Transforming Practice with Digital Scores: Developments and Challenges in a Transcontinental Residency

Jaslyn Robertson, Solomiya Moroz, Cat Hope, Craig Vear, Iran Sanadzadeh, Helen Svoboda, Chloë Sobek.

ABSTRACT

This article examines how practice-based researchers in a transcontinental intensive residency transformed their practice and developed their skills through composing digital scores. Four researchers from an Australian university undertook an intensive residency in Hamburg, focused on creating and performing new digital scores. An analytical study of this residency was conducted, centred around each researcher's connection to the materials, experiences of flow, changes in digital musicianship and transformations. The study revealed both challenges and illuminating experiences for the researchers. Each composition went through significant changes during, before and after the transcontinental project, resulting in changes to the digital scores, directions for interpretation, and the researchers' established artistic practices. Exposure to new environments and facilities allowed them to develop fresh approaches to collaboration and technology. Engaging with digital scores led to new skills being developed and new collaborative projects with each other and international musicians. The intensive and transcontinental nature of the project resulted in significant developments to the skills and approaches of the four researchers.

INTRODUCTION

This article examines challenges and transformations undergone by practice-based researchers composing digital scores in an intensive international residency. In December 2022, four Monash University PhD researchers who are each composers, performers and practice-based researchers took part in a project-oriented residency.[1] The residency was designed by Monash University Professor and composer Cat Hope while she was a resident at the Hamburg Institute for Advanced Study (HIAS) and a partner in the ERC-funded *DigiScore* project.[2] The project involved the creation and premiere performance of four new digitally scored works at the Hochschule für Musik und Theater (HfMT) Hamburg. Analysis was done through a series of surveys and interviews of the Australian researchers by *DigiScore* researchers. This analysis tracked the process of the Australian researchers to gain insights on how integrating digital scoring into their practice affected their approach and pushed them in new directions. The impact of creating in an intensive transcontinental environment was also determined through this analysis.

A digital score is defined by *DigiScore* as 'a communications interface of musical ideas between musicians utilising the creative potential of digital technology'.[3] The practice and study of digital scores encompasses many areas of computer music research, digital music practices, creative computing and human-computer interaction. Central to the *DigiScore* project is a study of the transformations in creativity and musicianship afforded by digital and computational technology.[4] This focus shaped the approach of the *DigiScore* analysis of the

---

[1] Pascal Gielen, 'Time and Space to Create and to Be Human: A Brief Chronotype of Residencies', in Elfving, Alexander, Reijnen and Stevens (eds.), *Contemporary Artist Residencies: Reclaiming Time and Space* (Amsterdam: Valiz, 2019), pp 9-26.

[2] https://cordis.europa.eu/project/id/101002086.

[3] Craig Vear, *The Digital Score: Musicianship, Creativity and Innovation* (New York: Routledge, 2019), pp. 19.

[4] https://cordis.europa.eu/project/id/101002086.

residency, investigating how working with digital technologies affected the processes and outcomes of the practice-based researchers.

The residency aimed to build collaboration between the Melbourne-based PhD candidates and researchers in Hamburg, and to expose the group to different approaches and technologies towards the development of new works and the concert presentation. The participants were able to focus on their work, develop relationships, and continue or shift their participation in artistic traditions, movements, and discourses.[5] Activities included attending workshops and concerts at HfMT Hamburg, performing a concert of improvised solos at HIAS, and workshopping and premiering their new works as well as performing other digital scores. Their work in the residency fuelled new collaborations and caused disruptions in their typical approaches to composition, resulting in rapid development of technological skills and perspectives on digital notation. Most of the composers had not previously written digital scores, and taking part in this intensive project allowed them to develop their skills as digital musicians.[6] The impact of the experience was measured by questionnaires, journals, interviews and personal statements of the composers through the *DigiScore* research. Before leaving Australia, the participating researchers prepared some of the material for their pieces and planned their works around the spaces and technology available in the MultiFunktion Studio at HfMT Hamburg, a black box theatre where the works would be performed.

