`

‘From Strings to Sensors: Movement Representation in AI Theatre’
Author: Abhik Maiti
Source: *Moveable Type*, Vol. 15, ‘Movement’ (2023-24)
DOI: 10.14324/111.444.1755-4527.1777

Moveable Type is a Graduate, Peer-Reviewed Journal based in the Department of English at UCL.

© 2024 Abhik Maiti. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (CC-BY) 4.0 https://creativecommons.org/licenses/by/4.0/, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

From Strings to Sensors: Movement Representation in AI Theatre

Abhik Maiti

On February 26, 2021, Daniel Hrbek, the director of Svanda Theatre in Prague, helmed a novel theatrical production titled 'AI: When a Robot Writes A Play'. This event, the first-ever theatrical work generated by an artificial intelligence, or AI, system, marked a significant milestone in the realm of performing arts.[1] The play achieved widespread acclaim beyond Prague, reaching stages in London, New York, and Chicago where it garnered praise from publications such as *The Daily Telegraph, The Times,* and the *British Theatre Guide*.[2]

The assimilation of AI technology into theatre practices has inaugurated an expansive frontier of possibilities for both thespians and spectators. In terms of movement, this involves the use of avatars, which inhabit a customary screen milieu (encompassing three-dimensional in-world scenography) that necessitates simultaneous consideration of a tridimensional theatrical space and coexisting performers, within a moment of real-time inception and interconnectedness. This complex confluence raises questions pertaining to the 'avatarisation' of corporeal embodiments on the theatrical stage and the consequent emergence of novel performative methodologies.[3] Within AI-enabled performances, the use of motion capture technology, commonly known as 'mocap', entails the recording of skeletal data from physical actors, referred to as 'mocaptors', who wear a geo-spatial system for motion capture. This is then translated into digital data that can subsequently be used to animate digital characters or avatars.

This paper seeks to analyse the use of AI within the theatre, in particular how it enables the representation of movement through wearable biomechanics, and how the use of this technology contrasts with its customary deployment in conventional theatrical productions. While conventional theatre frequently has to grapple with the limitations of representing human motion due to the physical constraints of human actors, AI theatre possesses the capacity to enhance and manipulate these constraints. Consequently, it empowers actors to execute movements that substantially depart from the confines of human physical capabilities.

The use of advanced motion capture technology enables the development of highly customised avatars tailored to specific theatrical performances. For instance, an avatar can be programmed to execute a particular dance routine or portray a specific character, with the ability to adjust its movements or dialogue in response to the audience or other

---

[1] 'The First Theatre Play Written by AI', Czech Universities, 2021 <https://www.czechuniversities.com/article/the-first-theatre-play-written-by-ai#:~:text=His%20famous%20play%20R.U.R.%20premiered%20in%201921%20and,Physics%20in%20cooperation%20with%20%C5%A0vanda%20Theatre%20and%20DAMU> [accessed 10 August 2023]

[2] c.Arifa Akbar, 'When a Robot Writes a Play', *The Guardian*, 1 March 2021 < https://www.theguardian.com/stage/2021/mar/01/on-the-scene-like-a-sex-obsessed-machine-when-a-robot-writes-a-play-ai> [accessed 17 August 2023]

[3] c.Rudolf Rosa et al, 'THEaiTRE: Artificial Intelligence to Write a Theatre Play' (2020) <ArXiv, abs/2006.14668> [accessed 10 August 2023]

performers. This flexibility and adaptability make motion capture technology a potent tool for creating dynamic and interactive performances that can respond in real time to the audience's requirements.[4] Beyond the technical aspects of redefining movement through the use of wearable biomechanics, this concept has the potential to revolutionise theatre by blurring the boundaries between the real and the virtual, humans and machines, and the physical and digital worlds. By employing AI to generate virtual limbs and body parts, performers can explore unprecedented forms of artistic expression and storytelling and engage with audiences in new ways.[5] As theatre continues to evolve and new technologies emerge, the integration of wearable biomechanics has progressively assumed a more crucial function in creating diverse expressions of movement that deviate significantly from those seen in traditional theatrical presentations.

