Electrifying Opera: Amplifying agency for opera singers improvising with interactive audio technology

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Abstract

This research project examines the technical, physical and pedagogical challenges that opera singers face in relation to the use of interactive audio processing technology in opera. It investigates acoustic and aesthetic conflicts between opera and electroacoustic music, explores reasons why opera singers have been slower than classically trained instrumentalists to embrace new technologies, and asks what types of sound design and interactive systems might reduce some of the barriers opera singers encounter in relation to the innovations of the digital revolution. The primary question driving this research is the following: What technical and aesthetic issues need to be addressed so that opera singers can incorporate the use of audio processing technology and improvisation in their performance practice?

Keywords: Opera, Sound design, Audio processing, Embodiment, Live interfaces, Sensors, Augmented instruments

Introduction

In October 2019 I began a PhD in Artistic Research at the Oslo National Academy of Art in the Opera department. My topic of research - Electrifying Opera: Amplifying agency for opera singers improvising with interactive audio technology - focuses on ways to incorporate audio processing into opera while maintaining the primacy of the acoustic voice and the agency of the performer. As a composer and classically trained singer, I have created numerous concert works that utilize live sampling and real-time audio processing. My attempt to create similar work for opera revealed challenges specific to the genre as well as some inherent conflicts between opera and electroacoustic music that need to be addressed.

Operatic technique focuses on developing a virtuosic voice of extended pitch and dynamic range able to project in large spaces without amplification. Opera singers are in effect playing to and with the acoustics of the space. Electroacoustic music on the other hand is dependent on amplification through loudspeakers, and the sound systems utilized have the ability to digitally simulate different types of acoustics independent of the physical space. The design of traditional opera houses, in fact, presents acoustic and structural challenges for live electronic processing in opera. The orchestral pit inhibits both sight lines and audibility between the orchestra and the singers and sets up a divided acoustic space. When electronic sound is used in traditional opera houses it can create a strange aural disconnect if the electronic sound is coming from mounted speakers that don't blend well with either the orchestra or the singers. In addition to the necessity of performing opera in spaces acoustically suited to the operatic voice, the role of the singer as actor and the need for mobility in the space further complicate the creation of work that utilizes performer controlled live audio processing.

Purpose of the research

Nina Sun Eidsheim (2015) theorizes an expanded unpacking of what music consists of, where aural, tactile, spatial, physical, material, and vibrational sensations are all important elements. Regarding opera, Eidsheim writes that "… the

unamplified power of the singers´ voices is part of the fetish that defines the artform."[1] Composer Hildegard Westerkamp asserted in a keynote speech at Invisible Places 2017: "sound experienced, produced and received as a physical process can be an effective counterbalance to attempts by commerce and technology to transform it into product and commodity." She elaborated further that "One´s own sound output or creative expression not only lessens the authority of externally imposed voices but also offers a new voice of vitality and energy."[2] This foregrounding of vibration and physical process by both Westerkamp and Eidsheim highlights the fact that sound always occurs as a vibration and an interaction in a specific acoustic setting, and that these vibrations and interactions *do* something to both the sound-maker and the listener.

In opera the unique "something" - the *doing* that defines it - is the direct, unmitigated transmission of sonic vibrations from the singer´s body to the listeners´ ears. It is both intimate and athletic, vulnerable and awe-inspiring, and somewhat magic. Unlike instrumentalists, who can be seen engaging in sound producing actions with their instruments, with singers only their supporting actions (movements for breath and articulation) are visible to the audience. The singer´s actual sound producing actions (air vibrating the vocal folds) are invisible. With the addition of language the singer embodies a role of both musician and actor. As a result (and in part because the singer´s sound producing actions are invisible) the singer´s body and hands have heightened semantic value; movements and actions are perceived in a theatrical context. In opera the singer´s movements and spatial location are also significant compositional and theatrical elements of the performance. All this complicates the question of controllers.

Many vocalist-composers, like myself, have been working with interactive technology and custom built controllers to expand the options for vocal expression. Both Franziska Baumann and Imogen Heap have designed sophisticated custom-built midi gloves and wearable controllers using a variety of sensors.[3] Pamela Z has developed multiple controllers, from those measuring electromagnetic signals of muscle contractions, to motion capture, to her most recent system incorporating sonogram technology.[4] Dafna Naphtali has designed an interactive system for controlling a GuitarBot and robotic percussion instruments using a hand held Wii controller.[5] Anne Hege designed a tether controller to process audio using the Wekinator interface. Although these vocalist-composers use their controllers to trigger voice and sound articulations in real time via gesture, they maintain a largely stationary position near the computer that is running the audio processing programs. This is partly a function of the type of controllers, but also, and perhaps primarily, a function of dependence on a visual interface to monitor the live audio processing. In concert settings this is unproblematic, but in opera singers must take into account the dramatic implications of their gestures and dramaturgy. Standing behind a computer and processing audio may be neutral in concert, not so in opera.

