Chapter 14
Sonic Robotics: Musical Genres as Platforms for Understanding Robotic Performance as Cultural Events

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Abstract This chapter examines how artist Wade Marynowsky's recent robotic performance art projects are framed within musical genres: Opera, in *Robot Opera* (2015), Ambient/Glitch, in *Synthesiser-Robot* (2017); and Disco, in *The Ghosts of Roller Disco* (2020). By positioning the projects within known music genres, the research expands the canon of Cultural Robotics by providing platforms that allow wider communities to understand the presentation of robotic performance as cultural events within a historical context. Notions of robotic agency, dramaturgy, choreography, robotic musical gesture, and robotic musicianship are explored across three case studies, which are presented in the contexts of live performance festivals and durational exhibitions: (1) *Robot Opera*, a dramaturgically designed, interactive opera for eight, larger than life-sized robots; (2) *Synthesiser-Robot*, a solo autonomous robot performance for a repurposed industrial robot arm, theUR3, and a hardware-software interface, the Ableton Push; and (3) *The Ghosts of Roller Disco*, a choreographed performance for eight robotic roller skates. The research highlights the importance of robotic agency by applying autonomous and interactive movement, localised sound, and surround sound design in creating immersive and engaging robotic performance art experiences.

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14.1 Introduction

In the *Cultural Robotics* chapter *Robot Opera: A Gesamtkunstwerk for the twenty-first Century* (Marynowsky et al. 2016) the notion of robotic performance agency is detailed through the history and theories surrounding representations of the robot in popular culture and art history. Thematics including the Uncanny, the Camp; the Robot as High Culture, and Reciprocity are examined in relation to Marynowsky's previous robotic artworks.

For example, *The Hosts*: *A Masquerade of Improvising Automatons* (2009) (Fig. 14.1); featured five larger than life-sized, and human-like, robot characters in ornate dresses. The work draws connections to the Venetian masquerade balls of the sixteenth century Renaissance and the ornate dresses constructed by Jaquet-Droz, such as The Musician [circa 1768 (Voskuhl 2013)]. The characters in *The Hosts* wear sumptuous, embroidered ball gowns and have individual masquerade guises: a clown in a black and white harlequin print, a princess in a pink-ribboned bodice, a military officer with stars and stripes, and a cowboy-hatted cowboy. Similarly, the sound design for each character is matched to the guises. Three female vocalists (Christina Harrison, Kusum Normoyle, and Debra Petrovich) were asked to perform abstract vocals and/or spoken word, which was recorded in the studio and transferred to the robot's internal computer. The robots' sound samples are randomly played when an object is detected by the ultrasonic range finding sensors, or when a particular programmed behaviour is activated over Wi-Fi communication sent from the control computer. The voice samples are intended to increase the emotional impact of affective gestures (Bramas et al. 2008), such as driving towards a human. It is intended that if the robots sound human, the audience experiencing them will understand the robots as being more like them (Eyssel et al. 2012).

The localised on-board sound coming from the robots' speakers had a strong influence on the main finding, which was that people had the sense that the robots were following and or approaching them individually, when in fact the robots were acting of their own accord. As a viewer of the work, Melody Willis recalled, "They all turned and gathered around me. I felt psychically powerful, like a child with extrasensory perception (ESP)". The main behaviour of the robots was being able to automatically navigate the space without colliding with any obstacles, including humans, so the experience that Willis describes was purely dependent on random circumstances. The artificial intelligence programme that allowed the robot to navigate is, in one sense, a sleight-of-hand tool that artists may draw from their bag of magic tricks to suggest that the inanimate is now animate, a definition of the Uncanny (Jentsch 1997). As the robots glide across the floor gracefully, they danced a completely automated, sensor-based choreography. The choreography was constructed of various scenes, such as slowly awakening from the darkness, coming to life one by one and navigating, spinning in unison, and so on. The duration of the performance was 10 min; the sequence then looped around in a cycle over the course of a day. These scenes of the overall arching choreographed sequence informed the dramaturgy of the later work, *Robot Opera* (2015) (Fig. 14.2).

