Radical Intangibles: Materializing the Ephemeral

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Abstract

New materialism considers that the world and its histories are produced by a range of material forces that extend from the physical and the biological to the psychological, social and cultural. In recognizing that heritage is not held in objects alone, new materialism discourses echo definitions of intangible cultural heritage (ICH) enshrined in the 2003 UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage. While museums understand the weight of responsibility when engaging with communities of practice, many still restrict the representation of archived ICH material to oral histories, object biographies, video and audio recordings of songs and performing arts. The technical complexities of archiving the 'live' perpetuate nineteenth-century museum display conventions, such as fixed-point perspectives and linear approaches to representation. To address this gap, we introduce 'computational museology', which brings a systems thinking approach to 'whole of environment' encoding. Such a framework unites, for instance, artificial intelligence with data curation, and ontology with visualization, as well as embodied participation through immersive and interactive interfaces. The implications of such a framework have yet to be fully theorized but it is evident that a new paradigm of materiality comprising 'radical intangibles' is taking shape in museums, which signals a break with both Western historiographic orthodoxies and hypothetical paradigms of tangible and intangible heritage. This article foregrounds the emergence of radical intangibles as crucial new digital materialities that are transforming reenacted and embodied practices. We demonstrate these radical intangibles in the in the discussion of two longitudinal curatorial projects based in China and Hong Kong: the first, 'Hong Kong Martial Arts Living Archive' (HKMALA) in collaboration with the International Goushou Association in Hong Kong, and the second, 'Remaking Confucian Rites' (RCR), undertaken in conjunction with Tsinghua University in Beijing. Both of these projects are significant for having taken up 'technologies of corporeality' – digital paradigms at the forefront of computer graphics, spatial and temporal modelling, and virtual reality. The powerful tools being developed across the two instances have begun to revolutionize ICH as a practice, a mode of transmission, and an object of study

Key words: digital museums; computational museology; new materialism; embodied historiography; virtual reality

Introduction

New digital materialities have, in recent years, become a vital apparatus for embodied practices of historical production and scholarship, from interpretation and documentation, to reperformance, display and transmission. What were once considered practices beyond representation or recording, the intangible realms of experience inherent to bodies (as they are conjoined with minds) are being transformed through computational processes into what we call 'radical intangibles'. We introduce the term radical intangibles to convey the paradigmatic change that digital materiality has wrought on objecthood and its ontologies,

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which are driving a new era of archiving lived and living cultures (Hui 2016). The application of these digital materialities to intangible, performed and embodied archives has the potential to create new forms of historiography and embodied knowledge transmission, both in quotidian cultural practice and in academic research (Balsamo 1995; Coté 2010; Kenderdine *et al*. 2014; Whatley *et al*. 2018).

This article pivots on the interplay of different forms of embodied heritage and the way that technologically-enabled scholarship and new media art practices are reshaping bodies as intangible objects of study. While museums are not the focal point of this text, they are the civic sites where computational approaches to the reperformance of the past come to life for the public. New digital museology and civic heritage approaches are reshaping museums into active sites of tacit experience, and opening up archives that can only be understood through bodily interfaces and interconnections, activating archives with 'liveness' through reperformable 'repertoires' (Auslander 1999; Schneider 2001; Taylor 2003; Parry 2007; Witcomb 2007; Taylor 2010). The novel radical intangibles we introduce here comprise performed and performing digital repertoires that are being produced behind the scenes, spawned at the intersection of tacit cultural practices and advanced computational processes (Kenderdine 2016).

Embodied cultural heritage can take many forms across diverse cultural practices, two definitions of which principally inform our discussion: intangible cultural heritage (ICH, as defined by the 2003 UNESCO Convention) and reenactment heritage.[1] These categories are examined through two extended scholarly projects that serve as case studies for this article: the 'Hong Kong Martial Arts Living Archive' (HKMALA) in collaboration with the International Goushou Association in Hong Kong (a longitudinal project with local kung fu master communities), and 'Remaking Confucian Rites' (RCR) undertaken in conjunction with Tsinghua University in Beijing. As collaborative interdisciplinary research projects, each of these endeavours have been undertaken by expert local researchers and/or practitioners – HKMALA by the International Guoshu Association, and RCR at the Centre for Ritual Studies at Tsinghua University in Beijing, China – in partnership with the present coauthors' respective research laboratories, Sarah Kenderdine of the Laboratory for Experimental Museology (eM+) at the École Polytechnique Fédérale de Lausanne and Jeffrey Shaw at the Centre for Applied Computing and Interactive Media (ACIM), City University of Hong Kong. These two examples have been selected as innovations in scholarship that meld embodied acts with the computational powers of documentation, archive and reperformance, and show new materialities are bringing embodied archives into the public domain through interactive and immersive displays.

Although the digital preservation of intangible cultural heritage is promoted as a high-level priority in China, their documentation problems mirror those around the world (see Zhou *et al.* 2019). But new applied research into computational tools are changing the recording, expression and transmission of the performative social, arts, craft, ritual knowledge practices of ICH and reenactment heritage (Whatley *et al*. 2018). Through the two case studies, in this text we demonstrate the application of Sarah Kenderdine's novel methodology of 'computational museology', which unifies computer science with digital museology and the humanities (as described in part 1.2) to generate new modes of research for the study of ICH and reenactment cultures.