To articulate this distinction between conventional and AI theatre, I will consider three recent productions that incorporate biomechanics: *Dream* (2021) and *The Tempest* (2016), both by the Royal Shakespeare Company (RSC); and *Play the Knave* (2017), which was developed as part of a research project at the University of California, Irvine. My choice of productions based on Shakespearean material is deliberate: Shakespearean plays have long garnered acclaim for the depth and complexity of their characters, their broad and nuanced emotional range and their intricate narratives, making them an ideal testing ground for the exploration of how AI might contribute to the art of acting and storytelling as well as faithfully replicate subtleties of human movement, expression, and emotion. Within Shakespearean plays, there exists a diverse array of dramatic moments that challenge AI to adapt convincingly to their portrayal, ranging from passionate love scenes to intense battles and profound soliloquies that delve into the deepest recesses of human emotions, and so these case studies endeavour to illuminate the particular set of choices facing creative practitioners and theatrical directors seeking to employ AI as a means to explore the frontiers of technological innovation and artistic representation. Ultimately, I hope to suggest paths for future developments within this exciting field, offering novel approaches to the seamless integration of AI into the world of performing arts.

Creating Organic Movements through Puppets

The practice of imbuing life into inanimate puppets originated with English theatre practitioner Edward Gordon Craig in the 1800s and the early 1900s.[6] It was further developed into the concept of biomechanics by Russian theatre director Vsevolod Meyerhold, who drew inspiration from Konstantin Stanislavski. Meyerhold incorporated the mechanical movements of the über-marionette derived from puppet theatre into the performance of live actors, resulting in a style of acting that appeared mechanical and distinct from the prevailing naturalistic acting of the period. By deconstructing the actor's body into separate components, he aimed to create a more expressive and dynamic

[4] c.Antonio Pizzo, 'Introduction: Drama and Artificial Intelligence' <https://iris.unito.it/retrieve/handle/2318/61616/7774/pizzo_intro_drama_ai.pdf> [accessed 10th August 2023]

[5] c.Wu Zhen and Lian Luan, 'Physical World to Virtual Reality—Motion Capture Technology in Dance Creation', *Journal of Physics: Conference Series*, 1828 (2021), 12–97.

[6] c.Rachael W. Guy, 'Enlivening the Uncanny: On Existential Mirrors and the Anthropomorphic Impulse in Adult Puppet Theatre' (2013) <https://www.academia.edu/9948540/Enlivening_the_Uncanny_On_existential_mirrors_and_the_anthropomorphic_impulse_in_adult_puppet_theatre> [accessed 10 August 2023]

performance. Drawing from *commedia dell'arte* and kabuki traditions, as well as Craig's writings, Meyerhold's system emphasised pantomime over verbal communication and guided actors to move in puppet-like postures under the director's instructions.[7] Rather than replicating human biomechanics, the puppet captures the essence of movement.

Meyerhold's ideas were further integrated into live performances with the incorporation of technology by American choreographer Merce Cunningham, who pioneered the use of motion capture technology, body sensors, and computer software in dance to push the boundaries of the human body. This revolutionary approach had a significant impact on the notion of movement in modern performance.[8] One notable example is the use of DanceForms software, which facilitated the modelling and animation of human movements on a computer screen, subsequently translated into physical performances by dancers. Cunningham employed motion capture technology to go beyond corporeal constraints and generate ethereal visual manifestations within a digital realm.[9] By attaching sensors to a person's body to capture their movements and project them onto a digital character or avatar in real-time, the performer gains control over the avatar's movements, analogous to a puppeteer manoeuvring a puppet through bodily movements.

Within the context of AI theatre, the concept of the puppet and the über-marionette assumes a renewed significance whereby avatars serve as digital representations of performers, programmed to execute specific movements and actions. The interaction between performer and avatar underscores the interplay between the organic and the artificial, as well as how these elements intertwine. While the performer's physical body is crucial for creating the avatar, the avatar exists independently of the performer's corporeal form. This raises questions about the avatar's performative nature and the extent to which it is entwined with the physical body. The director's artistic vision determines how the avatar should move and express itself. Thus, the performer becomes a conduit for the director's vision, further blurring the boundaries between the organic and the artificial. Consequently, in AI theatre, the performers may be likened to über-marionettes, with the director assuming the role of the puppeteer and the AI system, including motion capture and wearable biomechanics devices serving as the imperceptible strings guiding the movements of the über-marionettes.

