THE NEW BAROQUE ORGAN

ORGELPARK RESEARCH REPORTS
VOLUME 5 / PART 1
5/1

VU UNIVERSITY PRESS

ORGELPARK

VU University Press
De Boelelaan 1105
1081 HV Amsterdam
The Netherlands

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ISBN e-book/epub 978 94 91588 11 2 (available at www.orgelpark.nl)
ISBN (this) paper edition 978 90 86597 14 7
NUR 664

Orgelpark Research Report 5/1

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Proximity and Communication with the New Baroque Organ at the Orgelpark

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My performance experiences in the Orgelpark have been as a flutist and composer working with amplification and live electronics. I have performed works of my own and by others in ensembles that have included the Sauer organ, the Verschueren organ, the Elbertse chest organ, the Molzer organ and live electronics. I have also improvised with organists using the moveable console of the Sauer organ, the Verschueren organ and the Elbertse chest organ. The only organ that I have digitally processed in performance is the Elbertse chest organ.

It is very inspiring news that the Orgelpark is building a new baroque organ with the prospects of extending the timbre, the tuning, the independence of the pipes and the added advantage of a moveable digital console. These additions to the traditional organ will give composers and performers who use the instrument many opportunities to substantially contribute to new musical adventures both technically and musically.

This article will focus on:
The use of live electronics with the new baroque organ including:
- Sounds from the wind system and the pipes as audio signals.
- The placement of microphones.
- Mixing the audio from the organ and the placement of loudspeakers.
- The MIDI console and the data communication system.

The structure of the organ and the placement of fellow musicians during performance.
The benefits of multiple temperaments for 21st century music.

Composers and performers and sound technicians will potentially use amplification, recording, audio signal processing and digital communication systems with the new organ. Therefore, in this article, I will use the term "composer / performer" for this group of practitioners. The term "composer / performer" from here on refers to: composers who do not perform, composers who participate in the performances their works, performers who play only composed music and performers who play both composed and improvised music.

Live electronics

The use of amplification and audio signal processing gives composers and performers the tools to stretch their musical imaginations by giving them the opportunity to combine the organ sounds with non-organ sounds, process the organ sounds and amplify sounds inside the organ that are barely audible. These audio techniques are useful for both composers and performers in their search to find a timbral repertoire that suits their musical visions.

Amplification and audio processing can be used in many stages of music making, beginning with gathering sounds for playback during the performance of a composition and extending to live audio processing during an improvisation.

Amplification and audio processing are tools to augment an instrument. My personal experience with live electronics has been focused on augmenting the flute. The technique of producing a sound on the flute is very close to producing sounds on the organ pipes. I see my instrument as a kindred spirit to the organ and my discussions and proposals for the new organ are clearly related to my own experiences with the flute. However, I have the advantage of being able to play more than one pitch from the same pipe and I can walk around while doing that!

Microphones

The signal flow chain for amplification and processing begins with the microphone.

Placement of the microphones in the new organ is the first step to consider. To decouple the organ sound from the influence of the room will give the strongest and most clear signal. The Orgelpark has a natural reverb that suits the acoustic sounds of the organs but the microphones for amplification and processing need to be placed where they will pick up as little signal as possible from the church reverb. This will depend on the type of microphones, the number of microphones and the positions of the microphones.

One microphone placement area would be on or as close as possible to different parts of the windchests outside and inside.

Depending on the microphone and the construction of the windchests, it may or may not be possible to hear the action of the mechanical movements inside each windchest. The mechanical sounds from the windchests could be processed, recorded or even used as triggers in compositions and performances. The range of audio signal quality from hi-end condenser microphones to inexpensive contact microphones is incredibly broad. Hi-end microphones are not always preferred because each microphone signal can be used for a specific musical function. Contact microphones would probably be the most appropriate for the outside walls of the windchests but this depends on what the composer / performer would like to do with the sounds. If they want to mic material where subtle timbral differences can be heard, then condenser microphones rigged inside the windchests would be the most appropriate. In the case of micing the windchests, systematic experiments would be useful to find out what the ideal positions of the microphones are to mic particular sounds. Therefore it would be advisable to have a range of microphones available for composers and performers to use on or inside the windchests.

It is important to know whether the mechanisms in the different windchests make different sounds or do they all sound exactly the same? And is it musically relevant to couple the sounds of the windchests with the corresponding pipes that are sounding? I would say yes.

I propose that the microphone positions on each pipe are moveable. The minimum would be: near the mouth and at the end of the open flue pipes; near the mouth of the closed flue pipes; and at the end of the reed pipes. That is not to say that all 3500 pipes should have multiple microphones installed on or in them at all times. The point is that a composer or performer should have the choice to place microphones on each pipe where will receive a signal suited to the sounds they want to either process, amplify or use for other input in their electronic set up.