This article is presented in four parts: 1.1 Defining ICH and Reenactment Heritage: Globalized and Chinese Perspectives; 1.2 Computational Museology: A 'Systems Thinking' Model for New Materialities and Digital Embodied Heritage; 1.3 HKMALA: Digital Intangible Cultural Heritage and Hong Kong Martial Arts; and, 1.4 RCR: Reenactment and the Computational Remaking of the Ritual Chinese Body.

1.1 Defining ICH and Reenactment Heritage: Globalized and Chinese Perspectives

ICH and reenactment heritage are vast and complex topics that have both been extensively theorized (e.g. Kirshenblatt-Gimblett 2004; Kurin 2004; Smith 2006; McCalman and Pickering 2010; Schneider 2011; Smith 2011; Agnew *et al*. 2020).[2] Yet, because concepts of intangible cultural heritage and reenactment can overlap, a number of key terms and notions need to be defined, insofar as the scope of this present publication permits.

First of all, reenactments can be ICH instances, yet not all ICH is or can be reenacted. Reenactment practices stand apart from ICH more clearly as a form of 'reperformance' (after Taylor 2016) of a cultural practice that was discontinued at some point and which contemporary reenactors must therefore recreate. There is also confusing crossover between ICH and reenactment, especially due to the notion of 'living history'. This phrase is deployed, on one hand, in the context of a live dramatization event at museums or historic sites, and can include historical reenactment as one of its expressions (Jackson and Kidd 2011; Daugbjerg 2017). In contrast, the term 'living' in ICH literature implies that a heritage practice is alive because it has been perpetually maintained and performed by its cultural proprietors (Kirshenblatt-Gimblett 2004; Kurin 2004).

Furthermore, distinct from reenactment, ICH is a prominent international heritage governance policy and global discourse grounded in the 2003 UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage. It is defined in the Convention as a performed culture that has been practised 'with a sense of identity and continuity' that is vanishing or threatened.[3] The ICH Convention's wording implies that it aims to preserve traditional (minority) cultures, instead of all forms of human performative or social practice. But, as Kurin points out (2004: 69), it is not viable to totally exclude contemporary ICH iterations (e.g. street dancing, rap music). Meanwhile, critics of intangible cultural heritage policy and discourse, such as Harrison (2013) and Smith (2006), claim that UNESCO is at the root of 'authorized heritage discourses' as elements of modernity and globalization, through which universalizing, nationalistic and colonialist hegemonies are legitimized and reinforced.

As a practice, reenactment is said to have roots in ancient Greek and Roman eras, with the restaging of epic combats in the theatres of Athens and the Roman colosseum, and later in Medieval European religious pageants and reconstructed military victories (Cook 2020: 187; Daugbjerg 2020: 25), which underwent a kind of revival toward the end of the nineteenth century in Britain and its former colonial nations: the United States, Canada, and Australia (Bénichou 2017). In the mid-twentieth century, the term entered historical discourse as a way to describe the historian's mental visualization of the past (Collingwood 1946/2005; Dray 1995). Today, reenactment cultures proliferate in innumerably diverse iterations and cultural expressions, which can be studied from multiple angles, spanning ritual and ceremony, dance, sport, martial arts, theatre and performance, contemporary art, virtual reality and gaming, documentary and reality television, and cinema.

The academic field of reenactment studies is, moreover, relatively new but rapidly expanding, already encompassing the above humanities disciplines as well as performance and cultural studies, sociology, public history, and art theory, among others (see Rokem 2000; Agnew 2007; Rejack 2007; Vowinckel 2009; McCalman and Pickering 2010; Smith 2011; Schneider 2011; Johnson 2015; Franko 2018; Agnew *et al*. 2020). Despite being a subcategory of reenactment, ever since becoming widely popular during the 1990s, historical reenactment has become its most prominent genre. As a form of public history, it tends to reinforce memories and narratives of past events through realist aesthetics (though not always genuine) replica costumes/makeup, weapons/props, gesture/movements, scenography/landscaping, etc., that are supplanted into the present (see Gapps 2009a). Finally, historical reenactment has been critiqued for upholding hegemonic nationalist, imperialistic, and colonial narratives (Cook 2004; Agnew 2009; Gapps 2009b; Elliott 2019; Winter 2020).

In this article, we differentiate historical reenactment from the scholarly work of the Remaking Confucian Rites project. For one, due to their contrasting conceptual and political foundations, popular and academic reenactment tends to be, as Bénichou contends (2017: para. 15), fundamentally 'contradictory regimes'. Dreschke (2020) further emphasizes that in the field of ritual studies[4] there is a sharp distinction between the popular social dimensions of historical reenactment and how it is used as a method of scholarship or an analytical tool. This view is echoed in European Martial Arts scholarship, which the authors say is 'rigorous and thorough' because it is grounded in applied scientific methodologies, akin to experimental archaeology (Jaquet *et al*. 2015: 16). But some aspects of the two approaches are common. For example, they share an aspiration for authenticity, and the reintegration of past experience through embodiment, affects and acts.

While this theoretical background informs our article, its primary focus is on the

applied scholarship at the nexus of historiographic and computational museology specific to the sustenance of Hong Kong martial arts practices in the HKMALA, and secondly to the reenactment of Confucian Rites (RCR) in China. Ultimately, our aim is not to dichotomize theoretical classifications, but rather to illustrate the new knowledges arising from the application of computational museology to both ICH and reenactment heritage along with other scholarly digital methods and approaches that are facilitating the reperformance of embodied repertoires.