This relationship contrasts sharply with those found in traditional theatre where performers theoretically possess complete control over their movements and actions on stage, enabling them to infuse their own interpretation of the character into the performance. In AI theatre, the performer's autonomy is often supplanted by the director and the AI system which is based on codified algorithmic instructions that govern the movements of the avatars. These instructions can either be pre-programmed or generated in real time, taking into account external factors such as audience response. The director may employ these instructions to guide the performers, exerting even more control over their movements and actions. Moreover, the AI system itself can suggest instructions,

---

[7] c.Chloe Whitehead, 'An Explanation and Analysis of One Principle of Meyerhold's Biomechanics', *Tormos, Theatre, Dance and Performance Training*, 8.1 (2017), 89–102.

[8] c.Thecla Schiphorst, 'A Case Study of Merce Cunningham's Use of the Lifeforms Computer Choreographic System in the Making of Trackers' (unpublished masters thesis, Simon Fraser University, 1986) <https://www.academia.edu/177957/A_Case_Study_of_Merce_Cunninghams_use_of_the_Lifeforms_Computer_Choreographic_System_in_the_Making_of_Trackers.> [accessed 10 August 2023]

[9] c.Roger Copeland, 'Cunningham, Collage, and the Computer', *PAJ: A Journal of Performance and Art*, 21.3 (1999), 42–54.

introducing unexpected or unique elements into the performance, thereby engendering an unpredictability and dynamism that may not be attainable solely through human-controlled performances.

Dream (2021), based on Shakespeare's *A Midsummer Night's Dream*, illustrates this. This British production—a collaboration between the RSC, art collective Marshmallow Laser Feast, and the Philharmonia Orchestra—offered a compelling connection between puppet theatre and AI-driven performance. Through the implementation of AI, *Dream* introduced pioneering forms of movement that deviated from traditional norms. Its heightened kinetic configurations drew inspiration from puppet theatre and Meyerhold's biomechanical principles, further amplifying the production's unique fusion of traditional and innovative elements. Clad in motion-capture suits, the actors enlivened their virtual avatars through their performances, establishing a unique rapport between the tangible and the digital. This unconventional approach provided the audience with an opportunity to engage directly with AI-generated avatars on the screen, crafting novel movement patterns.[10] Spectators transitioned into active contributors who could reshape the AI-generated avatars on screen, combining and altering movements to create their own distinctive sequences. This interactive collaboration transformed the production into a dynamic, ever-evolving experience, where each viewer's manipulation generated fresh arrangements of movement and artistic expressions in real time.

Another Shakespeare production that similarly redefined movement through the use of AI is *The Tempest* (2016). Through the fusion of traditional stage design with AI technology, the RSC, in collaboration with Imaginarium Studios and Intel, created an immersive virtual reality experience for this performance.[11] This multidimensional viewing experience extended movement beyond the physical realm into virtual reality, offering audiences a real-time encounter that blurred the boundaries between the live and the digital. Anchuli Felicia King's examination of this production illuminates the synergy between the hardware and software used by RSC and Intel as they interact with Ariel's textual portrayal as a supernatural entity, mirrored in the seamless, fluid movements of the digital puppet.[12] As avatars and projections move seamlessly through the virtual space, the idea of movement becomes unusually fluid, transcending the limitations of physical space and gravity. The AI generation of virtual appendages and body components, such as Ariel's virtual wing, also enabled innovative configurations of physicality. Thus, through the use of digital puppetry, achieved through live motion capture techniques, introduced a new dimension to movement on the stage.

