INSIGHT 4k HFR 360 Multi-View 3D projector. Instead of providing 120 frames per second used in all active stereoscopic projections, which is enough for single user 3D, the INSIGHT 4k HFR 360 delivers an unrivalled 360 frames-per-second at native 4k resolution.

Since the discovery in 2012 of serious structural damage to the Abbey St Michel, Bamberg, the building has closed to the public and subject to an immense restoration project managed by the City of Bamberg. As part of this process, ArcTron 3D was commissioned to realise a high-resolution, three-dimensional digitization of the abbey's entire interior as well as photorealistic 3D reconstructions of its complete inventory of art treasures.

In tandem with ArcTron 3D, collaborators from the Virtual Reality and Visualization Research group at Bauhaus-Universität Weimar were brought on board to develop real-time rendering techniques for these large 3D models. Their novel presentation in immersive virtual reality as part of unique multi-user 3D projection technology was later industrialized and commercialized by Digital Projection, a digital imaging pioneer and industry leader. Finally, Consensive collaborated with ArcTron 3D to realize the interactive multi-user exhibit presented in *Deep Fakes: Art and Its Double.*
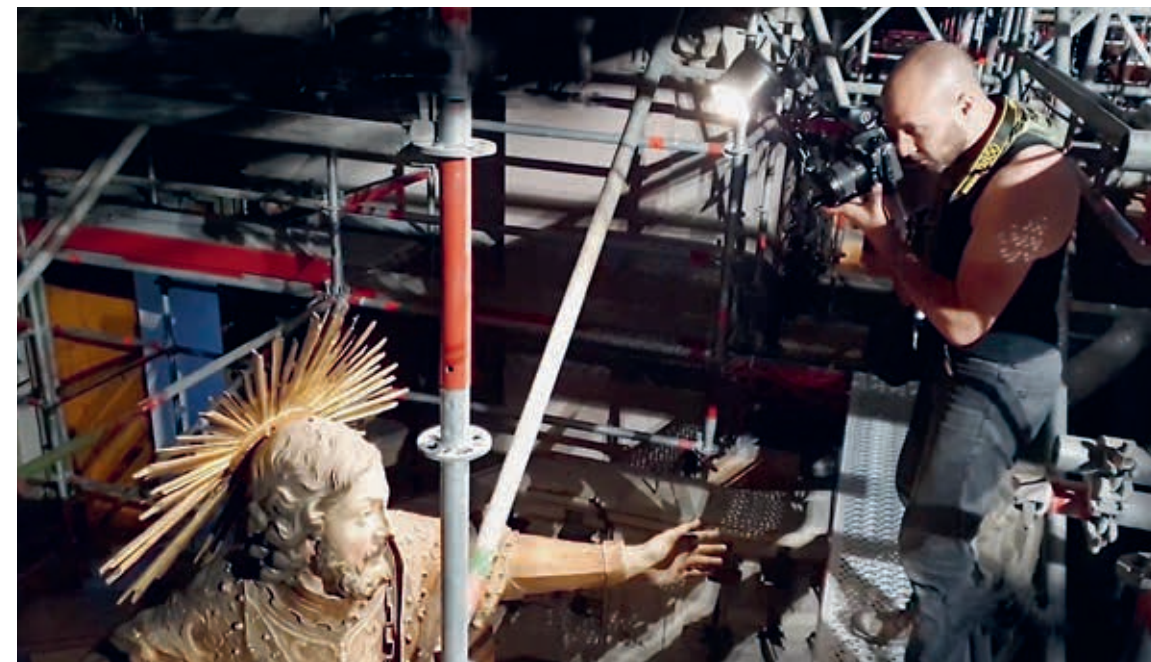
Terry Kilby

Speaking Back is an interactive installation based on two 3D models created in June 2020 and January 2021, witnessing the momentum of Black Lives Matter protesters who transformed a symbol of hate for their own empowerment.

For over a century, Richmond's Monument Avenue in Virginia, USA featured five enormous bronze statues of Confederate leaders, vestiges of America's national trauma, the Civil War. Today, the last one standing is that of 19th-century American Confederate general Robert E. Lee. Statues devoted to such divisive figures in American history have become a flashpoint for legal and physical clashes about their dual significance as symbols of white supremacy as well as memorials erected to commemorate the deaths of Confederate soldiers and citizens in the Civil War.