If the voice is to be used as a sound source in live interactive audio processing and real-time sampling, it necessitates capturing the vocal input with a microphone. Common practice for most vocalists currently using live electronics has been to amplify the voice simultaneously and mix the amplified voice with the electronic sound, matching the vocal volume level to the volume of the electronic signal – a similar principle of sound design as in rock, hip-hop and pop music. In opera, however, this design robs both performers and the operagoer of one of the primary characteristics and thrill of this genre: experiencing the power and beauty of an embodied unamplified voice resonating an acoustic space. Amplification also adds other potential problems to opera: loss of spatialization, loss of full dynamic range, distortion of vocal timbre and distortion in the higher ranges. The extreme dynamic and register range of the operatic voice presents challenges.

In this research project I intend to investigate the issues outlined above with the goal of designing an electroacoustic interactive system that will foreground and accommodate the unamplified virtuosic voice of the operatic singing-actor. The challenge remains to design an interactive system that can accommodate mobility in a dramatic performance, and where the choice making of the performer can be based on aural rather than visual cues.

Methods

Working together with computer engineers, a research assistant and a group of opera singers recruited to be part of a voluntary Participatory Design Group (PDG), various configurations of real-time interactive processing and sound design systems will be tested to address the following questions:

1. How can we create a performer driven interactive audio system for opera singers that addresses their needs for physical mobility, dramatic coherence, and acoustics suitable for the unamplified virtuosic voice?

2. What kind of interactive systems, controllers and mappings might best enable opera singers to enact performer driven control of audio processing, and can we discover best practices through participatory design?

3. Since the ability to improvise is integral to the use of interactive systems, what types of training should be developed to re-introduce the practice of vocal improvisation to the field?

Based on initial research of existing systems, I will hypothesize which types of movements might be most suitable for controllers designed for opera singers, keeping in mind acoustic and mobility needs. I wish to design a system that can utilize common embodied performer motions: hand gestures, the motions of handling a prop, playing an accompanying instrument, or engaging with a costume or piece of the set. I will evaluate potential controllers, both MIDI and OSC. Using machine learning software such as The Wekinator, I will test models for controller design with the Participatory Design Group. The Wekinator, an open source software created by Dr Rebecca Fiebrink,[6] allows anyone to use machine learning to build new interactive systems by demonstrating human actions and computer responses, instead of writing programming code. The Wekinator is well matched to the aims and design processes for this research as it allows for rapid prototyping and exploration of mapping options through human-machine interaction, using the computer as a partner. It does not require extensive programming skills, but rather enables performers to create mapping through embodied interaction. I will evaluate mapping options by testing them first myself as a performer, and then with the Participatory Design Group.

Electrifying Opera is a transdisciplinary research project. It spans the fields of operatic performance practice, interactive computer music and composition, sound design, machine learning and the emergent field of active acoustics. It also intersects with costume design and scenography. As a composer and a singer I will be drawing on multiple modalities to investigate and develop innovative possibilities for opera singers to augment their voices with performer controlled interactive audio technology. Methods used will include workshops in vocal improvisation, in participatory design of data mapping, machine learning, prototyping, sound design, signal processing and musical composition. Documentation will include written logs, video and audio documentation. The final artistic application and outcome of this research will be to incorporate a custom designed interactive system into a newly composed chamber opera. A collaboration with librettist/designer Julian Crouch and the Ethos Percussion Group (both based in New York City) forms the basis of the external creative team for this newly composed opera, working title: *The Sailmaker´s Wife*.[7]

Description of the proposed approach

In this research I will explore how various conceptions of sound design and real-time interactive processing systems might address some of the inherent tensions between opera and electroacoustic music. Designing an interactive system that can be controlled “blind” will necessitate determining both what types of audio processing can be mapped to clear and simple actions, and determining the number of parameters that can be held in mind without visual reminders. I will investigate the kind of choice making and audio processing that instrumentalists commonly trigger with pedal boards and other basic controllers that facilitate signal processing without a visual interface, and I will test possibilities for similar choice making with controllers that allow for mobility in the space. Working with singers from the Participatory Design Group I will observe how they interact with various controllers, and experiment with varying levels of control of parameters.