A few clarifications need to be made due to the cultural specificity of this article. Firstly, China is at the forefront of global ICH registration: since their 2004 ratification of the UNESCO Convention on Intangible Cultural Heritage, Chinese authorities have listed 40 ICH elements.[5] In contemporary post-socialist China, ICH is a significant discourse with its own interpretation, logic, and lineages, which an increasing number of scholars are theorizing from diverse Chinese standpoints, beyond a Western perspective (Gao 2014; Zhu 2014; You 2015; Kuah and Liu 2017; Maags and Svensson 2018). Importantly for this article, Chinese martial arts has also been embraced within the ICH framework (Daly 2010). Yet critics, including Chen (2015) and Wu (2012), address concerns that ICH is a burgeoning discursive power being used to bolster the Chinese Communist Party's nationalistic heritage policies. Accordingly, perceptions of the politics of Chinese cultural heritage are complex and contested, both within and outside of China (see Hou and Wu 2013; Yan 2016), for which theorizations from a Eurocentric outlook are often insufficient.

In China today, historical military, ritual, and martial arts reenactment is flourishing in amateur circles as well as in Chinese state-sponsored productions that restage historic battles at Culture Parks and historic sites (Bowman 2016; Li 2020). But, in contrast to ICH, until very recently there has been limited theorization of reenactment and its intensification in China today (e.g. Jaurès 2012; Zhang 2021), despite reenactment being used in documentary cinema throughout the latter part of the twentieth century to promote Chinese Communist Party narratives (Qian 2013).

These cultural and conceptual paradigms are vital to our two case studies; however, specific conceptual and technical methodologies underpin 'radical intangibles', which we now elaborate.

1.2 Computational Museology: A 'Systems Thinking' Model for Radical Intangibles and Digital Embodied Heritage

The most apparent presence of radical intangibles today is in the ubiquitous augmentation of materiality in digital forms (Hansen 2006; Parikka 2012; Reichert and Richterich 2015). The transformation of physical archives and objects into digital repositories has not only altered how people engage with the past, it has also changed the notion of objecthood itself (Hui 2016). Where material was once assumed to be bound to objects, the decoupling of the original from its copy and its integration into networked culture has created new avenues for the lives of bodies as virtual (if not actual) museum artefacts, where the sense of presence, or its thingness takes precedence over the thing itself (Dudley 2010; Hui 2016).

From the early 2000s, transversal approaches to this thinking began to be described as 'new materialisms' with the overarching aim of transcending orthodox mind/matter and nature/culture dualisms, as well as the centrality of European humanism, in order to produce new agencies for materialities that foreground the social and its margins (see Latour 2005; Alaimo and Hekman 2008; Bennett 2010; Coole and Frost 2010).[6] Performance studies scholars, such as Schneider (2015), have also established new materialisms for the body and its ephemeral productions. The materiality of digital objects has, however, been more difficult to theorize, Yuk Hui (2016: 3) reasoning that 'their thinghood and their existential status have rarely been brought into question' because 'computation relies on a new type of materiality'. In terms of making digital objects accessible beyond computed data, new museological interfaces and immersive systems are being created to facilitate the sensory and auratic encounters inherent to intangible and tacit heritage archives (Kenderdine and Yip 2019).

In order to forge an integration of the material and immaterial for embodied and performed cultural heritage enabled by computational tools, we introduce in this article Kenderdine's

novel framework of 'computational museology'. Our objective here is to provide emergent scholarship with a unified praxis that combines fields of computer science (machine intelligence, data curation, ontology) with digital technologies and media art for embodied archives that enable participation (visualization, immersive and interactive interfaces) and the humanities more broadly. In linguistic terms, computational museology solves the problem of the lack of a common lexicon between computer science and the humanities, across reproduction, interoperability, gesture, ontology, or language (Hui 2016: 1).

Taking a 'systems thinking' approach, a number of theorists, including Jung and Love (2017), alongside Richmond (1994), have proposed that museums should operate as open and dynamic learning systems, as opposed to the closed status quo of compartmentalized and hierarchical systems. As cited in Kletchka (2019: 158) Anila, Foley and Quarcoopome, posit that systems thinking 'emphasize[s] interconnectedness, non-separability, nonlinearity, and polyvocality – from within the museum and without – allow[ing] new modes of interpretive planning to flourish in creating dynamic, inventive, and fresh installations of art'. Systems thinking underpins yet another major innovation, that of 'whole of environment' digitization, an approach that we define as the concurrent and integral linkage of many forms of digitized materiality – performance, objects, knowledge systems, representation, and participation – through their interlocked and interoperable digitization.

As a tool for the radical intangibles of performed and embodied heritage, whole of environment encoding stands apart from other approaches to digitization because of its three uniquely enmeshed computational processes: data capture, computational modelling, and algorithmic reenactment (each defined below). These three operational components collectively generate the data for research into the analysis of features based on the form and style of physical movement in 3D space. Ultimately, these digitized 'acts' are made accessible in the form of interoperable and reusable embodied performance repertoires for scholars, expert practitioners, visualization designers, and publics.

The first of these components, data capture, entails the creation of assets through the digital encoding of live acts, using a range of technological capture processes. The primary pipeline for creating these assets are: green screen video capture, key frame pose extraction, motion capture data, animation, physically-based rendering and photogrammetry. These various digital tools work in tandem with conventional 3D modelling, photography, video (all types), and audio recordings of musicians or orators, as well as information arising from analysed or transcoded historical documents, in addition to the metadata of any of the above.

