Impact case study (REF3)

Institution: Keele University
Unit of Assessment: UoA33 Music, Drama, Dance, Performing Arts, Film and Screen Studies
Title of case study: Repositioning perceptions of real-time electronics in interactive music making: new software, systems and commercial product development
Period when the underpinning research was undertaken: 2012-2018
Details of staff conducting the underpinning research from the submitting unit:

Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Professor Rajmil Fischman	Professor of Composition (Emeritus since 2019)	1989 - 2019
Professor Miroslav Spasov	Professor of Composition and Creative Music Technology	2005 - present
Dr Sohrab Uduman	Reader in Music	1996 - 2020

Period when the claimed impact occurred: August 2013-2020
Is this case study continued from a case study submitted in 2014? N

1. Summary of the impact (indicative maximum 100 words)

This authoring and application of new software, systems and tools for real-time electronics within interactive music has challenged preconceptions of electronic music, demonstrating new means for accessibility to audiences in Europe, the Americas, and Australia. Musicians within these new interactive systems have benefited by exploring extensions to their instruments, furthering their technique within performance. Research into the expressive potential of technology has driven developments of new commercial products taken up by others in and beyond the real-time electronic music making community, providing pathways to creativity and musicianship beyond academic contexts.

2. Underpinning research (indicative maximum 500 words)

Fischman, Spasov and Uduman's combined body of research in search of new audio processing systems for real-time electronic compositions (a compositional approach taking live audio from musicians via a microphone/sensor and subjecting it to computer processing to provide simultaneous changes to the sounding output) has yielded a variety of products, systems, tools, interfaces and compositions that retain musicality, expressivity and natural bodily gesture as part of the compositional process. Prioritising these qualities in real-time situations is distinctive, departing from tape/fixed media, abstract or algorithmic approaches.

Experimental electronic works often garner views of 'alienation' (Wolf, 2013 and Norman,1995) 'inaccessibility' (Stead, 2016), 'coldness' or 'sterility' (Drever, 2005), especially from new or non-academic audiences. By foregrounding human musical expression over visible technologic complexity, the researchers have facilitated greater accessibility and appreciation for compositions within the real-time electronics genre. A common goal of crafting expressiveness unencumbered by technological obtrusiveness has guided the researchers' outputs. Insights fall into two categories:

- By creating new software and systems that are responsive to live musician audio input the research shows that technology can adapt to composers' score writing approaches and inherent musical language, not interrupting, overshadowing or dictating the compositional process. **[3.1] [3.3], [3.4], [3.5], [3.6]**
- Natural idiomatic playing techniques and/or movements from musicians/participants can be 'mapped' (a term describing how a performer's movements and natural playing techniques can

be used to control changes to the electronics/sounding output) onto real-time processing, achieving highly expressive results. Sophistication of mapping, while simplifying user/musician interfaces, encourages participation/access since there is a general 'acceptance' of human agency in producing and controlling the sound emitted. **[3.4], [3.5], [3.6]**

Spasov's development of 9 Max/MSP software externals **[3.3]** implemented in widely performed compositions demonstrates complex programming that is 'easily accessible' (Spasov, 2015). Patterns derived from chaos theory's mathematical equations were packaged into viable, open-access tools **[3.3]** whereby users interact via on-screen visual 'pattern-generating' features for controlling sound processing in real-time electronics.

Fischman's Manual Expressive System (MAES) software enables music creation and performance using natural hand actions, preserving links between causality of gestures and everyday experience of the world, while yielding sound that is a believable result of the performer's movements. Combining glove gaming technology with new software, gestures are made programmable through mapping of hand motion and finger bends, enabling performers/users to realise expressive content with simple hand gestures **[3.2]**. MAES is useable by individuals without formal musical training. The mappings associated with simple hand gestures can be sophisticated because complexity is subsumed within the technology. MAES features in **3.6.**

Idiosyncrasies **[3.4]** and *Out of the darkness that envelops* **[3.5],** both for contrabass clarinet and electronics, investigated composition methods utilising music expression data obtained from performers' changes to air pressure while they play wind instruments. Innovative mapping of air pressure sensor data onto real-time sound transformation is observable in the music.

Fischman's *Clouds* software **[3.1]** was devised as a real-time asynchronous granular synthesis tool in which parameters are handled graphically for distribution across multi-channel loudspeaker arrays.

