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Introduction

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Tools to move to think

Human movement is not only anatomical and biological. It is also defined by historical and material conditions of motor issuance— conditions of interpretation, of attempted representation and enactment. Thus, human movement is transformed by developing techniques and evolving technological tools that expand and refine our motile capabilities, and thus help us to understand ourselves through cultures of movement. But if tooled thinking is affecting the evolution of human movement, then how is our capacity to move, and to know through movement, characterized by the digital? What techniques and technologies define our culture of computerized movement today? Throughout this book, we have acknowledged that digital movement is an area of great significance, and that it demands plenty of attention, not least because movement (and likewise sound) are fields that enable the direct (unworded) communication between humans and machines. If we can now move in order to be recognized by motion and gesture sensing devices and systems, what novel communicational interplays and dialogues between human and machine can be established, and do we need to critically assess this kinetic intercreativity?

Martin Heidegger (1962/ 2007) argued that since human knowledge is instrumental before it can become transcendental, we can therefore insert ourselves in a world defined by instruments, where Things can be defined as either "present-to-hand" or "ready-to-hand". The example of the latter, famously, is Heidegger's hammer. Interestingly, Heidegger speaks of a "state of equipment" (114). Is he implying that equipment is in a condition of stasis, of standing, or that things that are ready-to-hand are not capable of being motivated and motorized by their own will? Because the hammer is an instrument devoid of autonomous agency we can pick it up, we can bang a nail, we can put the tool back where it belongs. Heidegger clarifies: "the hammering of the hammer is not a property of entities" (114), thus it is not possible for "Things" to possess their own character. When we use a computer, however, we do not necessarily know what actions or moves are being performed once the computer is switched on. Sometimes we do

not even know what the motive behind automated computerization is, nor whose motives they belie, nor what the outcome of computerized actions might be.

Heidegger's hammer can be thrown up as a question: if we are no longer defined by instruments that are "ready-to-hand", but which are "already-handed" (in the sense that computerization involves an independent agency that is handed back to humans), where does technologization of movement land in a contemporary context? Admittedly, in a condition of possibilities defined by equipment whose kind is not static but kinetic. The digital computer can process information numerically using a two-base language—we all know that. Let us not forget, then, that the machine can also walk through data, and then produce a memory of these walks. The computer machine can be fed an input, from where it will walk, algorithmically (i.e. step by step), to an output. If a computer can process information thus, and if it can think and plan movement in abstract terms, then it can also perform movement outwardly at the level of a physical hardware or machinic/robotic movement performance. Unlike the hammer, computerized tools have the capacity to evolve independent character and agency. Computers can programme movement as thought –as software— and then perform it at the level of a command to move, closer to some physical hardware or technologized body. (That computers can perform movement is a point of enormous significance throughout this book—that is clear from our book title— especially since the performability of movement via technological materiality affords various levels of interpretation: i.e. performance as an artistic, technological or even economic/financial paradigm.) Drawing on Tim Ingold, one might say that because computers can think and perform movement, they have the means of being alive to our world, if only artificially. This highlights the power of autokinesis, of self-generated motion and self-generative creation, which distinguishes digital and smart technologies from, say, hammers. And so, unlike earlier histories of tooled movement and tooled thinking, we find ourselves transformed by a tool that can think and move outside our own human ontology, and which can force us to question, doubt and even debunk the subjectivity of being human, and the subjectivity of anthropocentric movement.

Movement returns to us from a technological agency as digital movement, provoking an undisclosible gap. The problem here is not that we see ourselves move on the screen as though we were some other person. This, for instance, is how Brian Massumi (2002) describes Ronald Reagan. The actor sees himself on the screen as others see him. Massumi brackets the terms

"mirror-vision" and "movement-vision" to discriminate between two modalities of intersubjective sight. "To see oneself standing as others see one is not the same as walking as others see one" (p. 50). The sight of movement at the interface is not, as in Massumi's biopic, the sight of a human that sees another human. What is happening is that we are sensing ourselves through computers (optically or otherwise). We perceive ourselves not only as a different person, but also as a different being. Digital movement is more than just intersubjective (human watching human). It is, if you can bear the mouthful, interontological, or interspecies: human sensing machine (or animal, or chimera), which in turn is sensing the human back. There is no mirror gaze here, but an inter-sensorium that is profoundly transformative given the ontological de-centeredness of the experience.

Movement on its own

This book was conceived with the following premise in mind: let us look at human movement as a modality of knowledge, as a way of knowing off balance and in-between. And so if we recognize that we move in a world that is in turn moving around us, how in the face of so much information and transformation can we know through movement—how can we know-on-the-go? The question here is not what movement is per se, or what it means. The question is how and what we know in and through movement. Kinetic and mobile knowledge are perhaps less understood in the scholarly community, and this might set expectations on our book to mark a field as yet unmarked. Perhaps this book can start providing new directions toward this more kinetic way of thinking and knowing. After all, "it is by moving that we know," going back to Ingold, "and it is by moving, too, that we describe. […] A being that moves, knows and describes must be observant. Being observant means being alive to the world" (2011: xii).