The Metamorphosis of the Performers: AI and the Über-Marionette

The integration of motion capture technology in AI theatre underscores the significance of the über-marionette paradigm within contemporary performances, one

[10] c.Boyd Branch, Piotr Mirowski, and Kory Mathewson, 'Collaborative Storytelling with Human Actors and AI Narrators', *Event Report* <https://arxiv.org/pdf/2109.14728.pdf.> [accessed 10 September 2023]

[11] c.Michael Billington, 'The Tempest Review – Beale's Superb Prospero Haunts Hi-Tech Spectacle', *The Guardian*, 18 November 2016 <https://www.theguardian.com/stage/2016/nov/18/the-tempest-review-simon-russell-beale-rsc> [accessed 7 September 2023]

[12] Anchuli Felicia King, 'Digital Puppetry and the Supernatural: Double Ariel in the Royal Shakespeare Company's The Tempest', in *Shakespeare and the Supernatural*, ed. by Victoria Bladen and Yan Brailowsky (Manchester: Manchester University Press, 2020), pp. 70–84.

balanced between increased control and increased unpredictability. Empowering performers to manipulate digital characters in real time, using their physical movements as a foundation for their performances, motion capture technology enables performers to generate digital characters that instantaneously respond to their movements and actions, granting them a level of precision and control that is unattainable through traditional human performance. Simultaneously, the avatar's movements are not constrained by the physical limitations of the performer's body; instead, they are governed by the digital technology underlying the performance which allows for input from multiple sources, thereby enhancing the contingency of dramatic performance.

The Shakespeare project *Play the Knave* (2017) blended technology, theatre, and video-gaming to explore the potential of AI in the theatrical representation of movement. Developed as part of a research project at the University of California, Irvine, it provided a platform for participants to engage with and perform scenes from Shakespearean plays within a virtual environment. Participants would step into the roles of actors and employ motion capture technology to interact with virtual avatars inhabiting a Shakespearean world. The motion capture technology tracked participants' movements, allowing them to exert control over the avatars' actions and gestures. The incorporation of works such as *Hamlet, Romeo and Juliet* and *Macbeth* into a technological framework sought to explore how modern technology could not only adapt but also enhance engagement with theatre classics.[13]

The production used the motion capture mechanisms of the software Kinect to allow participants to influence the behaviour of characters or even take on roles themselves in enacting scenes from Shakespeare's plays, via the following process:

1. Depth sensing: Kinect's depth sensors emit infrared light and measures the time it takes for the light to bounce back. This process creates a depth map of the physical space and the participants within it.

2. Skeletal tracking: Kinect's advanced skeletal tracking capability identifies and tracks the movements and positions of individuals in real time. It recognises joints and body parts, creating a virtual skeleton for each participant. This skeletal data is crucial in understanding how participants are engaging with the Shakespearean scenes.

3. Gesture recognition: Kinect can identify specific gestures and poses made by participants. In *Play the Knave*, this feature enabled users to interact with the characters or manipulate the scenes by gesturing and moving in ways that corresponded to the theatrical narrative.

4. Real-time interaction: Kinect processes the captured movement and gestures in real time. This data is then used to dynamically influence the progression of the Shakespearean play.

A pivotal facet of this engagement pertained to the latitude afforded to participants in generating innovative kinaesthetic expressions. Every participant bequeathed their

---

[13] c. Gina Bloom, Sawyer Kemp, Nicholas Toothman, and Evan Buswell, 'A Whole Theater of Others: Amateur Acting and Immersive Spectatorship in the Digital Shakespeare Game Play the Knave', *Shakespeare Quarterly* 67 (2016), 408–30.

distinct corporeal disposition to the performative tableau, thus generating an array of variegated movements and affectations. This collaborative mode of movement contributed diversity to the characters and scenarios, as participants invested the performance with their individual personas and emotions. Participants could experiment with diverse gesticulations, stances, and ambulations that may not have traditionally been associated with the characters they were enacting. The avatars become extensions of the participants' corporeal entities.[14] The interplay between the corporeal interactions of the participants and the digital simulacra of their avatars serves to obfuscate the boundaries between actuality and artifice.[15] This dynamic interlocution plunges participants into a milieu wherein their gestures wield palpable ramifications, thereby amplifying the emotive reverberations of the performance.