The questions that this multi-microphone proposal brings are:
Will there be access and enough space to place different kinds of microphones on the pipes and on the windchests? And if so, is it important to build specific microphone holders or should that be left up to each composer / performer to invent?
Is it possible and useful to install microphones inside the windchests?

Rather than proposing that the new organ's microphone placement be set in stone, I suggest that we look at their placement in terms of areas on the pipes. For example, the mouth area, the end-of-the-pipe area, the inside-the-pipe area. This implies that the exact placement of the microphones is up to the composer / performer. It also invites further research to be done to figure out where the ideal and/or exact places should be for optimal use in specific musical situations.

Augmenting the organ by using digital audio signal processing pushes the boundary of traditional organ sounds into unknown territory. Because each pipe has their own tuning and timbre, it is crucial to place the microphones close to the sound source of each pipe. That way the sonic parameters of each pipe could be virtually isolated, the audio signal quality could be controlled and the composer / performer would be able to access the highest quality signal possible.

Once a strong signal is received, a composer / performer can amplify it, record it and process it. This isolation of pipe sounds will give composer / performers the opportunity to recombine the pure and processed pipe sounds in countless permutations and in ways that are unconventional to the traditional organ. New sounds give birth to new music!

This proposal, if taken literally, would include more than a 3000 microphones. Needless to say it would not be practical or musically interesting to mic every pipe at the same time. One should have the choice to mic groups of pipes or single pipes depending on what they would like to musically achieve. I imagine that most musicians would like to mic each rank and then have a few pipes that have single microphones for close micing. Perhaps some musicians would like to mic 100 of the smallest pipes and all of the windchests for a completely different set of sounds. Or maybe a composer / performer would like to mic 96 pipes to create a set of 8 timbrally distinct octaves. Personally I would be interested in having the option to mic all of the ranks separately, to individually mic at least 61 single pipes and to research micing the mechanical sounds of the windchests.

Microphone placement for optimal professional recording of performances and for commercial release is another issue to be decided. I will gladly leave those decisions to be made by the experts in the recording field.

Loudspeakers

Mixing the pure, dry organ sounds with the amplified and processed sounds is another musical decision that should be looked at. Before discussing audio mixing options I will discuss the placement of the loudspeakers.

I propose, for general use, a set of 2 to 8 loudspeakers placed at either side and above the organ case where the organist and the other performing musicians are engulfed in the extended instrument's sound. When the loudspeakers are arranged around the organ, other musicians playing with the organ will not need monitors and the ensemble and audience would experience relatively the same sonic results. There are advantages and disadvantages to placing the loudspeakers behind the performers rather than in front of the performers. I have, in my own experience, found this to be the most musical set up because all participating musicians hear the composite sound of the ensemble which includes the acoustic organ plus the other musicians and their amplified and/or processed sounds.

The disadvantage of this set up is that some microphones will feed back. This can usually be solved with microphone placement in proximity to the loudspeakers. If moving the microphones does not solve the problem, I would recommend repositioning the loudspeakers by hanging them or experimenting with their placement. The priority above all is to create an ensemble sound that integrates the ensemble including the organ and the live electronics. The danger of determining a fixed position for the loudspeakers far away from the performers is that the music coming out of the loudspeakers and the music coming from the acoustic instruments loose their sonic relationship. They don't blend. They decouple and the musical reasons why the live electronics and the amplification should be used at all become confused and unclear.

There are many musical scenarios that will need attention with regards to loudspeaker placement in the Orgelpark besides the one I propose where all the musicians are sitting close to one another in the balcony. One that I assume will be common is that the ensemble, including the organist, and the audience will all be sitting on the main floor. For this set up, I would propose that loudspeakers in the balcony still surround the new organ and that the ensemble be flanked at the rear by stereo loudspeakers on the main floor. The organ sounds should also be included in the total mix on the main floor. That way the acoustic and the processed organ sounds will still be coming from one area in the balcony and be mixed into the ensemble sound in the hall. I anticipate that composers / performers and sound technicians will enjoy hours of experimenting with speaker placement to realize their musical needs. The questions that are important to consider are:

How many loudspeakers need to surround the new organ case to create a satisfactory mix between the pure organ sounds, the amplified organ sounds and the processed organ sounds.

Will these same speakers that surround the organ case also work when the ensemble is placed in the balcony close to the organ?

What is the ideal loudspeaker placement when the ensemble and the organist are performing on the main floor?