There is more to be said on kinetically sensed knowledge—i.e. on knowledge that flows directly from motor perception. Before we move on, however, let us assume movement can be an independent mode of sensation and let us decouple it from its neighboring sense: vision. If there is more than one modality of seeing (thinking), then to see through movement is not the same as to see from standstill. These are categorically different ways of seeing (thinking). The gaze "at rest" leads to knowledge that "arrests" things within still perception. This object-tethered vision serves the production of analytical and dialectical discourse well, but it poorly serves this

experience of being alive to the world that Ingold speaks of. And so if ceaseless movement involves having no point at rest, where does knowledge in motion start and where does it finish? How do we begin to think in motion, and how do we stop? If our ambition is to put together a book that is conceived as thoughts in motion, how do we extract concepts (or shall we say kinecepts) from kinetic experience, and how do we put these to rest in the domain of inscription representation, and discourse?

Start from nothing

Henri Bergson (1922) made a key distinction in his attack on dialectical intellectualism. He argued that we often visualize our world through snapshots and standpoints. Every time we do this we switch on what the French philosopher called the "cinematograph inside us" (p. 323). Bergson attacked this "ordinary knowledge of a cinematographical kind," which seeks to recompose movement through an artificial string of stillnesses. He wrote: "Vain is the attempt to range such states beside each other on the ego supposed to sustain them: never can these solids strung upon a solid make up that duration that flows" (4). To counter this knowledge, Bergson argued that it was necessary to stop taking refuge in this fixed consciousness we have of ourselves. "Install yourself within change," he rallied (324). The result is a coming and going of the mind between the without and the within, in the midst of which, according to Bergson, is a point at equal distance from both. From this moving point, he continued, "we no longer perceive the one, and we do not yet perceive the other: it is there that the image of Nothing is formed." (295)

Motion-blurred perception turns clearly defined objects (some things) into nothingness, a formless blurb, which is the potential for kinetic knowledge. This nothing is in fact full of things. Movement, if we are true to Bergson's word, is a nothingness full of potentiality. It is a blur from where virtually any form may materialize. To start from nothing then means that we must start this book from no single position, from uncertain theoretical perspectives, from no single categorical conception of movement, no single disciple and no ordinary method. That is where this book starts: with that formlessness and that in-betweenness that will allow us to install ourselves within change, and to be able to know on to go—to think things through as we become immersed in the motion of thought and body. We do not know where we are, except in a position

of nothingness and middleness. This knowledge in motion may not be suitable for an academic discipline (i.e. Movement Studies) concerned with arresting movement within cemented areas of study, but it is suited to a "creative evolution", drawing again on Bergson, since this immersion in nothingness fuels the motivation for kinetic creativity and novelty. What we do know is that we are directed toward the entanglement of movement and technology, and that our motivation is to sense (think) this entanglement from a kinetic way— movement is our method.

The blurred gaze

If what we propose by way of method is to make use of sensed knowledge (e.g. observation in motion) then the question that follows must be this: what kind of thinking comes about as a result of seeing blurred worlds? One thing that happens when we see through movement is that things appear distorted. Boundaries blur when we budge. The saccadic strategy does not work and motion perception becomes problematic, not least because perception turns to fuzz. The same applies to thinking and conceptualizing in motion. We conceptualise things that are in two or more places at once, and so we are confused. How do we know phenomena, which, by motor sensation, become paradoxical and uncanny? What kind of secretion of thought flows from this? What kind of words, what terms, what concepts (or kinecepts) can we use to give expression to this lack of definition? To generate concepts in an through movement it is necessary to think in between one thing and the other, and to open up room for the instability that prevails in this condition of irresolvable in-betweenness. It seems that our terms become hyphenated to make room inside more unstable concepts. Thus the blurred gaze cannot rest in fixed representations or terminological language either: state-ments do not account for move-ments. Alfred Jarry (who was Bergson's student let us not forget) spoke of the "syzygy of words" (1965, p. 245),[1] which can yield blurred out terms like here-there, male-female, or abstract-concrete. Deleuze also became a mouthpiece for Bergson when he spoke of movement in relation to "centers of indetermination", where we find a "coincidence of subject and object" (1986/1997, p. 65). If what we seek is some faithful representation of movement in materialized thought (i.e. in language), then we must accept the possibility of a non-representability or a syzygy where words slip along strange hyphenations and other linguistic gestures.