Motion capture is the primary data input technology for documenting embodied acts. The technology entails an array of infrared cameras to track a performer's body that is mapped with reflective markers (Fig. 1). For the advanced documentation of expressive tacit movement, the motion capture record of motion over time – or spatial/temporal modelling – produces continuous topological model datasets with unprecedented levels of detail that are particularly suited to documenting performed heritage. It has also been exploited for academic purposes by European martial arts scholars (see Channon and Jennings 2014; Farrer and Whalen-Bridge 2011). Because motion capture data can be subsequently reconstructed as a virtual 3D, interactive model of the performer's body, the technology is able to translate physical action into transferrable knowledge, especially when paired with mailable and navigable interactive platforms to support transmission (Rotman 2002; Kenderdine and Shaw 2017; Kenderdine 2021). As such, it is a crucial tool for documenting both ICH and reenacted forms of digital heritage today (Hamilton 2015; Karreman 2015).

The second element, computational modelling in the digital visualization sphere, harnesses advanced computer graphics technologies to create virtual visual (and acoustic) constructions of environments and objects, approaches that are in widespread use in computer imaging for architectural, archaeological astrophysics, and biological research, as well as gaming and many other visual domains (e.g. Rabinowitz 2015; Lock *et al.* 2018).

A number of researchers have employed movement modelling and visual and semantic ontologies to encode ICH for the performing arts. The EU Horizon 2020 project *Terpsichore* (2016–2020), for example, validated a framework for the affordable digitization, modelling, e-preservation, and presentation of folk dances and music (Doulamis *et al.* 2017). Another European Commission project, *i-Treasures* (2013–2017), applied multi-sensing capture and

analytic technologies to develop a system to extract specific features or patterns of dance (Dimitropoulos *et al.* 2018).[7] *i-Treasures* has also established 'MotionMachine', an open source library for the rapid prototyping, extraction and visualization of motion capture features, as well as a public platform and digital repository for research and education with game-like application.[8]

As our two case studies reveal, the visualization of computationally modelled embodied acts bear little comparison to other visualization approaches, primarily because the latter innovations build on their distinct modes of 'aesthetic transcription' (see 1.3) of embodied acts developed for dance, performance and media arts. The unique knowledge modelling for performance also embraces virtual production and sensory interfaced databases, which facilitate not only the recording of performers' bodies in motion over time but also the transcription of the tacit cultural knowledges that their actions express.

Algorithmic reenactment is the third novel component integral to whole of environment encoding. Defined as computational instructions, algorithms are intrinsic to digital media. Algorithms are also increasingly used as a tool of computer vision for (semi)automated video analysis and curation, such as the automatic extraction and interactive feature tracking of film/videos (Adams *et al*. 2002; Buchanan and Fitzgibbon 2006). The curation of algorithms broadly falls under the emerging domain of 'Computational Media Aesthetics' (Dorai and Venkatesh 2002). In the context of computational museology, algorithms combined with artificial intelligence are helping to open up otherwise abstract information in embodied knowledge archives and make it reperformable (e.g. Pizzo *et al*. 2019). The upshot of these approaches is that scholars of ICH and reenactment can both learn from and teach using these interactive databases (see 1.3 and 1.4 for further discussion).

While the ramifications of applying a whole of environment framework to encoding embodied acts has yet to be fully theorized, the two case studies we are about to describe show that a new paradigm of materiality comprising 'radical intangibles' is taking shape in the context of scholarly work on ICH and reenactment practices.

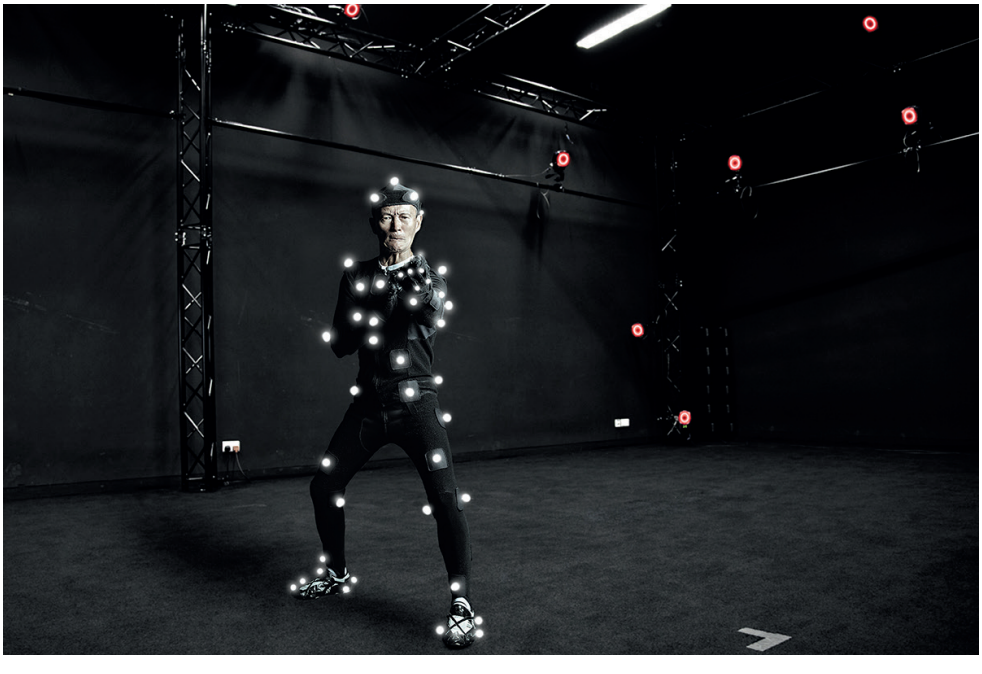

Figure 1: Kung Fu master in motion capture studio. Photo: Sarah Kenderdine.