Fig. 14.1 *The Hosts: A Masquerade of Improvising Automatons*, Mediations Biennale, (2019), The 2nd International Biennale of Contemporary Art, Poznan, Poland, 2010

Fig. 14.2 *Robot Opera* (2015), National Kaohsiung Centre for the Arts, Taiwan, 2016

The representation of robots in film has had a strong influence on the audience's mental model of how a robot should behave (Latupeirissa and Bresin 2020). In *The Hosts,* the ambient background sound created by Marynowsky was influenced by György Ligeti's *Atmosphères*, used in Kubrick's soundtrack for the film *2001: A Space Odyssey* (Kubrick and Clarke 2001). The genre of music in *The Hosts* is not directly referred to but through the atmospheric sound design, an outer space and science fiction film world is suggested.

The dramaturgical platforms explored in the earlier works mainly focused on the Uncanny (Hover et al. 2021) and the Uncanny Valley (Mori et al. 2012), which predominantly explores the visual representation of a robot's appearance, whilst in *Robot Opera*, the focus was on the importance of sound, music, and choreography to communicate a sense of artificial life in a stripped-back machine aesthetic. Whilst the earlier chapter defined the conceptual framework of *Robot Opera* as a Gesamtkunstwerk for the twenty-first century, a detailed inspection of the sound design and the use of operatic form is first presented here. The conference paper "'The Ghosts of Roller Disco', A Choreographed, Interactive Performance for Robotic Roller Skates" details the technical research and development of the work and was published in TEI 2020-Proceedings of the 14th International Conference on Tangible, Embedded, and Embodied Interaction (Marynowsky et al. 2020), whereas this chapter details the sound design for the work and the importance of musical genre.

14.2 Musical Genre and Its Role in Robotic Performance

Much previous work has focused on robotic musicianship from the perspective of mechatronics, algorithmic musical models, machine learning/listening, and the technical aspects of human–robot interaction (Hoffman and Weinberg 2010; Weinberg et al. 2020), but to date, little work has been done to critically reflect on the role of performance context and musical genre in robotic musicianship. On the basis of the three robotic performance works outlined in this chapter, we propose that this overlooked dimension of robotic performance is critical in how works are interpreted and received by audiences. Moreover, when we speak of musical genre, it is important to consider that this manifests itself in a wide range of performance practices around the music as well as in the musical materials themselves.

In the field of human musical performance, it is axiomatic that genre and the related concept of performance context have a profound bearing on the presentation and reception of musical works (Fig. 14.3). In order to understand how genre operates as a vehicle, it is important to recognise that genre is not only expressed through musical style and materials but also through the extra musical or performative conventions that operate around the musical materials. In this way, we might understand genre to be an expansive multi-modal, multidimensional concept.

At the highest level, there are specific relational structures and an established set of ritualised practices between performers and the audience that are associated with the notion of genre. In specific terms, there are established performance