Our contributors try out many different ways of naming this way of thinking off-balance and in-between. Norman speaks of a "malice" in the object when the visual field correlated by spatial situation allows material accoutrements to give life to immaterial abstractions. Birringer speaks of "dis-alignment", Popat sees an "undisclosable gap" and a resident uncanny, which Fensham echoes when she speaks of virtual costumes as "sensory doppelgangers". Portanova speaks of "nebulized" and "intensive vision", Charlton speaks of "non-representability" and the state between art object and subject. Lee mentions "non-performability" in the unstable relation between performed and datarized movement. Schiphorst and Calvert reminisce their collaborations with Merce Cunningham and speak of "doubting" as a way of seeing movement differently. Rotman's position is likewise sandwiched between the "virtual and the actual" in the midst of which he finds a movement whose mathematical determination as thought is linked with its physicalisation in the body. Bleeker subsequently relates this same threshold (drawing also on Brian Massumi) to "lived abstraction." Our understanding of how to think movement is thus characterised by being caught off balance, squeezed between thought that is conceived via abstraction and thought that is conceived via physical means. Without ever being cut off dialectically, we accept that when moving and thinking via movement one has to dwell in a threshold, in the midst of which lie all manner of complementarisms—that creative opportunity found inside Bergsonian nothingness. And because of this condition of in-betweenness inherent to movement, what we achieve when we move is the linking of differences. We can cancel differences out and make them appear as though they were part of a polarized sameness. We move to establish communicational links between humans, or between animal species (see Nabais's chapter), or between humans and computers (see Neff et al.), or between human sensation and machine hapticity (see Polydorou et al.). We exploit the gap as a potential for emergent artistic practice (see Époque and Poulin) as well as critical intervention (see Coniglio).

Computer aided movement

The computerization of movement is an issue that demands many trajectories and many lines of enquiry. Rodolfo Llinás's line (2002) is a fine one to get us re-started. For Llinás, a Colombian neuroscientist, brain activity is the evolutionary upshot of motorization. "That which we call thinking is the evolutionary internalization of movement" (35). As soon as living organisms

began to move purposefully, Llinás argues, they evolved nerve and brain systems of great complexity. The tunicate or sea squirt is Llinás's most memorable example: this creature starts life as a tadpole-like larva, and then undergoes metamorphosis, becoming sessile and plantlike, at which point it digests its ganglion brain. In its vegetal form, the tunicate has no need for a brain. Of course, even though the human brain has evolved to process much more than motorization, motricity and mentality are nonetheless engaged, according to this thesis, in a relationship of co-dependence, co-determination and co-evolution.

It would be interesting to float this insight over to the domain of artificial intelligence. After all, the human brain is a machine that has evolved as far from the sea squirt as digital computers have evolved from brainless tools. For mathematician John von Neumann, the so-called father of the modern computer, computers and human brains— or what he called "the two automata"— are comparable since the nervous system has "a prima facie digital character" (1958, p. 91). This is because nerve pulses can be viewed as two-valued markers. For von Neumann, the language of the brain and the language of mathematics are similar in this regard: "when we talk mathematics, we may be discussing a secondary language, built on the primary language used by the central nervous system" (82). In other words, mathematics and computer languages are layers of representation built over the natural digital language of the human brain. This brings us straight onto the in-between identity of all things digital: in the narrow sense, "digital" refers to a transit-state between discrete body part (finger), and discrete abstract value (0-9), or to the transit between physical signal (electricity on/off), and the representation of the physical signal as binary digits 0 and 1. Like movement, digital is neither here nor there. To speak of digital movement is thus to merge two ontological conditions (physical and abstract), and to reside in-between: digitalized human movement is caught between mathematics and mechanics, between computer languages and mechanics. Together, hardware and software can motorize digital things in ways other than our own neurologically disposed movement. Knowledge through movement, when faced with an agency of control that is both independent and exceedingly powerful at the processing level, leverages a politics of control that is inextricable from any serious debate on computer-assisted movement (see Birringer, in this volume). This is why the computer tool has radically shaken the entire history of tooled knowledge that has come before us, and this is why digital movement has the potential to shape every aspect of the human kinetic experience (see Salazar Sutil, in this volume). Digital

movement opens up a political contestation that sees two agencies meet from opposite directions: we control the machine, but the machine can control us back.