Play the Knave also employed 'glitchy mechanics', or inadvertent aberrations or anomalies that manifest in the operational behaviour of AI-driven entities or components in a theatrical production. The erratic and quasi-spasmodic movements generated by these glitches, which arose from coding issues, were seamlessly integrated into the performance, contrasting starkly with the smooth and synchronised motions typical of theatrical avatars. This disrupted the seamless cadence of movements in ways that challenge established norms of movement representation within theatre. The movements showcased on stage were imbued with a distinctive digital aesthetic, characterised by their unpredictability and unconventional fluidity. Much like the unpredictability of a puppet's gestures, which can yield movements that are surprising, disjointed, and even surreal, the glitch-induced irregularities of *Play the Knave* bestowed upon the avatars a certain surreal quality, enabling them to transcend physical boundaries and execute movements beyond the capabilities of the human body.

While pursuing a notably digital aesthetic, the incorporation of these glitches also harken back to the declamatory style employed by ancient rhetoricians and early modern theatres, characterised by grandiose, formalised gestures momentarily suspended for dramatic effect. Matthew G. Kirschenbaum's observation that digital technology involves the segmentation of continuous motion into discrete, abstract representations also bears on this style of performance which employs gestures to convey emotions or states of action in an attempt to actualise the immaterial.[16] In *Play the Knave*, the performers simultaneously navigate the domains of corporeal entities (wherein they are physical actors capable of executing various movements), and abstract symbols (as on-screen avatars serve as visual indicators of those movements), concurrently inhabiting the domains of reality and abstraction.[17] This coexistence serves as a reminder that the avatar is a digital representation of the performer, rather than a direct embodiment of the performer themselves. Through the use of the wearable biomechanics, the performer's movements and expressions are translated into digital data points, which in turn animate the avatar.

---

[14] c.Luca Befera and Livio Bioglio, 'Classifying Contemporary AI Applications in Intermedia Theatre: Overview and Analysis of Some Cases' <https://ceur-ws.org/Vol-3278/paper4.pdf.> [accessed 10 August 2023]

[15] c.Befera and Bioglio, 'Towards Intelligent Interactive Theatre: Drama Management as a Way of Handling Performance' <https://arxiv.org/pdf/1909.10371.pdf.> [accessed 17 August 2023]

[16] Matthew G. Kirschenbaum, *Bitstreams: The Future of Digital Literary Heritage* (Philadelphia: University of Pennsylvania Press, 2021), pp. ix, 145.

[17] c.Radu Teampău, 'Emergence and Artificial Intelligence in the Performing Arts', *Theatrical Colloquia 12* (2022), pp. 105–13.

Consequently, the avatar assumes the role of a digital manifestation of the performer's idealised form, encapsulating the essence of the performer's performance while surpassing the physical limitations of the human body.

This notion of movement generated through the über-marionette becomes particularly salient in the context of digital avatars' performances within AI theatre productions. Within these theatrical presentations, the avatars demonstrate a capacity for executing motions that diverge from the capabilities of human actors while at the same time encapsulating the otherwise imperceptible aspects of their movement, as did the early 'moving' pictures of Eadweard Muybridge. AI theatre has given rise to a unique declamatory performance style, resulting in a distinctive form of movement that sets it apart from while also reintegrating it within the history of theatre. In the context of *Play the Knave*, the performers exist as both entities and metaphors, embodying real beings and narrative constructs, coexisting in a hybrid state of the human and the non- or supra-human. This is made possible through the concept of the empowered performer, who propels the narrative forward rather than being subordinate to the author and who possesses the capability to reinterpret the narrative in their own distinct ways.

The distinct declamatory movement style generated by *Play the Knave's* glitchy mechanics thus further reinforces the disparity between AI theatre's movement aesthetics and established norms.[18] While traditional theatrical performances rely on the physical abilities of actors to execute choreographed sequences, often grounded in realism, *Play the Knave* generates a synergy between technology and performance, yielding movements that are not merely distinctive but arguably transformative in nature. Movement in AI theatre, while not inherently superior to that of traditional theatre, exhibits distinct characteristics unlike the conventional paradigms of movements executed by human performers. Although AI-generated performances may not yet convincingly replicate the entire range of human emotions and subtleties of expression, they present unique movement forms which are otherwise unattainable by human actors. The future of movement in theatre will likely involve a blend of human and AI-generated performances.