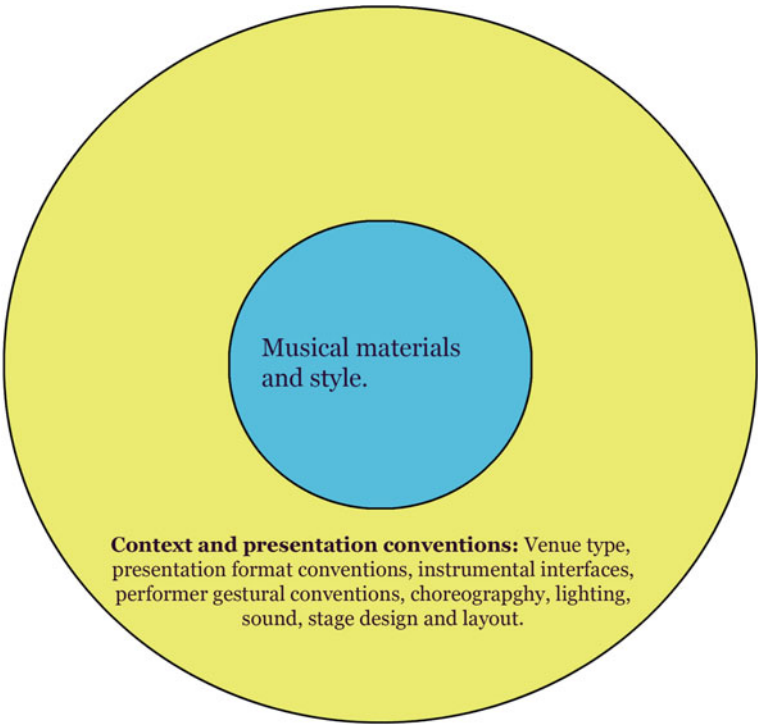

Fig. 14.3 Musical genre and performance context

settings and trends in the approaches to the mediation of performances via audio-visual technologies, common gestural conventions, and choreographic styles, not only in respect of instrumental interfaces but also beyond them. Beyond instrumental gestures, there are choreographic dimensions to musical genres that are core to performance, production, and reception, which operate as a shared language or set of expectations between performers and the audience. For example, in the classical music and operatic traditions, there are concert hall-based rituals governing performer placement and movement on stage and the formal acknowledgement of performers by the audience. Within the genres of popular music, there are similar conventions and rituals that differ from the concert hall traditions. The audience is more participatory both physically and vocally in an apparently less formal sense than in concert hall traditions, but arguably similarly ritualised. In rock, the instruments are distributed in similar or standard formations in a space. In electronica genres, the performers interact with electronic interfaces and there are less obvious connections between gestural inputs and sonic outputs. The proposition is that when composers compose, performers perform, and audience members observe, they are intuitively drawing upon this stabilised set of shared norms.

Genres carry with them a set of structural attributes which shape the work in space and time (scenes, interludes, sets, brackets, ‘drops’, etc.). These structuring

attributes operate as a set of 'conceptual signposts' for the work that provide the audience with a way of engaging with the work. These structural attributes are tied to notions of genre and performance traditions. We have not only found that they provide an important foundation for the creation of robotic musical works but that these performance conventions and associated aspects of theatricality are critical to the reception of robotic musical works by audiences.

It follows that a better understanding of these dimensions is critical to the further development of robotic performance works and to increasing our understanding of how audiences engage with robotic performance work as an emerging performance form. The three works examined here all use musical genres and their associated rituals of performance practice as organising principles. They form a sustained investigation into the role of the musical genre in robotic performance and examine the intersection of robot performance and musical performance in distinctly different ways.

14.3 *Robot Opera*: Robotic Performance as Musico-Dramatic Gesamtkunstwerk

Robot Opera is a dramaturgically designed, interactive opera for eight, larger than life-sized (2.3 m tall) robots with on-board sound, choreographed in a large theatre space with an 8–16 channel surround sound projection system. The project investigates the notion of the *Gesamtkunstwerk*, a term coined in 1927 by the German philosopher Karl Friedrich Eusebius Trahndorff (Trahndorff 1827) to describe the concept of the 'total artwork', that is, a work that synthesises all art forms into a single unified multidisciplinary work.

In the research and development stages of *Robot Opera*, Marynowsky and Julian Knowles (music and sound designer) worked in collaboration with the performance group Branch Nebula (Lee Wilson and Mirabelle Wouters) to develop a dramatic arc for the large-scale performance piece. The arc started with all the robots at one end of the space, all lined up in a row, equally spaced all lights and sound off, except for a low hum. Reveal—the robots slowly turn around to face the audience, with lights on robots coming on; then Sequencer—a beat sequence broken across eight robots, with local LED lights pulsing in response to the sound in various shaped pattern. Slowly moving forward, one robot comes forward and detects a human. A local controlled (DMX) moving head spotlight flashes in blue, while a robotic vocoder voice sample says 'Human detected'. This signifies detection and all robots move forward and interact, avoid and wander, intermingling with the crowd. After 10 min, they return to a rectangular formation. In the noise section, robots spin around fast as if they are out of control, before stopping all of a sudden. One robot returns to avoid and wander, a red light traversing the space and speaking in a female vocoder voice. All lights off, darkness.

In *Robot Opera*, the title of the work explicitly invites the audience to engage with the work as a musico-dramatic narrative that is located within a European performance tradition that predates robotic performers, stretching back to the late sixteenth century. Beyond its title, *Robot Opera* adopts a range of operatic conventions in its execution. These include scene-based dramatic structures that structure the work through time, a musical division between the soloists and accompaniment (in this case, sound produced by robots and accompaniment produced by surround speaker arrays), alternation between soloist and chorus structures (in this case solo robotic performance contrasted with full ensemble performance), and so on.

The intention of this work is to deploy well understood theatrical and musical devices as a structuring principle for the comparatively unfamiliar context of an entirely robotic performance work. In this way, the established traditions of performance can operate as a platform through which the audience can engage with an entirely non-anthropomorphic robot performance ensemble.

Whilst *Robot Opera* directly draws on operatic conventions, it also subverts them once they are established. *Robot Opera* manifests staging differences from conventional opera in that the work is presented in a large open theatre space where, for the second half of the performance, the audience is free to enter the stage area and interact with the robots. The second half of the work, therefore, sees the breaking of the 'fourth wall' between performers and the audience. This is a radical departure from the operatic tradition but at the same time introduces an element of theatrical surprise and a use of theatrical space that is more consistent with contemporary experimental performance traditions (Bailes 2011).