Creativity and transformation

"An intelligent being bears within himself the means to transform his own nature", wrote Bergson (1922, p.159). Let us replace the term "intelligent" with the term "smart" to provoke a slight but profound change of inflection. The significance of digital movement now becomes clearer: if we can move outside ourselves, through smart systems that move for us and through which we are moved, then digital movement is a kind of trance. On loan from Heidegger again, we can use the term "ek-stasis" (1962/2007, 377) to speak of a standing out of the self, not only in the temporal sense implied by Heidegger, but also in a kinetic sense (i.e. an "ex-kinesis"). Along with Drew Leder (1990), we might also argue that digital movement is an artificial "ex-corporation", an actualization of bodily movement outside the physical body, which can then be physically re-incorporated and re-embodied. Thus transformed, we return to the present body from its own digital absence. Whether our physical bodies are cut off from this digital ecstasy or not, and whether or not the passage from live to digital movement is continuous, we cannot tell. Are we being disconnected from our own live and living movement, are we withdrawing from some natural way of being to the world, or are we learning how to move anew every time we sense ourselves from the outside, from the bodiless ecstasies of the digital? These are questions that irk and divide our authors.

Having failed to agree on a definitive answer to these questions, is it assuming too much to say that computerized knowledge, which all our authors agree is profoundly transformative, is perhaps more transformational than any other historical form of tooled knowledge? André Leroi Gourhan went as far as to say (1993) that the only belief system comparable to our own contemporary worldview, at least in the extraordinary permeability of our thinking, takes us back to the Upper Paleolithic, when humans saw and moved halfway between human and animal, and when the ontological distinction between human and natural environment was blurred. If so, some might argue that digital technology has brought on "future atavisms" (Salazar Sutil 2015), for instance through a recovery of the language of gesture (see Rotman; Charlton and Portanova, in this volume), which can express thought in a permeable way (after all, gestural

communication can permeate the space between human and machine). Back then and right now gesture performs a modality of mobile thinking. Like the human-animal chimeras of Paleolithic culture, we now find ourselves reenacting an atavism according to which we see and move halfway between human and machine.

Based on these themes, it makes sense to have asked our contributors to help us reveal some of the imponderables of digital movement by an integration of two common factors: creativity and transformation. First, we asked our contributors to consider the interaction between the inventive theory and creative practice of digital movement. Second, and following on from the above, we probed the connections between movement architectures of both a soft and a hard kind. In this way, we wanted to find connections between movement inside digital thought (as represented in mathematics, computation, software), vis-à-vis movement inside digital embodiment (i.e. devices, robots, doubles, avatars). Third, we asked our contributors to help us reveal how digital movement can be materialized within the ambit of performance, in the broad sense of this term. How is digital movement issued in technological, choreographic, theatrical or even economic performance? Fourth and finally, Digital Movement is intended to address the way in which an integrated knowledge of technologized movement can lead to an intervention: whether artistic, critical or political even, so that creative movement may be used as an instrument to provoke a transformation of the kinetic self.

Kinetopoiesis

Elsewhere I put forward the term "kinetopoiesis" (Salazar Sutil, 2015), to speak of the possibilities of making and doing things out of movement. Kinetopoiesis is the potential to build from movement, and to do things through movement. One final question our authors were faced with is this: what exactly can you make or create with movement? And across and between what kinds of creative disciplines? What creative opportunities does human movement afford, and to what extent do digital tools enhance these creative and decision-making possibilities?

One thing we build kinetically is the virtual, whose structures are as close to thought as they are to the body— perhaps they reside in that midpoint, that point at nothingness that Bergson spoke of. Unlike the structures of a more conventional architecture, kinetopoietic artifacts can exist in a world that is transient and immaterial like the movements of a dancer or

the gestures of a mathematical diagram. Eleanor Metheny (1968) spoke of "kinestructs": the mental structures of movement that help build systems of kinesymbolic representation across a number of disciplines (in her case, sports and dance). In devoting this volume to the creative way in which kinestruction can be used to build, to structure, to compose new artifacts of the kinetopoietic imagination, we must not forget that in its virtual appearance and in its virtual architecture, purposeful movement is a creative potential that exists before any formal language or any material expression. Before any actual representation or physicalisation there is an inner motion-vision shared not only by those concerned with "aesthetic movement" (see Popat, this volume). The kinetopoietic imagination—and the making of cultural artifacts of structured movement—stems from an inner vision that can be shared by mathematicians (see chapters 1, 2, 3 and 4), sculptors (5), architects (7), choreographers (4, 6, 7, 12 and 13), theatre practitioners (1, 14 and conclusion) musicians (11, 12, 13), computer scientists (10 and 14), roboticists (9 and 13). This is not, of course, an exhaustive list.

What concerns us most generally about the kinetopoietic imagination is the possibility of building and sharing creative and transformational knowledge through movement, across disciplines. This brings us back to where we started. Knowledge of a kinetopoietic kind demands not only an embodiment and a situation of the thinking body in space, but also a recognition of our living body related to its world, and to other occupants of this world.