1.3 HKMALA: Digital Intangible Cultural Heritage and Hong Kong Martial Arts

Initiated in 2012 by the International Guoshu Association and City University of Hong Kong, HKMALA is an archival project that aims to redress the rapid waning of southern Chinese kung fu practices in recent decades (Chao *et al*. 2018). By the end of the twentieth century, a significant portion of traditional martial arts had already vanished, mainly due to their oppression alongside the expatriation of masters (many to Hong Kong) during the Chinese Cultural Revolution starting from 1969 (Amos 1983/1986: 280). While Hong Kong remains an active centre for elite kung fu practitioners, home to some of the most prominent martial artists in the world, the aging of the masters and the lack of means to record or transmit their expertise in their absence, threaten the total disappearance of the core traditions of kung fu.[9] Furthermore, as martial arts scholars underscore, embodied practices cannot be learned from a book (Jaquet *et al*. 2015).

Chinese martial arts is traditionally a strict hierarchical system of master to student transmission. As Daly writes (2010: 357-61) the 'difficult and often arbitrary nature of passing on traditional kung fu', and the 'essence of the system' requires, according to one master Daly interviewed, at least ten years of strict commitment. For this reason, digital prostheses,[10] are being developed as virtual embodied apparatuses in conjunction with computational interfaces for reperformance to create a computational chain of ICH knowledge transfer in the absence of master teachers (Chao *et al*. 2016).

The southern Chinese martial arts digital reconstruction that HKMALA has undertaken to date uniquely combines historical materials with creative visualizations building on advanced documentation processes for physical movement, including motion capture, motion-over-time analytics, 3D reconstruction, panoramic video, and 3D animation. The objective is to make these archives performative, to open up otherwise inaccessible embodied knowledge to practitioners, scholars, students, and enthusiasts of Hong Kong martial arts (Kenderdine and Shaw 2018).

Figure 2: HKMALA, Re-Actor interactive installation in exhibition, 300 Years of Hakka Kung Fu, Heritage Museum Hong Kong, 2016. Photo: Sarah Kenderdine.

The HKMALA archive currently contains 19 styles by 33 elite practitioners, comprising the largest motion data archive of its kind in the world, which offers a unique capacity for translating physical action into transferrable knowledge (Kenderdine and Shaw 2017; 2018). Access to the HKMALA archive is made possible through 3D interfaces, life-size models, and interactive real-time applications in large-scale virtual environments, designed at EPFL Laboratory for Experimental Museology (eM+) and City University of Hong Kong. Two HKMALA embodied system interfaces are presented here as illuminating examples: *Re-Actor: Interactive Kung Fu Analytics*, and *Kung Fu Pose Matching.*

Our first example from the HKMALA repertoire, *Re-Actor: Interactive Kung Fu Analytics* is presented in a five-metre diameter, six-sided virtual reality system called Re-Actor. The viewer can move around the two-metre-high hexagonal container, before choosing to interact with one of the six screens. Each active stereoscopic back projection screen features a motion capture recording of a unique kung fu *taolu* sequence performed by a kung fu master (Fig. 2). Created as mnemonic aids for kung fu novices, *taolu* are demarcated movement sequences used for practising and performing traditional Chinese martial arts styles, including spearplay, boxing, swordplay,

and broadsword play. Rigorous, repeated practice of the pre-determined choreography *taolu* routines imprints this knowledge on the learner.

Each side of the Re-Actor has its own interactive control panel with a joystick that enables the viewer to shift between six different 3D visualizations of the *taolu* performance. Through colour and motion graphics, these six forms of documentation dynamically visualize the aesthetics and spatial-temporal dimensions underlying the movements of kung fu masters. Various rendering processes of motion-over-time analytics and 3D reconstruction enrich the motion capture data with the aesthetic and tacit knowledge of the master. They reveal the depth and array of intricate dynamics in the HKMALA repertoire; aspects of kung fu motion usually indiscernible to amateurs.

Ascribing meaning to performed acts in a way that is decipherable and reperformable is a critical challenge for embodied archives, but this is not a new problem. The translation of physical actions into a legible and communicable language has an extensive history in China in the form of martial arts manuals and ritual performance scripts dating back millennia, such as the *Yili* (see 1.4). In the West, the earliest complete systems of movement notion were the Laban/LMA or Labanotation (Laban 1947/1994) and Benesh (1977). These techniques were later taken up in pioneering digital projects such as William Forsythe's *Improvisation Technologies* (1999).