Following the murder of 46-year-old black man George Floyd by Minneapolis police on 25 May 2020, peaceful as well as violent protests erupted along Richmond's Monument Avenue. The statues themselves became the epicentre of civic uprising. Black Lives Matter protesters took over the Lee monument, setting up camp around it with tents, lawn chairs, and a barbecue. Rather than topple or deface the statue, which stands 60 feet high, its plinth was gradually covered with graffiti and signs calling for racial equity or expressing rage against Black oppression. It was also augmented with artwork, candles and flowers as makeshift gravestones for Black victims of police violence.

While a seemingly objective view, the 3D models of *Speaking Back* have provoked intense reactions across the political divide, showing how important digitaltwins could be for the decolonization of ostensibly immovable monuments. They also amplify the voices of those who found them for the first time in reclaiming the monument as

their own. As of 9 June 2021, the state's right to remove Richmond's monument to Robert E. Lee remains before the Supreme Court of Virginia.

In mid-2020, Terry Kilby was confronted with the images on social media feeds of the protests taking place around the Robert E. Lee Monument and the resulting graffiti. He also began to hear the first-hand stories of people living in Richmond, Virginia. Recognizing a pivotal moment in history, he decided to document the events taking place at the monument in the form of a 3D scan.

Hailing from Maryland in the US, Kilby is a 3D capture artist and aerial photographer specializing in the documentation of cultural heritage sites. Terry was a pioneer in the burgeoning drone industry of the late 2000s and has written several books, magazine articles and case studies on the topic over the last decade. His work combines elements of aerial photography, terrestrial based LiDAR and custom-built camera systems to capture high resolution 3D models and panoramic images of the sites he documents. He also leverages his background as a software developer to create public experiences around the assets he captures.
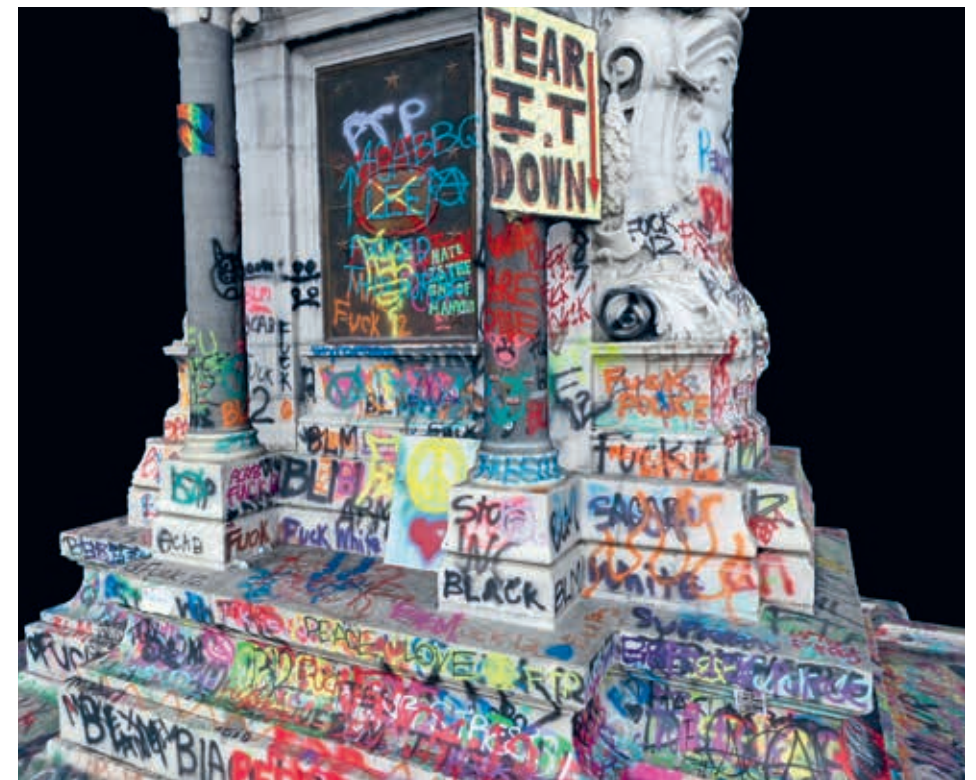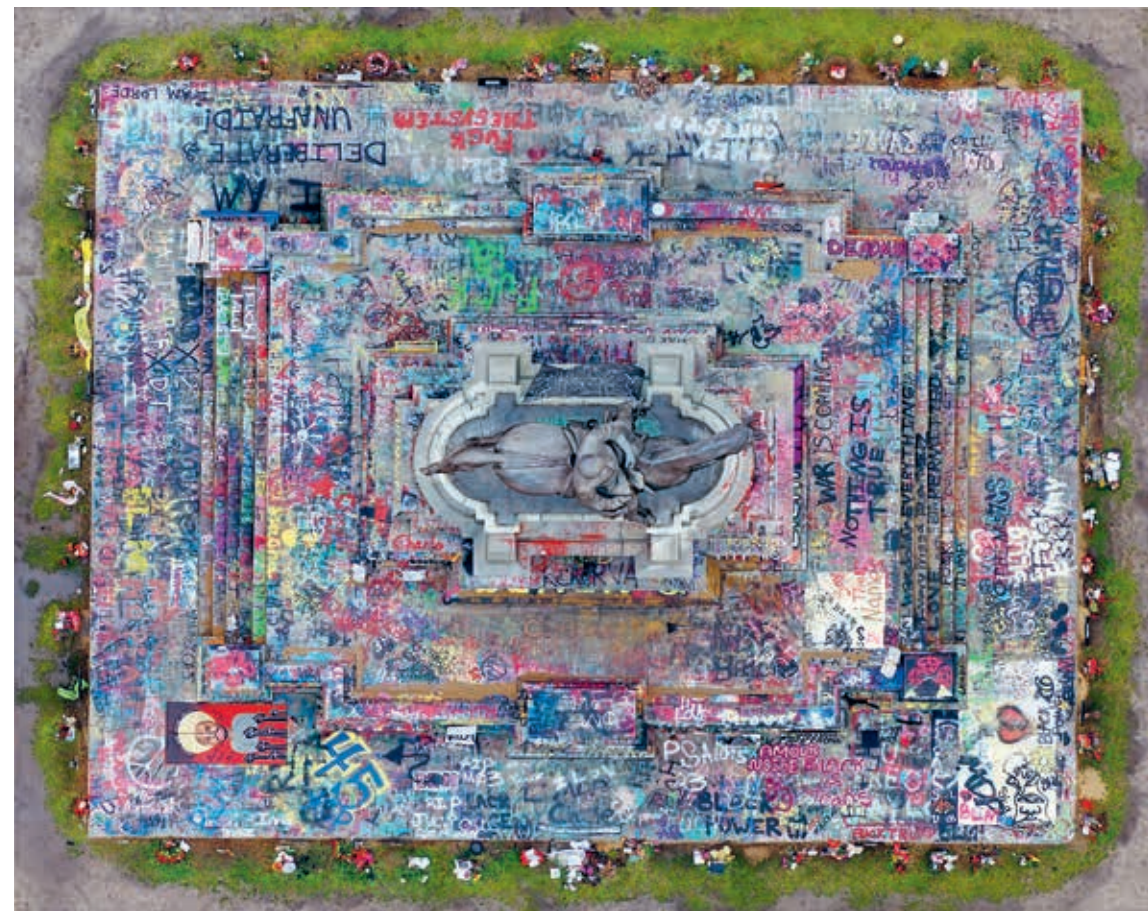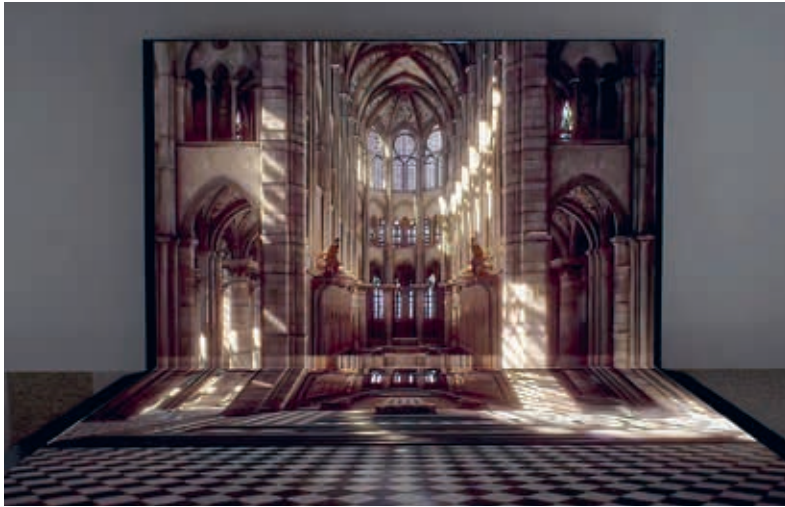

Images courtesy: Terry Kilby

Ubisoft

Images by Sarah Kenderdine, courtesy Ubisoft.