Some of the composers engaged technical assistance for their works in Melbourne and in Hamburg, as they were all working with digital processes that were new to them in some way. This technical assistance included programmers who helped the researchers realise their ideas with visuals created in Max/MSP, or by analysing data with machine learning. It also included assistance with multichannel diffusion of audio, programming lights, and working with VR technology. While this assistance allowed new possibilities for the researchers and their works, it also caused new challenges. The researchers had to communicate their ideas and manage technical collaborators in Melbourne or Hamburg, adding pressure to the already intensive process. The researchers who worked with technical collaborators in Melbourne did not have access to them during the residency itself, meaning that they had to either develop their own digital skills to make changes to their pieces, or think conceptually and change the interpretation instructions for their digital scores without altering the actual object. For the researchers who worked more with technical collaborators and equipment in Hamburg, their pieces could not be completed and tested before leaving Australia. This meant they felt the pressure of taking a risk on a piece that might not be fully realised in the concert at the end of the residency.

The residency disrupted the usual practices of the Australian researchers by challenging their skill sets, requesting them to compose and perform in a new medium that most had not previously attempted. Each of them integrated new technologies and mediums into their process while retaining their conceptual and aesthetic values. This proved to be both challenging and rewarding, leading to realisations about their compositional goals and identities. Being in a different country and institution affected the researchers' ways of working. Some of them created their pieces around technical equipment and possibilities at HfMT that were not easily accessed in Melbourne. Others faced challenges because of distance from collaborators who were not part of the residency. For all the participants, the fast-paced intensive nature of the residency meant that quick decisions and changes were

[5] Kathryn S. Roberts and Sara Malou Strandvad, 'Artist Residencies as Creative Ecologies: Proposing a New Framework for Twenty-First-Century Cultural Production', in McCormick (ed.), *The Cultural Sociology of Art and Music: New Directions and New Discoveries* (Switzerland: Springer Nature, 2023), pp. 43-70.

[6] Andrew Hugill, *The Digital Musician* (New York: Taylor & Francis, 2018).

necessary. These factors all contributed to changes in the pieces themselves, and in the researchers' digital musicianship skills and compositional approaches.

PARTICIPATING RESEARCHERS AND THEIR NEW DIGITAL SCORES

The four researchers who took part in the residency each composed pieces reflective of their own areas of practice-based research. All of them entered the residency with concepts and aims for their pieces, and left with new perspectives on digital scores and changes in their musical practices. This section of the article introduces the research interests and artistic practices of each researcher, an overview of their pieces, and how their goals were affected by the residency.

Helen Svoboda is a double bassist, vocalist and composer whose research explores extended techniques and arco harmonics on the double bass to expand the melodic potential of contemporary double bass music. Her digital score *Wormwood* was performed by herself with the potential to be expanded to include other instrumentalists. With programming assistance from Australian composer Ciaran Frame, this work was Svoboda's first digital score created with Max/MSP. The residency allowed her to 'dive deeper into technology as a way of exploring animated graphic notation for the first time'.[7] She appreciated being able to show a work in progress in front of an audience and found that this let her process become more experimental.

The digital score for *Wormwood* abstracts patterns in a photo of tree bark into graphic representations of overtone groupings and their integer multiples. As a static background, the edited bark photo is visible on the projected screen behind moving animated graphic scapes. The graphic shapes, created in real-time through the Max patch, prompt improvisatory moments performed on the double bass.[8] Working with digital technology gave Helen new ideas for how to express her research. After the residency, Helen planned to build upon *Wormwood* in the next stages of her PhD research.

Figure 1: Helen Svoboda performing her own piece *Wormwood* at HfMT Hamburg, December 2022.

A composer and performer on the *terpsichora* pressure-sensitive floors, Dr. Iran Sanadzadeh's work is concerned with relationships between movement and sound.[9] Her digital score for the concert, *502 Days of Self*, was also programmed in Max/MSP. While Sanadzadeh has experience with Max/MSP, she collaborated with programmer Daniel Pitman in Australia to integrate a machine learning algorithm into her patch, analysing 502 recordings of her own daily rehearsals on her pressure-sensitive floors. The goal of the machine learning element was to analyse the way her performance practice on her instrument has developed throughout changes in her life and environment, and to create an animated graphic score that allowed an ensemble to sonify those changes:

> 'The piece aimed to use recordings of my developing instrumental practice on the interactive pressure-sensitive floors to understand how it is that I have formed my

[7] Helen Svoboda, 'Legacy statement', as part of 'The Australian composers' residency in HfMT, Hamburg, Germany' dataset, University of Nottingham Research Data Repository. http://doi.org/10.17639/nott.7297

[8] Helen Svoboda, 'Program note for *Wormwood*'. (Unpublished, 2022).