On a musical level, the relationship between the musical materials in *Robot Opera* and the opera tradition are conceptual and structural, rather than direct or imitative. The *Robot Opera* score does not sound like opera, yet it adopts a great many of the compositional structures from it. Musically, the eight sound-enabled robots operate as an ensemble and as a collection of soloists. At various times, they sound together as a tight ensemble. At other times, there is a soloist, or a soloist is surrounded by supporting sound from the other robot performers. At the perimeter of the space, there is a multichannel loudspeaker array that provides an accompaniment to the performers on stage. On a conceptual level, this loudspeaker array can be understood to be the equivalent of the orchestra pit. The loudspeaker 'orchestra' provides atmosphere, accompaniment and generally supports the on-stage sound from the robot performers and the dramatic action.

Speech and text play important roles in *Robot Opera* as they do in the opera tradition, with the robot performers vocalising at various points. The vocalisations from the robots consist of single words randomly hocketed around the robot ensemble who are wandering randomly across the stage area. These are supplemented by nonverbal speech-like electronic utterances, (Robinson et al. 2021) referencing the robotic languages of popular culture film. The result is a spatial cloud of words and utterances from the robot ensemble as they move through the audience. The use of speech in this context resembles operatic recitative but stops short of traditional narrative function. Its purpose is an affective speech layer of evocative words rather than a vehicle for the delivery of narrative content. In the latter half of the work,

the robots seek out humans, engage them, and verbalise material via on-board loudspeakers, introducing a level of performer/audience interaction that is not part of the opera tradition. The closest the robot text comes to meaningful speech is the utterance of the words 'Human detected', which occurs when a robot detects an audience member in front of them. This text is delivered in a 1:1 relationship with a proximate audience member as opposed to the typical 'one to many' format of opera recitative and it creates a state of heightened dramatic tension in an intimate connection with a single audience member.

Given that there were no human performers in the production, the audience looked for agency in the robot performers, viewing the robot performers as autonomous performance agents, and projecting a number of qualities onto them as a result of the mise-en-scène and performance context. Rich data was collected on this work, including audio and video documentation of audience interactions and research surveys of audience members. These data clearly shows that audience members projected qualities onto the robot performers that arose from an imagined view of robots as agents, some of which were not programmed or present in software. These imagined qualities suggest that the performance context and musical genre are critical in how an audience reads a robotic performance work. The technical reality of agency or interaction in this instance was less important than the imagined agency or interaction. Much as we understand theatrical illusion to be a critical part of all human performance, so it is with robot performers.

The work invites the audience to consider robots as performance agents within a performative and dramaturgical system based on the operative form. The title, references to genre, mise-en-scène, choreography, dramatic structure, and musical score all support this reading. The work shows how musical genre, and its performance conventions can be explicitly used and subsequently subverted within the same work. The key insight is that genre and the expectations of performance practice play important roles in the exchange between the audience and robot performers.

14.4 *Synthesiser-Robot*: Expressive Robotic Gesture and Emotion in Robotic Music Performance

Synthesiser-Robot is a semi-anthropomorphic robotic musician (Kemper 2021) that performs a solo autonomous performance for a repurposed industrial robot arm, Universal Robots' UR3, and a hardware-software interface, the Ableton Push. Mounted to the end of the UR3 is a Robotiq adaptive gripper normally used to pick and place in a factory setting. In this instance, the gripper is used to turn knobs and press the buttons of the Ableton Push, much like a musician or DJ would in a live performance context. A custom-built tripod stand was created to raise the UR3 to table height. A custom-built lectern was also created as a stand for the Push and placed in front of the UR3, evoking the notion that the UR3 is about to perform a piece of music (Fig. 14.4).