On 15 April 2019, the world watched on as the Notre-Dame de Paris was almost destroyed in a devastating fire. As the tragedy unfolded, people began sharing memories of the cathedral with photos and videos reliving those moments. Others were able to relive their memories virtually through the video game *Assassin's Creed: Unity*. While it is closed for restoration, the *Notre-Dame de Paris* allows viewers to experience the cathedral through a moving game engine experience. Recreated for *Deep Fakes: Art and Its Double* in the 0.5 Cave, the installation challenges the premise of heritage as frozen, and opens up new opportunities for historical knowledge production.

Adapted from the 3D model first created for Ubisoft's videogame *Assassin's Creed: Unity* (2014), the reconstitution of Notre-Dame de Paris is the result of 5,000 hours of detailed graphic work. Ubisoft has been collaborating with historians for years, meticulously collecting data and testimonials to reconstitute the iconic monuments of Paris within the game. This model however is not intended to be scientifically accurate.

While the game returns players to mid-18th century Paris, at the time of the French Revolution, this virtual visit is nonetheless a journey back in time, in the history of Notre-Dame. Out of the need to empower storytelling and hold the interest of the audience, Ubisoft chose to represent the famous spire, and the gargoyles, which were only added by Eugène Viollet-le-Duc after the French Revolution. And the fountain on the forecourt was destroyed before that date. But the paintings in the nave were present at the time, and so was the Bastille prison that can be seen from the hot-air balloon.

Since the fire took place, Ubisoft have presented this experience to those undertaking the restoration of Notre-Dame de Paris. From the stonemasons and stained-glass window makers, to the architects, and the Archbishop of Paris, they have all loved the emotional quality of this restitution!

As a creator of history-based virtual worlds for videogames, Ubisoft is deeply concerned with the preserva-tion of cultural heritage. The company works with historians, archaeologists, architects, and all kind of experts to recreate ancient civilizations and monuments.

With this project, Ubisoft leverages the empathic power of virtual reality. This model of Notre-Dame is spirited and emotional because it is rooted in a lively 3D model of Paris: you can see boats on the River Seine and people in the forecourt of the church, and you can recognize famous Parisian monuments all around. In response to destruction, we bring digital rebirth, and to give tribute to a cultural wonder that can be shared even when it is no longer physically accessible.

This virtual tour will be featured in an exhibition on Notre-Dame at the Archeological Crypt of Paris, opening in the second half of 2021.

Recreated Reality

2021

Collart-Palmyre Project, University of Lausanne

Tirésias UNIL database. Screenshot of some of the Collart-Palmyre collection. (2021).

Listed as a UNESCO World Heritage Site in 1980, the site of Palmyra, of which the Temple of Baalshamin is part, was destroyed with explosives by the Daesh / ISIS group in 2015. Thanks to the numerous collected photographs, files, notes, letters and plans, the archives of Paul Collart are the best source in the world for documenting the sanctuary. The long-term preservation of this information, in a digital format accessible to all interested people, is an essential step in order to preserve the memory of the place. This cultural heritage is an important element for social cohesion and the reconstruction of identities in this post-conflict context.

This installation features four tablet-based works: an interactive map of the archaeological site of Palmyra with photos from the Paul Collart archive; a diachronic animation of 3D replica models of the Baalshamin sanctuary across

the 1st century BCE to the 12th century CE; a portal to browse digitized archival documents in the ASA-UNIL database Tirésias; and a digital version of an excavation notebook from the Collart archives.

Launched in 2017 by the Institut d'archéologie et des sciences de l'antiquité at the University of Lausanne, the Collart-Palmyre Project aims to ddigitize and disseminate the entire archive of Paul Collart relating to the Baalshamin sanctuary, archived and studied by UNIL. Undertaken from the mid-1950s, the Collart collection records the first excavation of the ancient sanctuary of Baalshamin in Palmyra, Syria, as well as its reconstruction at the time using novel experimental archaeology methods.

Collart-Palmyre Project is supported in Switzerland by Association Paul Collart au Proche-Orient, Loterie romande, Office fédéral de la Culture, Société académique vaudoise, Fondation Leenaards, the Fondation UBS pour la culture, SICPA, Fondation ALIPH.

Rudolf Fellmann. *Palmyra / Tadmor, sanctuary of Baalshamin. Temple, view of the du north-east.* (1954–1956). B&W photograph. Paul Collart © IASA-UNIL.

Unknown photographer. *Scenic photograph of Palmyra/Tadmor with Paul and Madeleine Collart.* (c. 1954–1956). B/W Photography. Paul Collart © IASA-UNIL.