Trajectivities

Paul Virilio (1997) has lamented that the question of the path is hardly ever addressed explicitly, adding: "One hears of objectivity and subjectivity, certainly, but never trajectivity." Then he hammers the nail on the head: "Between the subjective and the objective it seems we have no room for the trajective, that being of movement from here to there, from one to the other, without which we will never achieve a profound understanding of [… the] techniques and modalities of displacement" (1997, p. 24). This forces us to speak not only in terms of this book's trajectory, but also its trajectivity. As we run down the description of chapters, we find an ongoing desire amongst our authors to come to terms with this "being of movement", this "profound understanding of techniques of displacement", of this construction and articulation of a knowledge off-balance and in-between.

In the opening chapter Sally Jane Norman moves us through time, displacing the contemporary digital avant-garde (and its concern for computational formalisms) through consideration of a forerunner in the historical avant-garde (and its concern for mathematical formalisms). She contextualizes Oskar Schlemmer's kinaesthetic art and its aesthetic underpinnings, highlighting the contemporary resonance of those historical endeavours to fuse embodied and abstract sensibilities. Schlemmer's Triadic Ballet (1922) deploys a mathematics of the body in kinaesthetic space, featuring the diverse corporeal behaviours induced by the geometries and materials of heavily architectural costuming. The creative tensions inherent in these earlier endeavours, Norman argues, resonate with those encountered by today's artists who seek to affirm the irreducibility of the corporeal presence whilst simultaneously sublimating it through digital processing.

A further historical frame is provided by Nicolás Salazar Sutil's reflection on the kinetic economy (or "kineconomy") of post-revolutionary Russia. Salazar Sutil focuses on a Soviet-sponsored programme that sought to design everyday movement according to a political agenda concerned with the industrialization of labour and the modernization of people's lives. Alexei Gastev's Central Institute of Labour (CIT) is the chosen case study for an examination of how technology and mathematical studies of movement provided the Soviet establishment with a scientific discourse (an adaptation of Taylor's scientific management), according to which a social re-engineering of the Russian peasantry could take place. Salazar Sutil's argument is that the laboratories of biomechanical science that sought to discover how movement is controlled by the brain and central nervous system were in fact controlled by a central political system. Thus, behind movement there is an intelligence, and behind intelligence lay a political intelligentsia. The author argues that this analogy between motor and state control via movement is an antecedent to contemporary histories of movement, in the sense that our own way of moving in the digital era is profoundly affected and informed by the digital technologies we control (or which control us). As such, our everyday practice of movement— our culture of movement— is indirectly influenced by a business intelligence driving production of new technology and the commoditization of human mobility, which deeply politicizes the relationship between movement and technology.

Part II is entitled "Gesture and the Digital Object". In his essay "Mathematical Movement: Gesture," Brian Rotman muses over a sense of movement— of gesture in

particular— that can be baked inside certain mathematical languages, and by extension, inside the technologized mathematics that underpins digital computation. Gesture inducts us into speech, we are told, and it also prescribes many art objects where gesture is deployed as a creative visuo-kinetic resource. Rotman identifies gesture as a midwife to bring mathematics (and by extension digital computer languages) into contact with actual bodies, and indeed, with the business of staged performance. Drawing on an experimental choreography entitled Ordinal 5, conceived by Rotman and presented in London's Tate Modern in 2011, the body's disciplined mobilities are examined in a trajectory from frozen forms to formalized abstractions, and back. Rotman thus produces a choreographic proof of two concepts that link mathematical and corporeal motion from opposite directions: the first from the material body through the diagram to abstract, immaterial object, the second from diagrammatically abstracted objects to bodies performing in space.

Stamatia Portanova provides examples of both directions of Rotman's conceptual trajectories in Chapter 4, tracing Michael Jackson's Thriller and Psy's Gangnam Style dances on their pathway from specific corporeal manifestations through abstract mass mediations and back/onwards to move (other) bodies in space and time. She defines the virtual choreographic object as what is created when digital applications contribute to the generation and replication of movement ideas across people and cultures. Such contagious choreographies circulate, become adopted and adapted, continuously mutating as they are separated from their original contexts and meanings and employed, both consciously and serendipitously, to different ends. Portanova applies mathematical topology to contemporary cultural and social dynamics in order to trace the trajectories of these infinitely repeated dances. She describes digitalization as a form of movement codifier, an amplifier of reproduction and imitation, facilitating choreographic contamination between human bodies, and between the human and the movement experience.

James Charlton builds on the preceding discussions by arguing that gesture poses a fundamental sculptural concern as well. Object and subject are brought together, according to Charlton, when a sculptural practice inclusive of digital media can reposition the sculptural artifact as residue, or as "after-fact" (as opposed to "arti-fact"). Rather than seeing the digital as a system of representation, Charlton suggests digital actions should also be located in a dynamic non-representational space directly between artist and material, thus eliminating the necessity of any representational mediation by digital media. If gesture opens up new domains of sculptural

creativity, it does so once we agree that sculptural materiality is an unstable moving point caught between ontological agencies. And if the communicational potential of gesture is said to be intersubjective, it is because it might engage the digital while maintaining our analogue existence in the body. This chapter finishes with a reflexive look at sculptural movement via Charlton's own practice as a sculptor and digital arts practitioner, especially in relation to his works Leaking into Ourselves and 32-Bit Catch, both of which provide Charlton with ample opportunities to reflect upon the ontology of being in movement, and being inside digitally mediated movement.