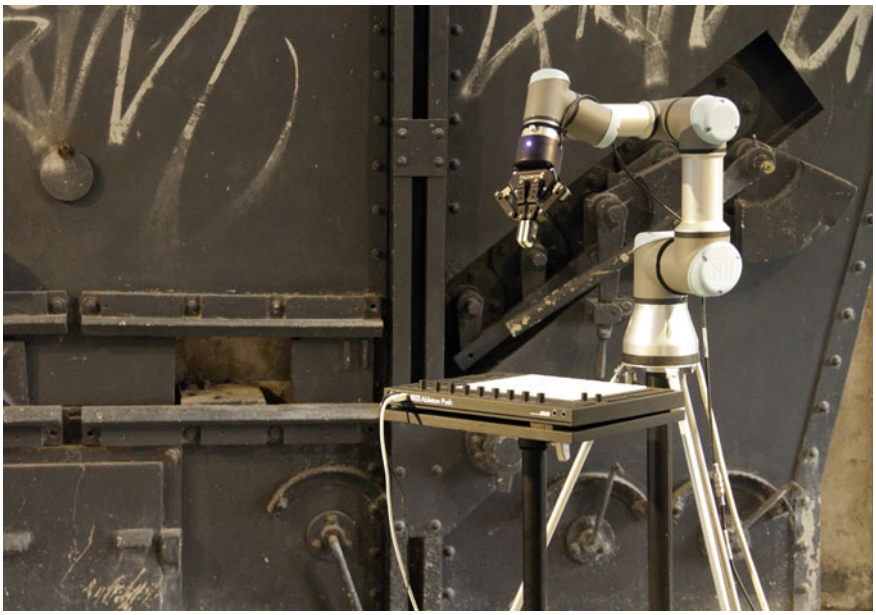

Fig. 14.4 *Synthesiser-Robot* (2017). UR3 robotic arm, custom stand, Ableton Push, Mac mini, speakers, audio, installation, and duration variable

The Ableton Push pads were configured, in Ableton Live, to have sound samples assigned across the 64 pads. The pads were velocity sensitive, allowing touch sensitivity via the applied force of the UR3 gripper. Individual ambient/glitch sound samples were designed for each of the 64 pads and a musical composition was created whereby the UR3 would play the musical events from the Push controller.

Whilst installed in a gallery environment, *Synthesiser-Robot* references electronic music performance in its musical materials, performance interface, and performance gestures. Like *Robot Opera*, it uses these reference points as a set of conceptual signposts for the audience to invite them to engage with a robot as the primary performer. Unlike *Robot Opera*, however, the musical score has a closer sonic relationship to the genre it references, being ambient electronica and modern DJ performance. Within these genres, performers typically manifest a range of non-functional, expressive gestures, such as dancing or head nodding, that are not directly connected to the production of sound but are purely expressive in the visual domain. These gestures can equally be thought of as a form of performative expression and an invitation from the performer to the audience, encouraging them to respond to the music.

Musically and performatively, this work quite closely models itself on the conventions of electronica composition and performance. In keeping with the norms of electronic dance music performance, at the beginning of the performance, *Synthesiser-Robot* presses the play button on the Push to trigger a predetermined sequence of ambient background tracks. After the background music starts, the UR3 begins its

7 min 30 s performance, adding live electronic elements over the top of the background by playing the Push controller. This is a very common performance practice in electronic music genres. The performance is driven by a manually created preprogrammed sequence of single and repetitive loops in which the UR3's arm moves up and down pressing on the Push's sound pads in varying gestures. In between bursts of playing the Push controller, the UR3 reacts to the music by moving freely, performing dance-like movements. Similar to the way, a DJ might nod their head or fist pump the air to encourage the audience to dance, and the UR3 moves gracefully to the music, communicating to the audience that they may enjoy the music in the same way. In this way, *Synthesiser-Robot* demonstrates the expressive potential of dance-like movement and expressive gestures to expand the meaning of 'robotic musical gesture' beyond the context of direct instrumental performance (Hoffman and Weinberg 2010).

Synthesiser-Robot is a paradoxical title as both a robot and a synthesiser are human constructs that cease to exist without human interaction. In this case, both elements exist by interacting with each other in an automated and synthesised, self-contained programmed performance loop. As the robotic performance continues throughout the course of a day (during the month of the exhibition), humans are invited to the exhibition during opening hours and may encounter the robotic performance of *Synthesiser-Robot* at any time within its loop cycle. This highlights that the context and construction of the premise of the work relies heavily on the cultural understandings of the communities of the art gallery going attendees.