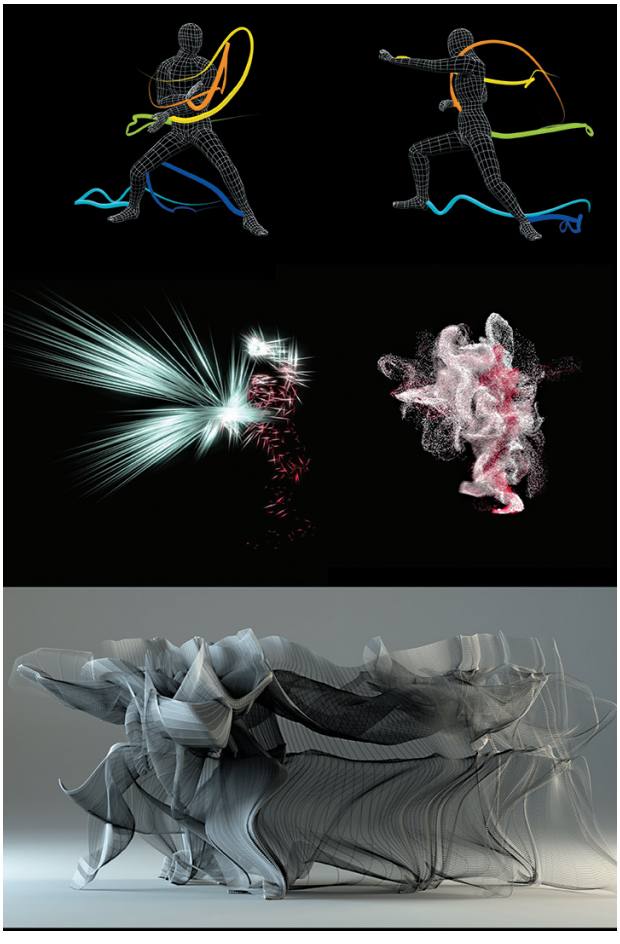

Figure 3: Kung Fu annotation and visualizations, 2016. Image: Sarah Kenderdine, Jeffrey Shaw and Tobias Gremmler.

As a tool for the visual analysis of choreographic dance forms, *Improvisation Technologies* features an overlay of motion graphics, animating lines on top of video images to visualize the underlying principles of Forsythe's movement (Ziegler 2016). From the end of the 1990s, leading interactive and immersive media artists (the authors of this article among them) theorized this technique as 'aesthetic transcription' (Brown *et al.* 2003; Kenderdine and Shaw 2009; Kenderdine 2016).

In the HKMALA project, aesthetic transcription is combined with interactive interfaces to support study, teaching and learning from its motion databases. In the case of *Interactive Kung Fu Analytics*, real-time visualization layers of visual transcription allow for interaction with the motion capture data itself, an effect that Karreman (2015: 37-8) has described as a form of recreating and extracting the capacity of a repertoire from that of its archive. This first HKMALA example thus serves as an important demonstration of the application of computational museology to the active archiving of intangible cultural heritage. Most important of all in terms of scholarship, such reflexive modes are designed to

capture new data arising from expert reperformance to incorporate new knowledge, rather than a simple *a priori* analysis, thus keeping the essential 'liveness' intact in the performative ICH archive (Auslander 1999).

Figure 4: Kung Fu Pose Matching in 300 Years of Hakka Kung Fu*, Heritage Museum Hong Kong, 2016. Photo courtesy of HKMALA.*

The second HKMALA system is the *Kung Fu Pose Matching* installation, which was developed for he 2016 exhibition 300 YEARS OF HAKKA KUNG FU at the Heritage Museum Hong Kong and the 2018 exhibition *Kung Fu Motion* at EPFL ArtLab. The work comprises a life-size, 1:1 scale video projection screen that shows a sequence of poses originally performed by a kung fu master (Fig. 4). Signage of two feet and a series of indicative images projected on a human-scale screen summon a single participant to step onto the square in front of the screen. Now within the detectable range of the motion sensors, the participant is shown a video sequence that guides them to match the pose of a kung-fu master by replicating their simplified movements. Built-in sensors capture the participant's movement – as soon as their body and limbs have configured the same position of the master, the video screen flashes to suggest that the task is complete, subtly playing on the reward credo of video game constructs.

Kung Fu Pose Matching builds on imitative pedagogic features of pre-existing gaming technologies, such as Kinect, and combines them with virtual and mixed reality technologies that have been shown to be powerful conduits for embodied knowledge transmission (Chan *et al.* 2011; Lindgren and Johnson-Glenberg 2013). Moreover, because kung fu is imitative, iterative and physically interactive learning is vital to its mastery (Komura *et al.* 2006). As such, during 2018, Sarah Kenderdine and Denis Hauw of the University of Lausanne (UNIL) completed an EPFL/UNIL funded study examining the transmission of embodied knowledge through 'imitation'. As a prototype of the eventual exhibited installation, the aim was to test the efficacy of virtual reality to engender enactivist (or cognition through doing, see Sumara and Davis 1997) models of learning for knowledge transfer from digital-master to human-novice. Realized in controlled conditions with sports and cognitive scientists, the evaluation documented some improvement in participants' movements with repetition, as the gap between the master and novice's speed and positioning of movements narrowed.

While there is no guarantee that a novice engaged in copying the kung fu master's movements will either comprehend, access, or acquire the tacit expertise they are replicating, the novel conjunction of gaming platform with motion capture archives opens an avenue for transmission that is more likely to engage beginners. Additionally, in contrast with classic Kinect console games like Dance Central, the use of sensor technology in this installation does not result in empty gestures nor a purely ludic endgame. Digital human movement depth sensors have already been applied and tested in ICH documentation (e.g. Protopapadakis *et al.* 2017). As such, despite the difficulties associated with apprehending ephemeral embodied acts, the installation is an archetype for avatar-based transmission modes of ICH.

The final and most crucial difference between mainstream mimetic simulation games and their application in the cultural heritage sector and *Kung Fu Pose Matching* is that threatened cultural heritage archives underpin the latter; a mission that is all the more crucial in the instance of broken transmission, such as for the revival of Confucian ritual practices today.