In regards to sound design, it is possible to capture vocal input without simultaneously amplifying the voice, and possible to combine both the embodied unamplified voice and the disembodied processed vocal signal as two separate instruments converging in one space. Starting from the aesthetic point of view that electronic sound in opera should accommodate the acoustic singer rather than the other way around, I will investigate various strategies for the diffusion of electronic sound, including localized loudspeakers, loud speakers embedded in scenography or costumes, active augmented instruments, and non-standard multi-loudspeaker diffusion systems (NSML systems). Although these are

expensive and probably will not be directly applicable to my artistic project, the concepts in the sound design offer many new possibilities for the combination of acoustic and electronic sound production.[8]

Localized loudspeakers parallel the way bass and electric guitar personal amps function in an acoustic jazz ensemble. David Lang did this in his recent "*Three Mile Opera*" where singers performed on a 3-mile stretch of an elevated former train line and were paired with their own individual loudspeakers. In her opera "Agora", Natasha Barrett used live electronics to turn an installation of membranes and aluminum bars into computer controlled mechanical acoustic instruments that mixed with electronic sound from multiple speakers. Long-term collaborators, singer Julie Wilson-Bokowiec and composer Mark Bokowiec have produced works where the performer, outfitted with multiple sensors and controllers, is placed within a "sensitized" performance space, a surround sound system of multiple speakers. Tod Machover has designed Hyperinstruments and sound producing controllers that invite the public to participate in collaborative music making in his operas. And composer-vocalist Pauchi Sasaki has designed a speaker dress[9] – a costume built of multiple small speakers that allows for mobility and localizes all electronic sounds to her body. I have previously used both localized speakers (custom-built hemispherical speakers) and active augmented instruments in my work. In my opera *The Trials of Patricia Isasa* I used an upright piano with transducers mounted on the soundboard, as a loudspeaker. All the electronic sounds were played through this acoustically active augmented piano, allowing the electronic sounds to be localized in the pit with the rest of the orchestra and blend acoustically. I will continue the exploration of acoustically active augmented instruments to project sound. The exploration of the sound design, like the exploration of controllers, will include singers from the Participatory Design Group. A number of workshops are planned to test out excerpts from *The Sailmaker´s Wife* using these strategies.

Expected Contributions

This research contributes to the development of emerging technologies in opera, to the development of the improvisational performance skills needed to engage with those technologies, and to the development of innovations in interactive sound design conducive to opera. Based on conversations with other opera composers and with opera singers, I believe there will be significant interest in this research.

Looking at some of the technical and aesthetic issues that need to be addressed so that opera singers can incorporate the use of audio processing technology in their performance, I expect to address three things in particular that I think will contribute significantly to the field: 1. Determining what types of controllers can work both with the theatrical context and with the need for mobility. 2. Designing an interactive system that is not dependent on a visual interface. 3. Designing a sound diffusion system that can accommodate both the acoustic unamplified voice and processed electronic sounds. Of these three, I expect that the second may be the most challenging. It may also yield some unexpected pedagogical insights.

Progress towards goals

My research is in its initial phase. I have been corresponding with composer and performer colleagues, reviewing relevant documented repertoire and conducting a review of interactive systems and controllers currently in use by composers working with live audio processing. I have conducted initial experiments with an acoustically active augmented instrument – an antique taffelpiano – experimenting with it as both a loud speaker (with transducers) and as an augmented resonator (with piezo microphones). I have also started to explore and design several simple prototypes for interactive patches in Max/MSP that are not dependent on a visual interface, and that can be controlled remotely. My experiments thus far have utilized commercially available wireless game controllers, tablets, phones, and a wearable sensor: the HotHand ring, which relays data from a 3-axis accelerometer. My initial goal is to get an overview of current practices and possible solutions to the challenges I have outlined. My overarching goal for this research project is to expand the range of options for interactive sound design and aesthetics in connection with voice, audio processing technology and live interfaces.

References

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[7] Based on a Japanese folktale, *The Sailmaker's Wife* is the story of a man's kindness to an injured crane who returns to him in the form of a woman and becomes his wife. She brings him a magical secret gift, at the expense of her wellbeing. The gift is requested one time too often, and her secret is ultimately betrayed. When her true identity is revealed the Crane-wife flies away. Since this opera deals with magical transformation, it is an ideal candidate for the magic of audio processing, unusual controllers, and the integration of wearable sensors and controllers into the costumes and/or scenography.

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