In respect of its musical materials, *Synthesiser-Robot* draws on the tradition of ambient electronic music and glitch electronica. Ambient music is a genre of music developed in the 1960s and'70s that emphasises tone and atmosphere over traditional musical structure or rhythm. Its history may be traced back to Erik Satie's notion of furniture music (Potter 2016), minimal music (Warburton 1988), and musique concrète (Deutsch 2009) and was popularised by composer Brian Eno's album *Ambient 1: Music for Airports* (1978). Ambient music has been associated with spiritual and new age movements due its use in relaxation and reducing stress. The genre has evolved to include a wide range of styles from electronic music using synthesizers and acoustic instrumentals using flutes and drums, singing bowls, to world music and spiritual chanting from indigenous cultures. In contrast, Glitch music emerged as a purely electronic genre of music in the 1990s. Pioneers include German labels such as Mille Plateaux and the work of Ryoji Ikeda in Japan. Glitch has been described by Kim Cascone as having an 'aesthetic of failure' (Cascone 2000) and may be distinguished by the deliberate use of glitch-based sonic artefacts such as clicks and cuts and deep digital signal processing. Oval's studio album *Wohnton*, produced in 1993, helped to define the genre by adding some of the aforementioned ambient aesthetics. The tradition of glitch music embraced to a certain extent the prior tradition of ambient music in that a large body of work responds to both aesthetics. It is in this convergence that the music for *Synthesiser-Robot* can be located.

The genre of ambient/glitch music is used here as a platform for expressing relaxing, contemplative and spiritual music, which is an unexpected form of music

to be played by an industrial robot arm. Traditionally, one would expect an industrial robot arm to play repetitive industrial music at high speed, but by programming the arm with slow moving gestures we invite the audience to consider the robot's movements as a response to the slowly evolving ambient music, which the UR3 is creating in real time. Glitching digital audio artefacts such as stuttering, decimation, and sonic bleeps are used to represent the "Ghost in the Machine" (Clarke 2011) in the Arthur C. Clarke sense by referring to the virtual consciousness inside the robot and its processes in operation. They symbolise and emphasise the digital nature of robotic performance as it exists in the popular imagination.

The contextual platform of the art gallery helps to frame these gestural and musical cues to guide viewer's response in considering the robot as a sentient live performer. The non-humanoid appearance of an industrial robot arm takes on anthropomorphic qualities as a result of its behaviours within this well-known mis-en-scène. Additionally, *Synthesiser-Robot* proposes a future in which humans might accept robots as solo musicians, pay money to see robotic bands, and purchase music created by algorithms. It was envisioned that with further research and development, the robot could be programmed with machine learning algorithms to have a greater knowledge of Abelton's Push grid button configuration. Machine learning algorithms could also be used to allow the robotics system to compose music, which questions the notion of originality in creative practice. When faced with artificial intelligence (AI) algorithms that can generate artwork that is sold at auction (Kinsella 2018), we can ask ourselves, what is the role of the artist in the age of computation reproduction embedded with machine intelligence? The role of the artist is to engage with the tools and times they live in. For example, the first AI generated portrait made by the French collective Obvious, which sold at Christie's in 2018 for US$432,000, is an important milestone in the history of AI art.

As detailed in the book *Beyond the Creative Species* by Bown (2021), artists have been using generative algorithms to create art and music to some extent since the 1980s (such as AARON by Harold Cohen [1985–86]) (Cohen 2017). More recently, a relevant musical example includes Artificial Intelligence Virtual Artist (AVIA), an electronic composer that was trained, using deep and reinforcement learning algorithms, to read and compose music, originally classical in genre. Since 2019, the company offers a commercial product, Music Engine, which is capable of generating compositions in various styles, such as rock, pop, jazz, fantasy, shanty, tango, and twentieth-century cinematic (Barreau 2019). The main difference between AI generated music and a highly skilled professional is that the human artist makes creative decisions to produce music that is currently at a much higher level in terms of originality and creativity. Importantly the artwork produced is assigned value by existing in a complex techno-social-cultural environment.

14.5 Sound Design for *The Ghosts of Roller Disco*: Deconstructed Fragments

Disco, a genre of dance music that emerged in the 1970s in the United States, developed in opposition to the rock and punk music of the time. Its sound is typified by four-on-the-floor beats, syncopated basslines, string sections, horns, electric piano, synthesisers, and electric rhythm guitars. Some of its most popular musicians include Donna Summer, the Bee Gees, Chic, etc. Roller Discos were a popular teenage alternative to adult discos and for a short time in the 1980s in Sydney, Australia, they were a highly popular weekend pastime.

In *The Ghosts of Roller Disco*, the theme is the genre of disco within the context of a roller disco, but this time treated in a more nostalgic way. In contrast to the previous works and their futuristic machine aesthetic, a set of eight robots were created and embodied in the form of autonomous retro'80s roller skates. Each robot used sensors and motors to drive the skates around a performance space with simple autonomous behaviours, such as coordinating path planning and object avoidance.