1.4 RCR: Reenactment and the Computational Remaking of the Ritual Chinese Body

Figure 5: Remaking Confucian Rights, Three-screen installation of the capping ceremony*, 8th Triennial of Contemporary Art, Ljubljana, Slovenia, 2016. Image: Paul Nichola*

Remaking Confucian Rites (RCR) is a major research project led by Professor Peng of Tsinghua University, Beijing, in collaboration with City University of Hong Kong, Lia Jin Hall, and École Polytechnique Fédérale de Lausanne (EPFL). At the core of this project is the renewed philological study of the *Yili* 儀禮 (*Book of Etiquette and Rites*), which describes rituals recorded by disciples of Confucius in the fifth century BCE. *Yili* was a core text in the Confucian canon and Chinese civilization for thousands of years.[11] It is founded on the Confucian cosmology, theory and ethics of *li*. As a moral code embedded in bodily, performed practices, *li* realized through ritual acts. Following the revolution of the National Republic in 1911, then during the Cultural Revolution from 1966 to 1971, a critical breakdown occurred in the cultural practice and social transmission of Confucian Rites and thus also *li* (Billioud and Thoraval 2015).

Today, Remaking Confucian Rites is fashioning essential new archives to support Confucian embodied knowledge systems, the latter being a topic of inquiry for several decades (Wei-Ming 1992; Ott 2017). The *Yili* was notably designed as a 'performance manual' for practical self-cultivation in relation to family, state and cosmos. The RCR project pivots on a reconstruction[12] process combining the line-by-line 'close' reading of the text, the study of diverse philological and archaeological sources. Based on this research, a script for reenactment has been created with music and dialogue. It also includes lists of props, produced from cross-referencing archaeological and textual materials for making replica architectural elements, ritual objects, and costumes.

The *Yili* contains a total of 17 rites. In this article we focus specifically on the fifth rite, the Archery Ceremony *Xiangshe li* (*Rites of the Provincial Archery Competition*) for two reasons. One, it permits an analysis of the RCR's novel methodology for the renewed reperformance and transmission of Confucian Rites today, which couples reenactment with advanced digital documentation forms, along with interactive and immersive media art experiences Fig. 5). Two, ritual archery is one of the few methods that remains linked to the traditions of practising and transmitting *li*, as traditional archery was assimilated within contemporary Chinese society (Selby 2000; Ma and Ma 2004; Peng and Han 2016).[13]

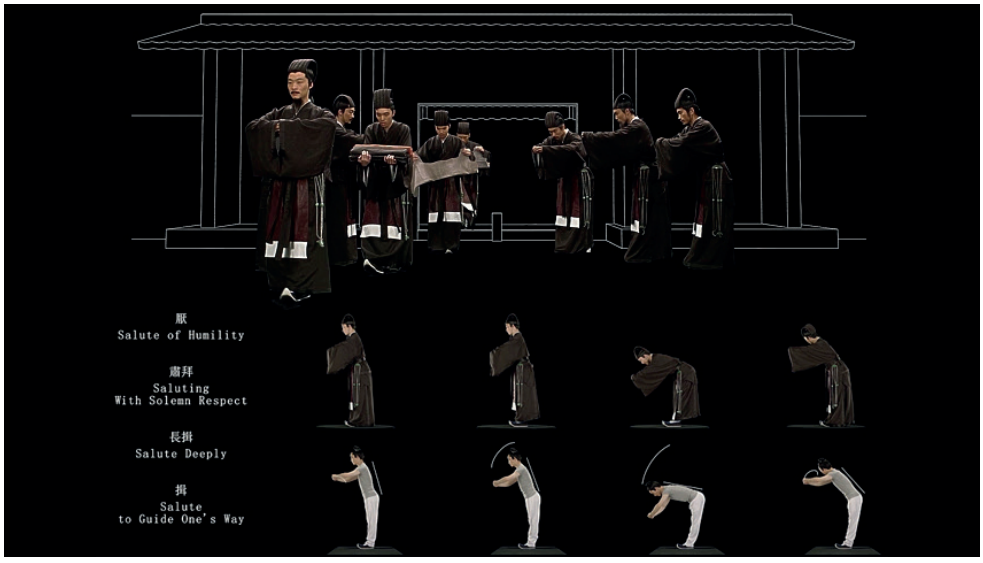

Figure 6: Multimodal recordings and annotation of the capping ceremony, Remaking Confucian Rites. Image courtesy of Centre for Chinese Ritual Studies, Tsinghua University.

In 2012, Peng joined with Kenderdine and Shaw to embark on the digital reconstruction and recording of the Archery Rite reenactment. An almost full-scale set of the ritual temple described in *Yili* was constructed in a sound studio in Beijing, and the entire ceremony was shot over several months with a troupe of thirty elite actors from the Beijing Opera at professional cinema quality (totalling about eight hours' viewing time). The latest Hollywood green screen techniques were also deployed for the eventual digital reproduction of the scenery around the temple complex.

While the photoreal representation of the location was prioritized, the main focus of the shoot was on the ritual behaviour of the actors. The actors' movements in the real space were documented using motion capture and tracked in 3D, building on the unique aesthetic and movement transcription techniques developed for HKMALA. State-of-the art 3D imaging was also employed, such as panoramic 3D and 360-degree photography, and spherical 360-degree videography. These high-resolution recordings have been used for in-depth statistical analysis, then transcribed into animations and annotated and real-time visualization

layers of text, colour, and motion graphics. Overlaid on the videos, these analyses convey the spatial and temporal features of the motion, displayed in a digital application specially created for the RCR project (Fig. 6).