[9] Iran Sanadzadeh, 'Bio', n.d., https://www.iransanadzadeh.com/about-1, (accessed 5 March 2024).

habits of movement and gestural vocabulary, sonifying them using other instruments with existing gestural vocabularies'[10]

Figure 2: Iran Sanadzadeh on the *terpsichora* pressure-sensitive floors. © Alexandra Davies.

Performed by five musicians, Sanadzadeh's digital score showed each performer coloured polygons that graphically represented different types of sound and movement, reflecting her performance habits and how they changed throughout different periods of her practice.[11] Developing and rehearsing her piece during the residency changed her understanding of her own musical aesthetic and how to communicate that in open scores, particularly when collaborating with new performers and without extensive rehearsal time.

Chloë Sobek is a composer-performer whose practice mainly revolves around performance on the Renaissance violone. Her piece *Immanence* is a digital score in Virtual Reality, and Sobek's first experiment with VR technology. Integrating her research and imagery from paintings by her brother, Julian Aubrey Smith, Sobek's digital score explored post-anthropocentric ideas in art and technology.[12] Sobek's original idea was to create an interactive VR work, where the audience could move through virtual environments and interact with objects, triggering sonic events. She found that she was limited by what she was able to create using Blender and was challenged by time restraints and computer processing power. Realising these limitations, for the residency she created a static VR environment that served as a graphic score for solo performance.

At the concert in Hamburg, *Immanence* was performed by Sobek herself wearing a VR headset, responding to the visual cues in the virtual space as a graphic score. A video version of the work was projected for the audience live, and viewers were invited after the performance to experience the VR environment. Sobek considered this the first iteration of her work, and stated that she would need to learn a game engine such as Unity or Unreal to realise her original concept. While in Hamburg, she attended a session with HfMT's Dr. Konstantina Orlandatou on Unreal, however there was not enough time to learn this program thoroughly and rebuild her piece. For Sobek, discovering the possibilities for future iterations of her piece was an important part of her experience in the residency. She wrote, 'the creation of this score was a transformative experience in terms of thinking about how the score could operate in a more interactive, immersive VR environment.'[13]

Jaslyn Robertson is an experimental multimedia composer who works with both classical musicians and improvisers, as well as performing electronic music. Her current practice-based research is focused on ideas of censorship in music. Jaslyn had composed digital scores before this residency, mostly as animated graphic scores. She wanted to take this opportunity as a challenge to think more openly about what a digital score could be, and create a score that was not presented on paper or a screen. Through this line of thinking, she came up with the idea to try light as a score, working with Max/MSP to program DMX lights to be activated randomly within the structure of her piece.

---

[10] Iran Sanadzadeh, 'Residency journal', as part of 'The Australian composers' residency in HfMT, Hamburg, Germany' dataset, University of Nottingham Research Data Repository. http://doi.org/10.17639/nott.7297

[11] Iran Sanadzadeh, 'Program note for *502 Days of Self*' (Unpublished, 2022).

[12] Chloë Sobek, 'Program note for *Immanence*' (Unpublished, 2022).

[13] Chloë Sobek, 'Residency journal', as part of 'The Australian composers' residency in HfMT, Hamburg, Germany' dataset, University of Nottingham Research Data Repository. http://doi.org/10.17639/nott.7297

Her piece *Shadow Aria* is a provocation about erasure, asking the audience to consider silenced voices within the history of music.[14] The light score was interpreted by four musicians at the HfMT concert. Spotlights were randomised and performers were instructed to respond by freezing when the spotlight lit them. A spatialised electronic tape track in 24.2 diffusion supplemented the live performance, with the musicians instructed to respond to the movement of sound around them. Jaslyn's experience of the residency transformed her idea of what a score could be, and she developed new ways of composing for improvising musicians. She developed new technical skills by working with HfMT's Dr. Jacob Sello on programming lights through Max/MSP and learned the difficulties and limitations of this technology. From speaking to the performers after the concert, she realised how much the spatialisation of the tape track affected each performer's experience, and began to understand that this kind of work needs additional development and rehearsal time.

Figure 3: Aaron Wyatt and Helen Svoboda rehearsing Jaslyn Robertson's *Shadow Aria* at HfMT Hamburg, December 2022.