3. References to the research (indicative maximum of six references)

3.1 Fischman, R. (2016) *Clouds*, Multi-platform real time asynchronous granular synthesis tool created with Max/MSP, (https://cycling74.com/projects/clouds/)
3.2 Fischman, R. (2013) A Manual Expressive System (MAES) *Organised Sound,* Vol.18(3): 328-45.
3.3 Spasov, M. Attractors Library, Max/MSP externals (9 objects), available for download: https://www.keele.ac.uk/humanities/study/musicandmusictechnology/ourpeople/miroslavspasov/#software-download. These are fully explained in: Spasov, M. (2015) 'Using Strange Attractors to control sound processing in live electronic composition', *Computer Music Journal*, Vol.39(3): 25-45.
3.4 Spasov, M. *Idiosyncrasies* for contrabass clarinet and electronics (2018), Premiere - Sarah Watts (contrabass clarinet) and Miroslav Spasov (electronics). 3rd International Conference and Festival for Sensor Augmented Bass Clarinet Research, ZHdK (Zurich University of the Arts) – Konzertsaal, SABRE Concerts, Zürich, Switzerland, 2 February 2019. CD publication: *Into the Depths: Music For Contrabass Clarinet*, Sarah Watts and Anthony Clare, Cuillin Sound label, 2020.
3.5 Uduman, S. *Out of the darkness that envelops* for contrabass clarinet and electronics (2018). Premiere - Sarah Watts (contrabass clarinet) and Sohrab Uduman (electronics). 3rd International Conference and Festival for Sensor Augmented Bass Clarinet Research, ZHdK (Zurich University of the Arts) – Konzertsaal, SABRE Concerts, Zürich, Switzerland, 2 February 2019. CD publication: *Into the Depths: Music For Contrabass Clarinet*, Sarah Watts and Anthony Clare, Cuillin Sound label, 2020
3.6 Fischman, R. (2016) *La Jaula Invisible* for saxophone and glove (https://www.youtube.com/watch?v=EW6Kf2g4ES8)

This research is internationally recognised for originality, significance and rigour. Its quality is demonstrated by its publication in internationally renowned peer reviewed journals, by

international performances, independent commissions and the dissemination of the works through CD publication. The quality is also indicated by substantive funding that underpins the work, including an AHRC Grant for software development to support **3.2** and **3.6** (£71,432 in 2012) and income from the Performing Rights Society in association with the Esmée Fairbairn Foundation, (£8,437 in 2018) for **3.5** and *La cupidite de soufflé* for flute & live electronics.

Performances of the research cluster's real-time electronic works span a total of 50 concert performances in 10 countries (Austria, France, Germany, Lithuania, Macedonia, the Netherlands, Spain, Switzerland, Turkey and the UK) – see **5.9**, Log of Performances for full list.

4. Details of the impact (indicative maximum 750 words)

Uptake of software and influencing development of new commercial products
Research has developed into new open-access software for real-time composition including Clouds **[3.1],** Attractors **[3.3],** and MAES **[3.2]**. **3.1** has been used internationally, with end users describing it as 'simply remarkable...an incredible tool for granular sound design and performance' and 'a good companion' **(5.1).** **3.1** was used to create new music: *2 lukas para flauta y electrónica* and *Música Inmobiliaria* **(5.2)**. **3.1** was used within workshops for students (Orson Welles Institute, Peru, 2016) **(5.1)**, and **3.2** featured in the Summer Conservatory Program (Texas, 2017) **(5.1)**. **3.3** has inspired other software developments including new code (using the population growth equation known as 'bakers map') created by a software developer **(5.4).**

Uduman and Spasov influenced the development of a new commercial product known as the SABRE (Sensor Augmented Bass Clarinet Research) device, led by the Institute for Computer Music and Sound Technology (Zurich). The device captures air pressure data produced by wind musicians, generating numerical data for mapping. Spasov and Uduman fed into the design and testing from 2010, suggesting an idiomatic approach enabling performers to feel as comfortable performing live electronic compositions as they would any other instrument-only work. In 2018 they were commissioned to produce new music **(3.4** and **3.5),** providing proof of concept, and received critical acclaim **(5.5).** The performer noted that **3.4** and **3.5** 'demonstrated the SABRE Multi Sensor's creative potentials in the best way' **(5.6).** The SABRE project leader noted the researchers' role in having 'successfully tested and applied SABRE's potential in an original way. Their work with SABRE has made a significant influence on the way we will be developing the SABRE device' **(5.6).** Since 2018 40 SABRE devices have been sold **(5.7, 5.5).** A SABRE customer stated, 'The device …enhances my performative expression of real-time electronics …providing me with new and exciting musical possibilities.' She observed that the device 'steers the conversation between composers and performers to a common topic, discussing the possibilities for performative and compositional expression, which …is key to advancing the field' **(5.8).**