How many loudspeakers are necessary to create a mix between the acoustic organ sounds, the amplified organ sounds, the ensemble sounds plus the processed sounds?

The decisions as to where the loudspeakers should be placed and how the mix will determine what sounds are coming out of which specific loudspeakers should be made by the composer / performers and the technicians working with them. There are, however, many composer / performers who will appear at the doorstep of the Orgelpark with either a lack of interest in audio dispersion, little understanding of audio mixing or a small amount of rehearsal time. Therefore a set of presets for mixing acoustic and processed sounds would save time for many artists who come to work with their live electronics in the Orgelpark.

Mixing

I have proposed a microphone system that would include separate microphones for at least 40 ranks, individual microphones for at least 61 single pipes and the possibility for microphones to be built into the windchests. Mixing so many audio signals at one time could be a nightmare! The inputs for the microphones need to be systematically organized where the choices for using or not using them are arranged in hardware and software presets with options, for the more ambitious, to bypass them.

I have been working with the Roland REAC system that uses a CAT5 network to communicate digital audio from one location to another. This system is installed in Splendor Amsterdam. Using a digital audio transfer system similar to the REAC would streamline the wiring from the audio inputs from the microphones for the instrumentalists and the microphones in the organ. It would also cut down on the hardwiring from the microphone and processed audio mix to the various loudspeakers distributed in the balcony and on the main floor.

Information on the REAC system can be found here:
http://www.roland.com/products/en/exp/REAC.html
REAC (Roland Ethernet Audio Communication) is Roland's original technology for low latency, high quality digital audio transfer. REAC transfers 24-bit uncompressed multi channel audio with very low latency. REAC technology eliminates the typical problems found in analog transfer such as signal quality degradation or hums and buzzes. In addition, since REAC transfer happens over lightweight cable and is immune to externally induced noise, designers and integrators have more freedom for cable placement resulting in lower cost installations. Heavy analog multi core cable requires large, expensive conduit for installations, and suffers from high frequency losses and potential for induced hums and buzzes. REAC's transfer protocol provides digital audio in a lightweight, inexpensive and easy to install cable format.

Once the number of flexible and stationary microphone positions have been established, a digital snake system needs to be set up where stage boxes are strategically placed inside the organ case. These stage boxes should have easy access for plugging and replugging the microphones. The combinations of microphones that can be plugged into the stage boxes should be as flexible as possible. Ideally the audio would be transferred digitally to a submixer that is located next to the new organ and/or another mixer on the main floor. The location of the mixers will depend on who is mixing the sound. In many cases, a submixer will be needed in the balcony while another mixer is located on the main floor. A mixer in the balcony seems unavoidable. It would be terribly inconvenient if a composer / performer was experimenting with mic placement and he or she would have to run up and down between the balcony and the main floor for every adjustment. Likewise, if the entire ensemble is in the balcony and the composer / performer is managing the submix, a mixer should be accessible to them in the balcony. In other cases, where the ensemble is performing on the main floor, the mixer on the main floor would be sufficient and the digital snake(s) should run directly from the new organ in the balcony to the main floor.

The flexible placement of the microphones and the mixer(s) is necessary because it gives the ultimate mixing control during the experimental process to the composer / performer / technician and it gives them the choice to place the submixer and the main mixer where they need to be during performances. The working/creative places and the performance places are potentially different and those places may even change during the process of creating the piece.

As an extra, I would like to propose experiments placing small loudspeakers inside the larger pipes and playing sounds through these loudspeakers, using the pipes as natural filters while playing the organ at the same time. This combination of speakers-in-pipes could produce some lovely sonic results. That would mean that a person would need to access the tops of the larger pipes and lower loudspeakers into the pipes. Or, depending on the size of the mouth of the pipe and the size of the loudspeaker, one could place the loudspeaker inside the pipe near the mouth. I have used this "loudspeaker inside the tube" principle by placing a Monacor SP-45/4 inside a tenor saxophone. The sounds played through the loudspeaker were filtered and processed by the fingerings and the sounds the saxophone player played. This rendered some lovely sonic results!

I have also been working with the composer Hugo Morales where audio is played into the flute through a plastic tube that is inserted into the end of the flute while I play the flute at the same time. Our experiments have led to some surprising and inspiring results so far.

These two experiences where someone is playing an acoustic "tube" while audio is played into the tube at the same time interest me very much. It would be handy to have 12 - 24 extra output channels in stage boxes in the organ case to manage the audio being played into the organ pipes.

Information over the Monacor speakers can be found here:
http://www.monacor.de/index.php?id=128&artikelid=2108&L=1

Communicating with the organ digitally.