ANALYTICAL APPROACH

DigiScore's analysis of the intensive residency in Hamburg centred around four areas of research – materials, flow, digital musicianship, and transformational experiences and impact. Focusing on these indicators elucidated the transformative and disruptive experiences of the participants in each area.

In addition to supporting the four practice-based researchers, the *DigiScore* project collected research data throughout the lifecycle of the project. This data was intended to provide critical insights into the benefits and challenges of digital score creation and realisation in a collaborative residency environment. This has been done through analysis of a complete data set encompassing reflective journals, semi-structured interviews, intention statements and legacy questionnaires.[15] The questioning process was undertaken by the *DigiScore* project researchers, and was guided by a theoretical framework that underpinned all the methods in the dataset. These provided common features for the analysis as a whole, and built upon the theoretical framework presented in Craig Vear's *The Digital Score*.[16] The format of the questions guiding the theoretical framework for this project focused on four categories:

- The ***materials*** of the digital score – the connections to the materials that form the parts of the digital score (sounds, images, game-worlds). Also, how the musicians formed relationships with the active materials such as pre-recorded melodies, machine intelligence, creative media, evoked music-worlds, or the other musicians.
- ***Flow*** in the moment of performing – what journeys were the musicians taken on, how involved in the music did they become.
- ***Digital musicianship*** – what skills, knowledge, and approaches did the musicians use to facilitate a creative engagement with the piece.
- ***Transformative experiences and impact*** – for example, did the score communicate innovative music ideas, new music experiences, novel compositional approaches, new performance opportunities, music-making engagements, or broader accessibility/inclusivity for musicians? Has this experience changed their outlook on

[14] Jaslyn Robertson, 'Program note for *Shadow Aria*' (Unpublished, 2022).

[15] Solomiya Moroz and Craig Vear. 'The Australian composers' residency in HfMT, Hamburg, Germany', 2023, http://doi.org/10.17639/nott.7297

[16] Craig Vear, *The Digital Score: Musicianship, Creativity and Innovation* (New York: Routledge, 2019).

music-making in general? Will the impact of this experience carry over to other future projects?

DIGITAL MUSICIANSHIP

The data collected provided valuable insights on digital score creativity in addition to critical insights on changes in participants' digital musicianship as the result of their new experiences. For the analytical research, the *DigiScore* project evaluated digital musicianship from the point of view of 'a person's ability to perceive, understand and create sonic experiences',[17] which was expanded upon with Hugill's *The Digital Musician*.[18] Specifically, *Digiscore* examined digital musicianship through these categories:

a) skills
b) contexts, cultures & literacy
c) musical identity & creative practice
d) perception & aware-ness of (digital) music

It was pertinent to consider how these categories, within the context of the HfMT residency, interplayed and positively impacted the digital musicianship of the participants.

During their residency, the participants developed many new digital skills, building on their previous backgrounds and the contexts that they were working in as composers and performers. Thus, they were able to implement elements of their creative practice in the making of the digital scores, which was a new experience for them. For example, Sobek used her skills in editing and recording with Reaper DAW as a springboard to learning Blender, the application in which she created assets for the VR piece. Moreover, she employed her expertise in Reaper to record a soundscape featuring field recordings and her instrument, enhancing the immersive ambiance of the digital score. Robertson used her skills in Max/MSP and spatialisation to learn how to program DMX lights through Max. In doing so, she learned to adapt previous skills in audio spatialisation and new skills using DMX to the performance space in Hamburg. Svoboda had little previous experience with Max/MSP, but by collaborating with a programmer was able to animate a graphic notation for double bass overtones that she had been previously developing. In Sanadzadeh's case, new digital skills were learned before the residency, such as which types of algorithms work effectively for data categorisation and their transference to visualisation in Max/MSP. However, Sanadzadeh already had a good knowledge of Max/MSP and learning new approaches to using machine learning with this software extended her skill set.

The change in context for the participants played a major role, changing their perspective on music-making by working with digital scores in an unfamiliar setting. In particular, the shift from working with technical partners in Australia to a residency in Hamburg for projects like *Wormood* and *502 days of self* had a significant impact. This scenario required the composers to navigate technical challenges and adjust their compositions independently, without the immediate support of their collaborators. This process led to a deeper reflection on the nature of collaboration, where relinquishing some control is often necessary for the sake of the work's development. Despite the initial disruptions, this experience provided valuable insights into the practice, highlighting the challenges of using new technologies in unfamiliar performance spaces with different setups. The positive outcome was the acquisition of new skills and a greater sense of independence in managing the technological aspects of their digital scores.