Part III is entitled "Movement Inscription/ Movement Performance," and it deals with the duplicity of movement as an alphabeticized, coded, or datarized form of inscription, versus movement as a form of doing (a performance). The debate gets started with the essay "Movement and 21st Century Literacy", where Maaike Bleeker opens up a theoretical dialogue between Brian Rotman and Mark Hansen concerning the co-evolution of humans and technology from the point of view of an emergent corporeal literacy in 21st century technoculture. Once again, Bleeker identifies in moving bodies a capacity for abstraction. The continuous passage from live movement to formally scripted movement becomes a medium for the communication and mediation between humans and machines not only at the level of direct (i.e. non-worded) representation, but also enactment. This corporeal literacy has the potential to transform our sense of subjectivity and our construction of selfhood, and it is for this reason that it should be examined critically. The emergence of a post-alphabetic and enactive literacy performed through gesturo-haptic action requires not only technical, computational or kinetic know-how but also a critical awareness of how the intertwining of lived and abstract movement defines what emerges from our interactions with digital media, and how our own doing (our artistic and everyday performance of movement) is implicated within the affordances of these media.

A critique of the relationship between live and codified movement is also the subject of Lise Amy Hansen's contribution. Where Bleeker sees the production of 21st century literacy in relation to motion capture tools specifically, Hansen considers aesthetic and poetic practices found in other emergent technologies that are becoming ubiquitous not only in digital dance contexts, but also in everyday life. As in the preceding chapter, the medium of coded movement or what this author calls "movement scripts", assumes the role of a reflexive thinking tool. The representation of movement also offers opportunities for subversion, according to Hansen. When representing movement in written or graphic form, and when materializing the coded body, we

can deliberately leave our marks in the wrong place. Hansen then urges us to re-examine the strategies for categorization and interpretation in the visualisation and application of movement through the Sync tool (developed by Hansen in collaboration with Hellicar and Lewis), to understand the role of movement and its potential for meaning-making, thus informing both a critical view and the skill sets with which to understand and to create representable and performable movement.

Building on the previous two chapters, Wan-Gi Lee shows how the datarization of live movement can also inform practices of commercial signification and valorization, which directly inform creative strategies for the description (as opposed to inscription) of movement within the ambit of marketing and the development of state-of-the-art technology. Focusing on motion-controlled smart TVs, Lee uncovers a system of "movement performativity", according to which multinational technology firms like Samsung or LG can objectify a user's kinetic and cognitive behaviour, so as to design commercially successful products accordingly. Drawing on Georg Simmel's classic study of value, Lee follows the circulation of reified movement from its physical issuance, to processes of segmentation, to codification, and finally to valorization— a narrative that is construed by technology firms and the expert business intelligence they support. Lee expands on the current politics of motion control by arguing that "subjection" (the making of technology-consuming subjects) is deeply engrained within our everyday relationship with high-tech commodities. This is of particular concern in the case of devices like the smart TV, which can sense our everyday movement in the intimate space of our living rooms, and which can register our private kinetic lives as data that firms will subsequently analyze, interpret and narrativize for commercial self-interest.

Moving on to Part IV, which deals broadly with the notions of technology, materiality and materials, Sita Popat turns to "aesthetic movement", or movement within an art context in general (dance, sculpture, performance, installation art, etc.), in order to find means of critically examining Heidegger's revelations surrounding the essence of technology. Reflecting Heidegger, Popat grounds her essay on an understanding of technology in relation to the notion of technê (which is also found inside art), and which involves knowledge of a craft and the gathering of materials together to reveal an object (or artwork) from those materials. The knowledge that stems from this materializing process and this "bringing forth" opens up another trajective, in this case the "undisclosable gap" between the known and the unknown. Such a gap, which

simultaneously opens up the rift between subject and object, gives leeway for a discussion of Freud's notion of the uncanny as a critique of Heidegger's position. Popat claims that movement in art does not have the power to reveal essential truth, in a Heideggerian sense, but that the aesthetic conception of movement pries open a position of in-betweenness (known-unknown, subject-object) where the uncanny resides, and as a result of which we find ourselves off-balance in relation to the world. It is because technology leads to our withdrawal from the world— a condition from which we in turn withdraw ourselves— that movement art can offer technology a salvation. It is from within this gap that the uncanny finds a way of linking movement art with technology; for instance, through robot design and robotic art. Reflecting on her own experience in the development of the SpiderCrab robot (created in 2007/8 by a team of researchers at the University of Leeds and engineers at Shadow Robots Ltd), Popat concludes that the making of humanlike robots is perhaps as much about the fundamental revealing of essences that we do not want to acknowledge as it is about the confusion between technological and human essence.