Next Steps: The Future of AI in the Theatre

AI theatre has the potential to reconfigure the traditional paradigms governing theatrical movement representation. It can challenge and enrich the conventional understanding of movement in the performing arts by expanding the horizons of human movement, redefining choreographic authorship and integrating technology with audience participation. This transformation is not without apprehension, however. While AI theatre offers the potential to transcend traditional human performance boundaries, however, it concurrently raises pressing concerns about the displacement of human actors and its repercussions on employment prospects. As AI systems advance, they may encroach upon roles previously exclusive to human performers, potentially diminishing the demand for human actors and disrupting industry employment.

These concerns are exemplified by recent events such as the 2023 strikes organised by the Screen Actors Guild-American Federation of Television and Radio Artists (SAG-AFTRA), which included protests against receiving a single payment for the perpetual use of

---

[18] c.Gina Bloom, *Reimagining Shakespeare Education: Teaching and Learning through Collaboration* (Cambridge: Cambridge University Press, 2023), pp. 251–64.

an actor's image in AI applications without additional compensation or retention of image ownership rights. This would pose a significant threat to actors' livelihoods. The urgency of these protests underscores not only the immediate impact on screen actors' job prospects but also the broader implications for the performing arts community. Unchecked integration of AI technologies into mainstream theatre may compromise the core elements of human creativity, emotional engagement and the distinctive interpretative abilities of human actors.

While the juncture of wearable biomechanics and motion capture represents a pivotal paradigm shift in the landscape of performance, it is imperative to emphasise ethical considerations when integrating AI into human performance.[19] Moreover, transparency is paramount. The audience should be apprised of the deployment of AI in a performance context, enabling them to distinguish between human-generated and AI-generated elements. Such transparency not only respects the audience's right to be informed but also elevates the artistic experience, inviting a contemplation of the interplay between technology and human expression. AI algorithms and data sources should be scrutinised to ensure they do not inadvertently reinforce discriminatory practices or circumscribe the diversity of artistic expression.

Ultimately, the industry must engage in a thoughtful examination of the ethical dimensions of AI-theatre integration, fostering a dialogue that navigates the evolving landscape while safeguarding the livelihoods of human performers. This necessitates exploring collaborative opportunities between AI and human actors, using AI as a complementary tool rather than a replacement, and ensuring that the ethical, creative, and emotional aspects of theatre remain integral to its evolution. Only thus can the paradigm shift that AI theatre enables truly enrich our understanding of movement representation in the performing arts.

Works Cited

Akbar, Arifa, 'When a Robot Writes a Play', *The Guardian*, 1 March 2021 <https://www.theguardian.com/stage/2021/mar/01/on-the-scene-like-a-sex-obsessed-machine-when-a-robot-writes-a-play-ai> [accessed 17 August 2023]

Befera, Luca, and Livio Bioglio, 'Classifying Contemporary AI Applications in Intermedia Theatre: Overview and Analysis of Some Cases' <https://ceur-ws.org/Vol-3278/paper4.pdf.> [accessed 10 August 2023]

——- 'Towards Intelligent Interactive Theatre: Drama Management as a Way of Handling Performance' <https://arxiv.org/pdf/1909.10371.pdf.> [accessed 17 August 2023]

Billington, Michael, 'The Tempest Review – Beale's Superb Prospero Haunts Hi-Tech Spectacle', *The Guardian*, 18 November 2016 <https://www.theguardian.com/stage/2016/nov/18/the-tempest-review-simon-russell-beale-rsc> [accessed 7 September 2023]

[19] c.Mária Tajtáková, 'Theatre in the Digital Age: When Technology Meets the Arts' (2014) <http://www.cutn.sk/Library/proceedings/km_2014/PDF%20FILES/Tajtakova.pdf> [accessed 10 September 2023].