---

[17] Andrew Brown, 'Musicianship in a Globalised World' in Brown (ed.), *Sound Musicianship: Understanding the Crafts of Music* (UK: Cambridge Scholars Publishing, 2012), pp. 26.
[18] Andrew Hugill, *The Digital Musician* (New York: Taylor & Francis, 2018).

Figure 4: Chloë Sobek testing HfMT VR headsets and related equipment for her piece *Immanence* at HIAS, December 2022.

In terms of digital music skills required for the performance, all the digital scores presented were accessible to performers and the audience. For instance, none of these pieces necessitated advanced technical digital music skills from the performers, except for a basic understanding of interpreting animated digital scores and the capacity to improvise. *Wormwood* and *Immanence* were accompanied by projected video for the audience, while *Shadow Aria* utilised lighting as both a score for performers and a dramatic lighting display for the audience. The participants also had the advantage of working with Decibel New Music Ensemble, an Australian ensemble touring during that period, renowned for their expertise in animated notation.[19] However, one of the challenges was that some performers had to reframe their approach to interpreting the digital scores. While *502 days of self* was an animated score easily interpretable by the expert group, it had a few special instructions from the composer that performers had to observe. For example, the performers had to follow the intentionality of their sonic gestures more than following changes to the shapes. One of the instructions was that players could stay silent through 2 or 3 changes if it helped them to start or finish their gestures more smoothly. This instruction for the interpretation of the digital score was added during the process of workshopping and rehearsing the piece (Figure 4). Without changing the score itself, the performance was altered by tweaking the interpretation instructions so that the resulting sound reflected the musical concept better. Creating a digital score can be a technologically demanding process that separates itself from the resulting performance. The residency environment allowed the composers who had their pieces performed by others to see and hear how they would be interpreted, adjusting their pieces before the performance.

Figure 5: Aaron Wyatt, Iran Sanadzadeh, Chloë Sobek and Helen Svoboda rehearsing Iran Sanadzadeh's *502 Days of Self* at HIAS, December 2022.

CHALLENGES AND CHANGES DURING THE RESIDENCY

Through the examination of the data *DigiScore* collected, it became evident that each Australian researcher experienced challenges, changes in their pieces, and ultimately underwent experiences that enhanced their practice. Developments occurred in their digital musicianship and their connections to the materials of making and performing digital scores. Each researcher spoke or wrote about unexpected results that altered the way they thought about technology in their practice, and led to reflections on how they would change their compositional process in the future because of the residency. Such moments of surprise, whether disruptive or creatively useful in the moment, give practice-based researchers the opportunity to reflect and make changes in their process.[20] The transformative experiences varied in their level of impact, with some researchers profoundly changed by the residency and others finding small ways of integrating their new skills and understandings into their future practice-based research.

Iran Sanadzadeh's creation of *502 days of self*, using machine learning analysis from recordings of her performance practice to form an animated graphic score, changed her perspective on how to translate her conceptual and aesthetic ideas into an open score. She

[19] Decibel New Music Ensemble, 'About Decibel', n.d., https://decibelnewmusic.com/about/ (accessed 5 March 2024).

[20] Linda Candy, 'Reflective Practice Variants and the Creative Practitioner', in Vear, Candy, Edmonds (eds.), *The Routledge International Handbook of Practice-Based Research* (London: Routledge, 2021).

was affected by working with a technical collaborator, cultural experiences in Hamburg, and by the process of working with musicians in an intensive environment. While she had a strong concept behind her piece that she communicated with the programmer, Sanadzadeh reflected that the patch he sent her looked quite different to what she had imagined, and that her limited understanding of machine learning prior to this project left her unsure about what the results would be. She was ultimately happy with how machine learning contributed to her piece, and was surprised that the challenges she faced were less about technology and more about the musicians' interpretation of her digital score. In rehearsals, the graphic shapes and the directions for the performers to interpret them were not resulting in the sounds that Sanadzadeh wanted from her piece, as 'there is too much and too little in the score simultaneously'.[21] Being away from the programmer she had worked with, and with little time to make changes in the Max patch, Sanadzadeh found that she had to change the directions for the performers instead of the digital score itself. Realising that she wanted the piece to sound more in line with her own performance aesthetic, soft and sparse, she added in directions that would prioritise this sound-world. This process caused her to examine the relationship between movement and sound, encouraging performers to explore their gestural vocabulary. She felt that the residency transformed her compositional practice, saying 'This week's been really intense and really short. It's going to give me so much to keep going with and so many things to develop that I'm really excited to keep developing'.[22]