In Chapter 7, Fensham and Collomosse's iWeave project also refers to the critical position of uncanniness in its exploration of digital archiving processes for dance and dance costumes. iWeave undertook the digitization of material objects in the form of four original costumes from the Madge Atkinson dance collection dating back to the 1920s, and immaterial objects including four reconstructions of original dances based on photographic footage. Computer-animated versions of the dresses and dances were rendered to support a Kinect interface, where users could try on the historical costumes virtually, as well as interact with choreographic re-constructions. Working with dancers who understood the tensile properties of clothing and these earlier expressive dance forms became vital to understanding the flow, shape and pattern of what might constitute "digital kinesthesia". The project was a success from an archival perspective, since the dress could be seen dancing again. The uncanny, shadowy being of the costume avatar evoked a level of kinesthetic empathy as she invited the viewer to watch her movement and the digital reanimation of the delicate costumes that she wore. Yet the transmission of this content was stilted by reductive notions of how the "natural" or the "touchless" and their correlation to a user interface should be designed around a gaming paradigm.

Wearable materials also provide an entry-point for Johannes Birringer, whose concern lies with what he calls a "gestural materiality" typically found inside the worn dispositif or

sensor-based wearable technology systems used in a number of digital dance and digital music practices. In addition to reintroducing gesture to the discussion, and its historicity within the technologically inflected performing arts of the historical avant-garde, Birringer finds the need to reflect on the issue of control, or control via gesture, in contemporary avant-garde practice. Birringer then takes a detour—he finds the concept of "disalignment" on route to a debate on wearable space or the mutual embedding of body and space through sensor technology. Destabilizing proprioception and intra-actional behaviour, technologized movement and wearable technologies can become new nervous systems, which afford innovative modalities of control. Drawing on two related case-studies: Robert Rauschenberg's Open Score from Nine Evenings: Theatre and Engineering (1966) and Chunky's Moves Mortal Engine (2008/2012)—Birringer wonders whether, in the context of wearable dispositifs in digital performance, it is the performer who controls the instrument or whether the relationship player-instrument has become more unstable. After all, and this is the hard-boiled question Birringer leaves echoing behind him: who is controlling who, or indeed what is controlling whom?

Doros Polydorou, Tychonas Michailidis and James Bullock also grapple with issues of human control in interactive performance in Chapter 12, but they take a different perspective. They refer to two performance pieces, Ukiyo Moveable Worlds and Whisper[s], to illustrate their point. In Ukiyo Moveable Worlds, the performer is immersed in an interactive environment and her movement triggers particular visual imagery, yet the system is unable to provide feedback to the performer about what it is doing or when it has completed specific actions or elements of the scene. Thus the purportedly interactive environment operates in the performer's experience as a one-way channel of communication from human to technology. In contrast to this, they describe the Whisper[s] project, which uses haptic sensation to provide "kinesthetic and proprioceptive intelligence" to the performer/participants about the proximity and activity of others around them. Their analysis leads these authors to propose a system of sensory feedback as a potential way to close the loop and create a "creative and corporeal link" between performer and technology, and between the performers themselves. Drawing on a theoretical framework grounded on Rotman's notion of "gesturo-haptic writing", and whilst acknowledging that "vibrotactile feedback" might not be appropriate in every case, they provide three scenarios to show how this approach might function in practice and to describe the benefits that it offers.

In Chapter 13, Fernando Nabais reflects on human fascination with creating life and its representations. He presents a historical lineage of robotic performances and artworks, starting in the 1960s and culminating with his own work in the present day. Ontological questions have been critical throughout this brief history, at the most fundamental level of questioning what a robot is. The expectations of the audiences for such works are as important to these questions as the technical and creative possibilities. The increasing independence of artificially intelligent robots leads to questions about the robot performer as an entity. Louis Philippe Demers refers to the machines as "it selves" media (2010), arguing that robotic art today is more concerned with the behaviour of the robot than its representational form. Nabais refers to his performances with flying robots or drones, where the robot does not attempt to represent the physical form of an animal but its autonomy and its relationship with the human performer provides both performer and audience with a strong sense of its agency as a performer in its own right.