21.2 *Clouds of Palmyra* 2021

2:25 minutes. Originally commissioned by the Institut du monde arabe, Paris, for the exhibition *Age Old Cities: A virtual journey from Palmyra to Mosul*

Iconem

Images: Iconem

A ten-metre wide projection shows the Temple of Baalshamin. Based on exhaustive photogrammetric reconstruction of the site, the video depicts how modern technology is facilitating insight into and analysis of monuments that have been destroyed. The destruction by Daesh / ISIS in 2015 of Baalshamin Temple was primarily achieved through the placement of explosive charges at key points in the centre of the structure, causing a radiating blast whose crater can be seen at the base of the pile of ruins. Using this geometric radiation, the position of the collapsed blocks makes it possible to deduce their original location within the building itself and thus envisage their restoration. The reconstruction of the temple combines a digital model created from drone-based photogrammetry with historical archives from the Paul Collart collection.

Founded in 2013, Iconem is an innovative company that specialises in the digitisation of endangered cultural heritage sites in 3D. Iconem's mission is to further the conservation of these endangered places by digitising them for exploration and study, today and tomorrow. Their expert team travels the globe, combining the large-scale scanning capacity of drones and the photorealistic quality of 3D to create digital replicas of the most treasured places, record them for future generations, and champion them today.

21.3 *Archives on display* 2021

Collart-Palmyre Project, University of Lausanne. Installation of artefacts presented on a light table, originals from the archives of Paul Collart, conserved at University of Lausanne

Pages from *Sketchbook of Baalshamin sanctuary sculptures* (1954) featuring drawings by Michelle Boissonnas and notes of Paul Collart. 32×21 cm.

Incorporated into a table-top display are objects from the Paul Collart archive, such as the *Sketchbook of Baalshamin sanctuary sculptures* (1954) featuring notes from Paul Collart and drawings by Michelle Boissonnas, Rudolph Fellmann's *Photograph sheet of the funerary monument of the Baalshamin sanctuary* (1956), and a drawing by Jacques Vicari and Paul Collart of a pediment from the Baalshamin Temple (date unknown).

21.4 *Dialogue with Syrian archaeologist Hasan Ali* 2021

Collart-Palmyre Project, University of Lausanne. Twin screen video installation. 7:43 minutes. Translation: Khaled Al Saleem, Patrick Michel. Video editor: Samy Mannane. Co-produced by Sabancı University, Istanbul, Turkey, and EPFL Pavilions

Dialogue with Syrian archaeologist Hasan Ali. Stills from video in English and French translation. Courtesy Collart-Palmyre Project, University of Lausanne.

This video of a dialogue with Syrian archaeologist Hasan Ali complements the recent sociological study undertaken with members of the Syrian diaspora for the Collart-Palmyre Project. This video was recorded with the intention of better understanding the role of new technologies, such as photogrammetry, image-based modelling and 3D printing, in the restoration of collective memory and heritage preservation. It also reveals the complexities of these digital doubles for the victims of cultural destruction and loss. This resurfaces debates about whether copies can retain the 'aura' and authenticity of the original.

Extended Credits

4   *Replica / Real / Replica* (2021)

Special thanks to: Helen Dorey, Deputy Director and Inspectress, The Sir John Soane's Museum. Dr. Mostafa Waziri, Secretary General of the Supreme Council of Antiquities of Egypt, Ministry of Tourism and Antiquities. Mohamed El Seaidy, Director of Scientific Office of the Secretary General of the Supreme Council of Antiquities, Ministry of Tourism and Antiquities. Marianne Tames-Demauras, Archaeological Scientist & Egyptologist, University of Cambridge. Professor Franco Porcelli, Department of Applied Science and Technology, Polytechnic University of Turin. Nannina Spanò, Associate Professor Polytechnic University of Turin. Filiberto Chiabrando, Associate Professor Polytechnic University of Turin. Professor Massimo Osanna, Director General, Parco Archeologico di Pompei. Lion Television.

5   *Double Truth* (2021)

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12   *The Next Rembrandt* (2016)

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18   *The Abbey St Michel, Bamberg* (2021)

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20   *Notre-Dame de Paris* (2021)

Acknowledgements: Ubisoft, based on the 3D assets from *Assassin's Creed: Unity*. Assassin's Creed TM & © 2020 Ubisoft Entertainment. All Rights Reserved. Music: Johann Sebastian Bach, *Fantasie in G minor* BWV 542 performed by Olivier Latry on the Cavaillé-Coll organ of Notre-Dame de Paris in January 2019. Courtesy of La Dolce Volta (℗ La Prima Volta & © La Dolce Volta 2019).

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Deep Fakes
Art and Its Double

EPFL Pavilions, Lausanne

17.9.2021 – 6.2.2022

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