Sanadzadeh was affected by cultural experiences as an audience member and tourist in Hamburg, as were many of the practice-based researchers. Being exposed to new possibilities for performance and research and growing connections with the other researchers and Decibel members were important parts of the residency. The researchers were inspired by a concert they attended with Berlin-based pianist-researcher Magda Mayas, that presented practice-based research as a performance-lecture.[23] Informal conversations with the other residency participants, HfMT and HIAS staff also affected the participants. Sanadzadeh recalled a conversation about practice with new instruments that took place while wandering through a German Christmas market.[24] The transcontinental context of the residency meant that the researchers were exposed to musicians and academics from Europe who could inspire their future research, and leisure time between scheduled residency activities allowed them to process and discuss their new thoughts and experiences with each other.

Helen Svoboda's visualization for the double bass in *Wormwood* encouraged spontaneity and challenged her improvisational habits, leading to the discovery of new sound combinations. The graphics that appeared in her digital score were randomised, with the goal of changing the way she usually improvises. Even though this was her plan, she still found herself confronted by this system when rehearsing and performing the piece:

> 'I think in that way it was surprising because I didn't really know what to expect in terms of the shape categories and there were times when I was just really thinking, oh, I wish a pink one would appear. And I really wish that would happen. And it didn't.

---

[21] Iran Sanadzadeh, 'Residency journal', as part of 'The Australian composers' residency in HfMT, Hamburg, Germany' dataset, University of Nottingham Research Data Repository. http://doi.org/10.17639/nott.7297

[22] Iran Sanadzadeh, 'Legacy Statement', as part of 'The Australian composers' residency in HfMT, Hamburg, Germany' dataset, University of Nottingham Research Data Repository. http://doi.org/10.17639/nott.7297

[23] Magda Mayas, 'Magda Mayas', n.d., https://www.magdamayas.com/ (accessed 5 March 2024).

[24] Iran Sanadzadeh, 'Legacy Statement', as part of 'The Australian composers' residency in HfMT, Hamburg, Germany' dataset, University of Nottingham Research Data Repository. http://doi.org/10.17639/nott.7297

> And I just had to sit with that, which is I guess going with that, breaking away from my usual habits and being OK with, you know, remaining in a space for a long time.'[25]

Having conceptualised her piece without fully knowing what to expect from the programmer, the result challenged her usual practice more than she had expected. The residency broadened her perspective on the benefits of animating digital scores and digital technology. After the residency, she envisioned expanding *Wormwood* into a longer piece to further elaborate on these ideas and provide greater opportunities for experimentation.

In *Shadow Aria*, Jaslyn Robertson created a performance environment that facilitated sensitive responses to spatialised audio and light. She faced intense challenges because she was working with technology that she was familiar with, but not yet confident in. While she had previous experience with multichannel spatialisation, she was not expecting how difficult it would be to follow her learned process in a new environment. Technical and logistical issues meant that the concert venue was not set up to test her diffusion until two days before the concert, leaving Robertson worried about whether her piece would fail. She taught herself how to implement DMX signals through Max/MSP before arriving in Hamburg and developed these skills greatly with Dr. Jacob Sello's assistance at HfMT. However, she was not aware that the hardware and software she was using were particularly unstable, and prone to crashing even when programmed carefully. For the concert, Jaslyn's setup worked well, but she felt that she could have improved the performance with more time to fine-tune the details of the diffusion, performance directions and structure of the piece. The residency had a great impact on her practice. The task to create a digital score inspired her to think creatively about new possibilities for collaborations with improvisers, and she gained an understanding of how to manage time and run rehearsals when working with new forms of technology.