Bloom, Gina, Sawyer Kemp, Nicholas Toothman, and Evan Buswell, 'A Whole Theater of Others: Amateur Acting and Immersive Spectatorship in the Digital Shakespeare Game Play the Knave,' *Shakespeare Quarterly 67* (2016), 408–30

Bloom, Gina, *Reimagining Shakespeare Education: Teaching and Learning through Collaboration* (Cambridge: Cambridge University Press, 2023)

Branch, Boyd, Piotr Mirowski, and Kory Mathewson, 'Collaborative Storytelling with Human Actors and AI Narrators', *Event Report* <https://arxiv.org/pdf/2109.14728.pdf.> [accessed 10 September 2023]

Chion, Michel, *Audio-vision: Sound on Screen* (New York: Columbia University Press, 1994)

Clapp, Susannah, 'Dream Review', *The Guardian*, 21 March 2021 <https://www.theguardian.com/stage/2021/mar/21/dream-review-rsc-royal-shakespeare-company-nick-cave-the-litten-trees-fuel> [accessed 9 September 2023]

Copeland, Roger, 'Cunningham, Collage, and the Computer', *PAJ: A Journal of Performance and Art*, 21.3 (1999), 42–54

Dobson, Michael, 'What Makes Shakespeare Endlessly Adaptable', *British Council Voices Magazine* (2015) <https://www.britishcouncil.org/voices-magazine/what-makes-shakespeare-endlessly-adaptable> [accessed 15 August 2023]

Guy, Rachael W, 'Enlivening the Uncanny: On Existential Mirrors and the Anthropomorphic Impulse in Adult Puppet Theatre' (2013) <https://www.academia.edu/9948540/Enlivening_the_Uncanny_On_existential_mirrors_and_the_anthropomorphic_impulse_in_adult_puppet_theatre> [accessed 10 August 2023]

King, Anchuli Felicia, 'Digital Puppetry and the Supernatural: Double Ariel in the Royal Shakespeare Company's The Tempest', in *Shakespeare and the Supernatural*, ed. by Victoria Bladen and Yan Brailowsky (Manchester: Manchester University Press, 2020), pp. 70–84

Matthew G. Kirschenbaum, *Bitstreams: The Future of Digital Literary Heritage* (Philadelphia: University of Pennsylvania Press, 2021)

Pizzo, Antonio, 'Introduction: Drama and Artificial Intelligence' <https://iris.unito.it/retrieve/handle/2318/61616/7774/pizzo_intro_drama_ai.pdf> [accessed 10 August 2023]

Prpa Fink, Marijana, 'The Influence of Meyerhold's Biomechanics on 20th-century Theatre: The Principle of Equivalence', *Zbornik Akademije umetnosti* (2015), 116–30

Rosa, Rudolf et al, 'THEaiTRE: Artificial Intelligence to Write a Theatre Play' (2020) <ArXiv, abs/2006.14668> [accessed 10 August 2023]

Schiphorst, Thecla, 'A Case Study of Merce Cunningham's Use of the Lifeforms Computer Choreographic System in the Making of Trackers' (unpublished masters thesis, Simon Fraser University, 1986) <https://www.academia.edu/177957/A_Case_Study_of_Merce_Cunninghams_use_of_the_Lifeforms_Computer_Choreographic_System_in_the_Making_of_Trackers.> [accessed 10 August 2023]

Tajtáková, Mária, 'Theatre in the Digital Age: When Technology Meets the Arts' (2014) <http://www.cutn.sk/Library/proceedings/km_2014/PDF%20FILES/Tajtakova.pdf> [accessed 10 September 2023]

Teampău, Radu, 'Emergence and Artificial Intelligence in the Performing Arts', *Theatrical Colloquia 12* (2022), 105–13

'The First Theatre Play Written by AI', *Czech Universities*, 2021 <https://www.czechuniversities.com/article/the-first-theatre-play-written-by-ai#:~:text=His%20famous%20play%20R.U.R.%20premiered%20in%201921%20and,Physics%20in%20cooperation%20with%20%C5%A0vanda%20Theatre%20and%20DAMU> [accessed 10 August 2023]

Whitehead, Chloe, 'An Explanation and Analysis of One Principle of Meyerhold's Biomechanics', *Tormos, Theatre, Dance and Performance Training*, 8.1 (2017), 89-102

Wu, Zhen, and Lian Luan, 'Physical World to Virtual Reality–Motion Capture Technology in Dance Creation', *Journal of Physics: Conference Series*, 1828 (2021), 12-97