In addition, each robot was equipped with a built-in speaker and synthesis toolkit enabling it to play music in real time, coordinated over Wi-Fi communication.

Musically, the goal was not to be faithful to the original musical style but to use the music and context as referential material to reconfigure and play with, situated in a dreamlike setting where the roller skates themselves have come to life as ghosts, detached from human bodies. The result is an ambient and experimental musical performance that is constructed from musical materials derived from disco themes but driven by this original performance context and its affordances. The array of fast-moving small speakers moving around on the skates provides the potential for a distributed choral ensemble of sound, coordinating with and reacting to each other. The real-time rendering of the sound was derived from the movement of the skates. Originally, the goal was to use the robots' movement control data to control parameters in the music, which could then be coordinated across the array of speakers to be musically in time. However, it proved more technically feasible, and as effective, simply to use data taken directly from an accelerometer built into each robot to control the sound—an appropriate proxy for the robot's movement control data.

We invited two professional musicians, Adrian Lim-Klumpes (keyboards) and Eve Klein (voice), to prepare audio samples inspired by specific disco tracks to create a 'sound world' of musical phrases with which to work; two solo voices that could be set on top of a fixed backing track played over a regular PA. The musical material was prepared so that it could be freely remixed in real time. Originally the goal was to have those phases played in a precisely timed way, but we found that allowing them to play in a temporally loose manner was effective in creating a more perceptually complex soundscape, which set up a rich interplay between the robots' sound and the strong pulse of the backing track. This lent itself to the sense of nostalgia and dreamlike feeling associated with the ghost-skate setting. This in turn also set up an aesthetic juxtaposition with the more comical presence of the darting, critter-like skates, suggesting more complex interplay between the characters. The

Fig. 14.5 *The Ghosts of Roller Disco*, (2020)

main sound used was Eve Klein's vocal samples that were stretched in time using the granular synthesis software installed and emended into the hardware inside the boots. An accelerometer sensor was used to map the movement of the skate to the granular pitch of the sample, creating a vocal sound stream across an elongated time frame. The installation of the work in the show *Never odd or eveN*, (TEI2020 Arts Track Exhibition, at Tin Sheds Gallery, University of Sydney), featured a large black light installed in the ceiling, making everything that was white—the skates, people in white clothes and teeth—illuminate, adding another experiential layer to the abstracted disco environment. Here, the memory of attending roller discos as a teenager is suggested in an installation of ghost-like robots, autonomously navigating and waiting in a parallel world for the cycle of repeating fashions and fads to reignite (Fig. 14.5).

14.6 Future Work

Each of the works has strong potential to be further developed and combined in multiple ways. Multiple *Synthesiser-Robots* could be incorporated into the structural frames of the robots in *Robot Opera* to further investigate the performative nature of individual robotic agents. This would enable the robots to have one to two arms, so that in addition to driving around, detecting, and following humans the robots could point in multiple directions as well as performing 'live' music on their Push pads.

It is intended that *The Ghosts of Roller Disco* project be developed so that two robo-skates are bound together by legs and a lower torso. This would enable the potential to develop human-like figure-skating manoeuvres such as circle work, figure eights, jumps, flips and mid-air spins. When these developments come to fruition, it is intended that the robo-skates enter the Robot Olympics. A social robot version could be a waiter or waitress that, with a tray on top of the lower torso, could deliver food and drinks to art gallery opening attendees.

With additional research, *Synthesiser-Robot* could be developed into a robotic band of four musicians along with a visual projection accompaniment, to create an audio-visual and robotic spectacle that could tour the world stage. To date, there have been multiple robotic musical bands that have toured internationally, such as Compressorhead (Davies and Crosby 2015) and Z-Machines, however, these bands are strongly situated and framed within the genre of rock.

The question of the future remains: will these types of robot performances be interesting enough to entertain a human audience and for how long will it last before the next robotic band comes along? Which genre of music will robots perform and in which contexts? Importantly, how can genres be expanded by robotic performers to create new art forms?

14.7 Conclusion

This chapter examines the role of genre and performance context in the reception of robotic performance works and, by extension, how such works can be understood as cultural events within a historical context. Whether the robot is remote controlled, tele-operated, autonomous, or programmed with artificial intelligence algorithms, the performance context, references to genre, and theatrical conventions play a significant role in the way in which works are read. Once a robot is placed within the context of a musical or narrative genre, it may be accepted to be a believable robotic agent due the suspension of belief and theatrically of the presented illusions.