Chloë Sobek's experience making *Immanence* allowed her to expand her sonic practice into visuality, creating a graphic score within the VR environment. The facilities and technology available to her at HfMT inspired her work - she knew ahead of time that the school had several VR headsets, which allowed her to plan for the audience to experience her VR work. However, because of the lack of time and resources to learn the programs required to realise her original idea, she changed the direction of her piece before arriving in Hamburg. After the residency, she had concerns about the difficulty of creating VR works while still maintaining her practice as a musician and composer. While she saw the project of making a digital score as beneficial to her relationship with music composition, she was also left questioning how deeply she could engage with VR without collaborating with media artists who work in this field.

Each of the researchers integrated their own performance practices into their compositions. Sobek and Svoboda performed their own works, drawing heavily on techniques that are central to each of their performance styles. Sanadzadeh and Robertson did not perform in their own works, but referenced their performance practices – Sanadzadeh by using her rehearsal recordings as a data source in the algorithm, and Robertson by including recordings of herself on synthesisers in the spatialised tape track. While each work had a different theme, ranging from environmental, to personal, to political, they all drew from concepts and musical languages that sit firmly in each composer's practice and research. Although most of the composers were not accustomed to working with digital scores, they all aimed to create pieces that were consistent with their usual practice. This aim resulted in

[25] Helen Svoboda, 'Interview', as part of 'The Australian composers' residency in HfMT, Hamburg, Germany' dataset, University of Nottingham Research Data Repository. http://doi.org/10.17639/nott.7297

challenges and experimentation as they each dealt with the different processes and outcomes that digital notation brought to their work.

CONCLUSION

The changes experienced by each of the participants continued to contribute to their practices throughout the following year. Both Sanadzadeh and Robertson presented their compositions in new iterations at the International Conference of Technologies for Music Notation and Representation (TENOR) in 2023. Svoboda performed her work at the Australian Jazz and Improvisation Research Network (AJIRN) conference in 2023. Most of the pieces were re-performed in a concert at Monash University in 2023, bringing these works developed in Germany back to their home in Melbourne. Their choice to continue developing their pieces, and particularly to re-stage them in conference concerts, shows the connection they feel between these pieces and their research.

Each participant sustained collaborations made or strengthened during the project in Hamburg which has led to the creation of new projects. Sanadzadeh and Sobek performed and presented together at the International Conference for New Interfaces for Musical Expression (NIME) in 2023. Sobek and Svoboda have continued to perform as a duo after experimenting with ways of playing together in Hamburg. Robertson returned to HfMT Hamburg to undertake fieldwork for her PhD and continue developing her skills in multimedia composition. The effects of this residency were not only seen in the development of each new digital score, but in the way the participants see their musical practice and their confidence to explore new approaches in the future.

Each researcher was inspired by the opportunity to create a new digital score, and used the prospect of developing their works at HfMT as a chance to experiment with technology that was new to them in some way. They learnt new digital music skills and developed confidence in their abilities as digital musicians. Svoboda experimented with Max/MSP, Sobek with VR, Sanadzadeh with machine learning, and Robertson with controlling DMX lights through Max/MSP. They all found both benefits and challenges to these new digital processes, but ultimately left with a better understanding of technological skills that they wanted to develop more, or where it would be useful to collaborate with skilled technicians. A joint decision to frame the concert at the end of the residency as a work in progress setting allowed each researcher more freedom to experiment. The intensive environment of the transcontinental residency was a key factor in the effectiveness of the project, supporting rapid developments in skills, knowledge of digital scores and associated processes, and collaborative relationships between the participants. Being in a different continent, some of them away from their technical assistants and all of them working in a high-pressure environment, caused a disruption in the usual flow of their composing process. However, they acquired new skills and a heightened sense of autonomy in handling the technological elements of their digital scores. Each participant experimented with new ways of composing that required them to question the impact of their new approaches. This resulted in extensive effects on their understanding of themselves as composers, performers, and researchers, evident in their continued outcomes. The acquisition of new digital skills as the result of the shift in context and cultural environment, and the participants' introspection on new processes of composing and their identity as digital musicians were made feasible due to the transcontinental intensive nature of this project.

ACKNOWLEDGEMENTS

The Digital Score project (DigiScore) is funded by the European Research Council (ERC) under the European Union’s Horizon 2020 research and innovation programme (Grant agreement No. ERC-2020-COG – 101002086).This project was possible thanks to the support of the Hamburg Institute of Advanced Study, Decibel New Music Ensemble, the

Hochschule für Musik und Theater Hamburg, and the Sir Zelman Cowen School of Music at Monash University.