Nicholas Toothman, Tyler Martin and Michael Neff discuss in Chapter 14 the importance of embodiment and movement in the design of computer tools for creative activities. These authors argue that spontaneity and embodiment are key components of creativity, and so tools for creative purposes need to support improvisation and gesture in order to enhance their effectiveness. Toothman, Martin and Neff consider digital animation and drawing in particular, making the case that tools for these activities need to be real-time and interactive in order to maximize the imagination and creative potential of the animator. They describe experiments in which they asked participants to use tracked Wiimotes to undertake a series of computer-based drawing, editing and animation tasks. Parameters were varied across the tasks, including the scale of the Wiimote spatial tracking so that at times the participants had to walk across the space in order to use the edges of the projected screen on which they were working. The authors analysed the results of these experiments and discovered that enhancing the scale of gestural input and the level of spontaneity led to more creative responses from the participants and also to higher levels of task engagement or "flow", even though increased physical effort might have been expected to result in greater fatigue over longer tasks. The authors propose the need for further research in this area in order to build on their preliminary findings.

Thecla Schiphorst and Tom Calvert's chapter also tackles the question of mobile thinking from the point of view of emergent creative practice. As part of the original team behind the development of the LifeForms/DanceForms choreographic software, Schiphorst and Calvert

have two decades of experience of working with digital movement representation. They provide an overview of the history of software for movement composition and notation purposes, tracing the lineage and placing their unique contribution into that context. Their work is situated at the confluence between technological and embodied epistemologies of practice, and they discuss the importance of interdisciplinary teams to the development of meaningful outcomes. For them, the question is not only how forms of technology impact upon choreographic processes but also how choreography as lived bodily movement informs technological design. Their historical perspective is brought right up to date with an insight into some of the latest developments of the DanceForms software in their current MovingStories project. MovingStories exploits the particular capacities of mobile computing (e.g. tablets, smartphones) which incorporate motion-sensors such as accelerometers and gyroscopes. Such sensors enable the capture of expressive movement parameters directly into the machine held in the hand of the dancer. The aim of this ongoing research is to enable dancers and choreographers to share motion data as meaningful, descriptive, rich movement language through digital means, and thus also to offer processes for mapping movement expressivity to inform methodological strategies for developing social and cultural knowledge.

In contrast to some extent, Martine Époque and Denis Poulin take issue with the possibilities motion capture technology and particle animation software can offer choreographers. Reflecting on their own digital choreographic practice, they contend that "infochoreography", or the choreographing of bodies through data, summons a "dance without bodies" or "nobody dance", which radically transforms the creative and aesthetic practice of movement making within the discipline of digital dance. Speaking of a dancing body released from the "apparent sarcophagus" of the body, Époque and Poulin contend that Mocap can liberate the choreographic imagination to invisible, pure movement. However, the technological media raises a great many imponderables, once again highlighting the difficulties of seeing technologized movement through a single perspective. What ensues is a new creative possibility in the movement arts, where the performer is forced to accept that the delivery of the movement is not entirely within human control, inasmuch as it is part of a distributed process of aesthetic interpretation that is handed over to a digital agency.

Whilst the preceding chapters offer enthusiastic testaments for new and exciting approaches to digital movement theory and practice, Mark Coniglio concludes the book with a

sobering dramaturgical reflection based on twenty years of experience as an artist in the field. He explains that "new" media or technology is never neutral in a performance, and the combination of "old" and "new" media always creates what he calls a dramaturgical problem. Sensor-wearing dancers are no longer just performing on stage – they are "a technically extended body" with influence beyond their natural and physical sphere. Coniglio notes that sometimes the artist, the press or the producing house feels that it is sufficient to advertise the work simply as including technology, which only exacerbates the issue. The problem, he explains, is that "new" technology is not yet part of the performance vernacular and so it does not have a set of dramaturgical norms as recourse for artist and audience. Coniglio proposes two ways to consider technology in the making of performance – the digital reflection (in which the technology is treated as protagonist) and the digital intervention (where the technology becomes antagonist). He is largely dissuaded of the creative usefulness of digital reflection, although he cites some exceptions to his disappointment. In contrast he describes Troika Ranch's Loopdiver, in which he and Dawn Stoppiello used digital intervention techniques to present their dancers with impossible movement scenarios that challenged their very physicality to find solutions. This endeavour inspired innovative and sometimes surprising movement solutions that were triggered directly by the technology. If digital reflection is to create interesting work then Coniglio calls for new systems that are more sensitive to human gesture and that have a greater sense of context on which to draw, so that they too can provide input to the creative process that can surprise and innovate. One day, he hopes, we will have a sensing machine that can intervene at the same time as it reflects. Coniglio believes that this will herald the start of a new age for digital performance practice.

Notes

[1] Syzygy refers to the movement and alignment of planets, two of which are at the opposite antipodes of the third. The term was used in Hermetic philosophy to refer to an antinomy, a coming together of opposites (human-divine, male-female, subject-object). Jarry used the term to refer to a concept, central to pataphysics, according to which the poetic and noetic coincide.