The underlying database is the most important attribute of all for the RCR team, who have been populating it with annotations of past performances and other archery rites.[14] In addition to this video documentation, the Archery Rite archive contains photographs, drawings, and text concerning attire, ceremonial objects, ritual gestures, as well as academic commentary. Because they can revisit, replay and review the live and annotated videos, RCR scholars can make a deeper excavation of the Archery Rite reenactment, and build on this knowledge with each reperformance. The RCR team are also exploiting the data archive to address otherwise unsolvable problems and test hypotheses drawn from the ritual literature, by comparing them with the performance of the ritual acts to mine what Lia Jin Hall and director Tsong-Zung Chang call the 'molecular structure' of *li*.[15] Digitally augmented in this way, scholarly reenactment generates ontologically intense knowledge because its liveness as well as more abstract ritual qualities can be contextualized in a wholly live and yet re-makeable encoded world.

The large-scale operation to record, encode and display the tacit contents of the Archery Rite reveals some of the potential for its renewed transmission through virtual interaction, presence and immersion within Confucian ritual knowledge systems. As it couples reenactment with the power of computational modelling, this approach could unlock and revivify the radical intangibles of *li* embedded in the ritual expressions of the modern Confucian body.

Conclusion

In recent decades, computational advances in data science and graphics modelling have been successfully applied to material cultural heritage, including 3D scanning and displays using immersive and interactive technologies to enliven immutable objects online and in museums. Unseen, behind the public presentation of civilization through objects, are archives of embodied experience. Apart from the challenges of display, these archives must first of all be elicited, recorded, and encoded, which is all the more difficult in situations where the repositories and transmitters of that knowledge have been ruptured or are at risk, which is the current concern of both the HKMALA and Remaking Confucian Rites projects.

As we have outlined in this article, our work to inaugurate computational museology intends to address the challenges of documenting and transmitting ICH and reenactment through the conjoining of data science, immersive technologies, and new museology. Computational museology pivots moreover on 'technologies of corporeality' – computer graphics, spatial and temporal modelling, and virtual reality – with multiple modalities and digital prostheses for the body as the principal repertoire and holder of knowledge, thus encoding acts and making them reperformable. Finally, both the HKMALA and RCR projects are examples of how computational museology can address the politics attached to the body in Chinese cultural heritage. They demonstrate how radical intangibles are bridging the gap between emerging forms of digital archiving and their modes of transmission in both ICH and reenactment approaches, with the greater aspiration of reconciling the Chinese body past and present.

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Notes

1 UNESCO, 'Text of the Convention for the Safeguarding of the Intangible Cultural Heritage', 2003. https://ich.unesco.org/en/convention, accessed 9 June 2021. See also UNESCO, 'China and the 2003 Convention', n.d. https://ich.unesco.org/en/state/china-CN, accessed 9 June 2021.

2 In terms of materiality and the digital in museums, there is much work to do to break old binaries of representation, systemic racism, and Westernized and imperialist structures. See Lonetree 2012; Fischer *et al*. 2017; Vawda 2019; Chipangura and Chipangura 2020.

3 UNESCO, 'Convention for the Safeguarding of the Intangible Cultural Heritage', art 2.2.

[4] Rites or rituals are formalized or performed ceremonial acts, arising either from long secular tradition or sacred orders, see Schechner 1993; Bell 1997.

[5] UNESCO, 'China and the 2003 Convention'.

[6] Since the late twentieth century, multiple strands of critical theory have been concerned with expanding the ethics of the material and social being, spanning feminism (Haraway 1985; Grosz 1994), philosophy and social anthropology (Latour 2005), queer, post-human, cultural and performance studies (Barad 2003; Chen 2012; Braidotti 2013), and intersectional, First Nations, decolonial, and critical race theorists (Crenshaw 1991; Sundberg 2014; Todd 2016).

[7] European Commission, 'i-Treasures: Capturing the Intangible Cultural Heritage and Learning the Rare Know-How of Living Human Treasures', EU Commission blog, 12 July 2016. https://ec.europa.eu/digital-single-market/en/blog/i-treasures-capturing-intangible-cultural-heritage-and-learning-rare-know-how-living-human, accessed 9 June 2021.

[8] European Commission, 'i-Treasures', 2016.

[9] Despite the recent 'explosion of "traditional" kung fu schools and academies in China' resulting from 'government encouragement' (Daly 2010: 354) it cannot repair the break in transmission without masters.

[10] On protheses as vessels of cultural memory, see Lury 1998; Landsberg 2004; Sobchack 2006; Stobiecka 2020.

[11] The Yili manuscript is available in Chinese as *Yili zhushu* (1957) Zheng, X. and Jia, G., Beijing: Zhonghua Book Company.

[12] In academic contexts, the term reconstruction is sometimes used instead of reenactment, for example in Historical European Martial Arts (HEMA), where it distinguishes rigorous, scientific reproduction of performed cultures from the popular activity of reenactment (Jaquet *et al*. 2015). Reconstruction also connotes the fabrication of reality based on tangible evidence, as in forensic architecture (Gallanti 2020: 80), or forensic crime scene investigation, a field that also differentiates the involvement of human actors as reenactment.

[13] See also Lin Peng, 'Practice Gives Deeper Understandings than Theoretical Readings. Why is the Reenactment of Confucian Rites Critical?', *Guang Ming Daily*, 12 December 2020. https://epaper.gmw.cn/gmrb/html/2020-12/16/nw.D110000gmrb_20201216_2-15.htm, accessed 9 June 2021.

[14] Peng, 'Practice Gives Deeper Understandings than Theoretical Readings'.

[15] As T.Z. Chang describes in his presentation at 'Deep Time Machine II: Remaking Confucius Rites', Potential Spaces Conference, Karlsruhe: ZKM, 2017. https://www.youtube.com/watch?v=ry2leciY58Q, accessed 9 June 2021.

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