Influencing musicians' understanding of real-time electronics
Through playing these pieces, musicians have gained greater understanding of the capabilities of real-time electronics without compromising musicality. The performer of **3.4** and **3.5** said 'the entire project has already helped me improve my contrabass and bass clarinet extended performance techniques and expanded the range of timbres I can produce in the various registers of the instruments' **(5.6).** Further clarinettists have praised the application of the SABRE device within **3.4** and **3.5:** 'the way the interaction between the electronics and the instruments worked has changed the way I will be approaching the performance of contemporary music in the future'. **3.4** and **3.5** have "raised my interest to broaden my bass clarinet repertoire' **(5.8)**, while others have commended the successful blend of 'natural musicality and performative expression with innovative real-time electronics' **(5.8).** NoiseFloor Festival emphasised that **3.4** and **3.5** represent 'valuable and unique additions to the limited repertoire for Contrabass Clarinet' **(5.9).**

Influencing audience perceptions of real-time electronics
Compositions from the research group have been performed on an extensive scale. Between August 2013 and December 2020, 50 performances have taken place in 10 countries **(5.9).** Audience responses to these performances demonstrate increased accessibility to real-time electronics. A musician attending a performance of **3.4** and **3.5** observed that the composers'

approach 'makes live electronics much more accessible' **(5.8)**. An audience member for **3.4** and **3.5** reflected on the experience: 'I discovered the sound of two wonderful instruments... I was transported into unknown musical worlds by the combination of these strange instruments and the electronic and digital audio processing'. **(5.10)** Reviewers have noted the importance of *Into the Depths* (CD publication featuring **3.4** and **3.5,** 2020) as a 'compilation first' **(5.5)** for the contrabass clarinet and "paramount in leading the way for future contrabass clarinettists, the establishment of new techniques and blends between instrument and technology' **(5.5)**.

The researchers have increased accessibility of the genre for young people via outreach resources. **3.4** was used as comparative listening to illuminate real-time electronics for A Level Music students studying Saariaho's *Petals* for cello and live electronics (Edexcel set works list). Worksheet and video resources were distributed to approximately 160 students from 14 schools during lockdown (March 2020) to assist their learning. One teacher stated: 'The resources have excited and engaged the students so much …finding new ways to make sound on their respective instruments and also process that sound electronically.' **(5.3)**.

5. Sources to corroborate the impact (indicative maximum of 10 references)

5.1 Compilation report of software and examples of uptake.
5.2 New composition using the *Clouds* software created by independent researcher and composer Jose Gallardo at the Mexican Centre for Music and Sound Art (*held within Keele's repository*).
5.3 Testimonial from Anna Power, Head of Music and Music Technology at Woking College.
5.4 Software developer using the 'Bakers map' code initially coded in the Attractors Library 'inspired by the chaotic attractors Max external by Miroslav Spasov':
https://gitlab.doc.gold.ac.uk/lwyll002/creative-research/commit/f45d98a030b72fa8dfb6418c453edef480199c4b
5.5 CD and music reviews:
5.5a Heaton, R (2020), 'Sarah Watts: *Into the Depths: Elizabeth Kelly, Franco Donatano, Tom Williams, Miroslav Spasov, Sohrab Uduman, Anthony Clare. Cullin Sound, CUIILL1006'* Tempo New Music Journal, Vol.74(294), 97-99.
5.5b CD review from Dr Tom Williams a composer of contrabass clarinet music.
5.6 Open Forum Discussion, SABRE Day Festival (February 2019), Zürich (summary of comments provided by contrabass clarinettist).
5.7a SABRE Multi-sensor product website https://www.sabre-mt.com/sabre-products-2
5.7b Details of no. of units sold (screenshot of Facebook correspondence).
5.8 International bass clarinettist testimonials from **5.8a** Marij van Gorkom and **5.8b** Stephan Vermeersch.
5.9 Log of performances and media.
5.10 Feedback from audience member (June 2019), Keele University Chapel.