Audiences must understand the language of the theatre, opera, music, and or cinema in order to follow the narrative construction of the form. The use of thematics and theatrical illusion may also be used to sustain a sense of empathy with the characters on stage, in film or a piece of live music. In cinema, the mise-en-scène, along with the cinematography and editing of a film, influences the believability of a film in the eyes of its viewers. Similarly, in robotic performance, thematic constructs such as autonomous and interactive movement, sound and light influence the audience's believability of a robotic agent with a robotic performance artwork.

As demonstrated in *The Hosts* and *Robot Opera*, to automatically navigate a given space without colliding with any obstacles is an essential component of expressing base level artificial intelligence. Additionally, when a robot interacts with humans by following them and stating 'Human detected' when they are in close proximity acknowledges that the robot is aware that a human is nearby, enhancing the believability of the robotic agent. Simple lighting effects such as pulsing the light in relation

to the volume of the local robot's audio or spoken word acting as a visual representation of speech has proven effective in communicating to the audience that the robot is speaking.

When using multiple robots, an audience may project social formations and hierarchies onto the robot group, particularly when they autonomously form recognised configurations out of what may seem to be a chaotic formation. For example, in *Robot Opera,* we used multiple formal arrangements to represent uniformity after intermingling within large audience groups. In the introduction and reveal sections, all the robots were lined up in a row, a metaphor for an army line of soldiers. Again, in the middle section, all the robots regrouped (after intermingling) to line up in groups of four and across from each other to form a rectangle in the middle of the space. Within the sequencer section, we referenced the left-to-right animated light patterns of electronic drum machines, by creating a beat sequence broken up across eight individual robots, with local LED lights pulsing in various shaped patterns. Above is a brief list of theatrical techniques that were employed to enhance Human–Robot Interactions with artistic contexts. It is clear that the future for robotic performance situated within these artistic contexts has strong potential for further engagement with audiences across a wide range of experiences and narratives.

14.8 Credits and Exhibition Listings of the Works

The Hosts: A Masquerade of Improvising Automatons (2009). Artist and sound:

Wade Marynowsky, Electrical engineer: Aras Vaichas, Programmer: Jeremy Apthorp, Lighting design: Mirabelle Wouters, Costumes: Sally Jackson. Exhibited at the Performance Space, Sydney, 2009; *Beyond Mediations*, Mediations Biennale, The 2nd International Biennale of Contemporary Art, Poznan, Poland, 2010; and in the retrospective, *Nostalgia for Obsolete Futures*, Ian Potter Centre, National Gallery of Victoria, 2014.

Robot Opera (2015). Artist: Wade Marynowsky, Music and Sound Design: Julian Knowles, Lighting Design: Mirabelle Wouters, Dramaturgy: Lee Wilson, Electrical Design: Ben Nash, Programmer: Imran Khan. The world premiere of *Robot Opera* was co-presented by Performance Space and Carriageworks in Sydney. It was the key work in the *Liveworks* festival of live and experimental arts. In 2016, the project's international debut was at the National Performing Arts Centre, National Kaohsiung, Taiwan, 2016. *Robot Operetta* was exhibited in *Dream Machines*, Hazelhurst Regional Gallery and Arts Centre, 2017.

Synthesiser-Robot (2017). Artist: Wade Marynowsky, Music and Sound Design: Julian Knowles. Exhibited in *Algorithmic Pareidolia*, Incinerator Art Space, Willoughby, September–October 2017; *Re/Pair*, part of the Big Anxiety festival, Black Box Theatre, UNSW Art and Design, 2017; and in *Data Life, Mechanical Life, Synthesise Life*, The Beijing Media Arts Biennale, Central Academy of Fine Arts Museum, Beijing, China, 2018.

The Ghosts of Roller Disco (2020). Artist: Wade Marynowsky, Hardware: Angelo.

Fraietta, Brendan Lamb, Nicholas Welsh, Software: Michael Gratton, Sam Ferguson, Alex McClung, Angelo Fraietta, Sound Design: Oliver Bown, with additional music and sound design by Eve Klein and Adrian Lim-Klumpes. Exhibited at *Never odd or eveN*, TEI2020 Arts Track Exhibition, Tin Sheds Gallery, University of Sydney, NSW, Australia, February 9–12, 2020.

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