The capability to communicate with the new organ digitally from various remote locations gives the Orgelpark a leadership role as a modern-day live-electronic instrument. These locations include digital consoles on the main floor and the balcony. The digital communication is not limited to the consoles, it can be via computers or controllers from anywhere in the world.

The digital organ console for the Orgelpark Sauer organ has proven to be a great resource for composer / performers in recent years. Some of the advantages are: that it can be positioned anywhere on the main floor; it has more registration combinations than most organs; it has a computer memory to store and recall not only settings but also music played on it; and it can receive and send MIDI to an external digital device including a computer.

I propose coupling this existing digital organ console to the new organ in addition to building a new one that can be easily transported to the main floor, the balcony and to the foyer on the lower floor of the building. That way the organ could be played from anywhere in the building. Most important, is that the console can be in close proximity to the actual instrument. The benefits of performing close to the organ are:

1. The organist needs to use the digital functions of the console but would like to be close to the organ to hear it more clearly.

2. An ensemble is performing in the balcony with the organist who is using the digital functions of the console and they prefer to be close to one another for more intimate contact for their ensemble playing.

3. A composer / performer is experimenting with microphone placement and audio processing and would like to be close to the organ while testing the various stages of his or her research. The advantages here are that the digital console can save the settings whereas the traditional console cannot and the digital console can execute more registration combinations than the traditional console. And who knows? Maybe the digital console will have places to put various iPad, iPhone, Arduino and Android devices on it where the wireless connections are part of the console's own communication system!

Organizing the communication between computers, controllers, the organ console and the organ itself should be done using a combination of a wireless and a CAT5 or CAT6 ethernet network. Current literature recommends CAT6 because it will become the standard in the future.

The advantages of communicating with the organ console and the organ via CAT6 ethernet is that a patchbay could be built in a central location and the devices that will need to be communicating can be patched into the patch bay. This patchbay would include: 1) a network router for wireless controllers and international remote communication; 2) any number of computers that communicate with the console, the organ and among one another; 3) one or more digital organ consoles; 4) and the organ itself.

Following this line of thought regarding wireless and ethernet connections among the various devices and to the new organ, part of the communication hardware design would include ethernet connections on the organ, on the console and in other points in the Orgelpark where the console, computers and wireless routers could be connected.

This may sound like a network circus, but it is similar to many live electronic setups. And remember, not all the possibilities for the digital communication would be used at one time. Too many devices communicating all at once is an example of over-ambitious-information-overload rather than an artful and creative musical event.

One scenario would be that a small acoustic chamber ensemble is performing with the new organ. They are sitting in the balcony with the organist who is playing the digital console. Two of the other players have laptops that are sending data to the organ console that switches registrations on the organ during the performance.

Another scenario is that there is one digital console in the foyer of the Orgelpark and one on the main floor of the hall. Two organists are playing the organ, one on each console. The organist in the foyer is hearing the organ in the hall via loudspeakers. A computer or an external digital signal processor is processing the organ sounds and

the processed sounds are mixed into the performance heard both in the hall and in the foyer. In addition, a computer located in the foyer is sending registration change information directly to the new organ.

The composer / performers / technicians that will use the communication system vary from beginners to expert computer programmers. Therefore the range of how the interfaces are built and programmed should reflect this range of know-how and capability. The hardware and software should be clear enough that the console programming is plug-and-play intuitive for organists that simply want to save their registration patches. On the other side, it should be flexible and powerful enough to create complex remote performances that involve multiple performers in and outside of the building.

MIDI vs. OSC vs. a combination

The advantages and disadvantages of MIDI have been under scrutiny for at least a decade if not more. The music community is still debating whether MIDI will retain its position as the primary communication protocol in commercial audio devices. So far, it has proven to be an incredibly useful communication standard and I suspect it will be with us for a while longer. However, Open Sound Control (OSC), another protocol for communication among computers, sound and other multimedia devices is optimized for modern network technology and would be appropriate for parts of the CAT6 ethernet communication system that I propose. My recommendation would be to use MIDI for the pitches and registrations for the new organ and use OSC for the communication between the organ, the console and other digital devices such as computers, iPads, Arduinos and other digital controllers. Devising the most streamlined and robust system using a combination of MIDI, OSC and other data communication protocols should be a major priority for the new organ.

Interface programs

When one looks at the programming languages that are often used by composer / performers using technology, Supercollider, Max and Ableton Live come to mind. These three programming languages have enormous users' groups where musicians are actively exchanging patches and constantly involved in mutual development and troubleshooting projects all over the world. If basic interface programs in all three languages were provided for the digital communication with the new organ this would offer composers a jump-start to interact with it.

The interface patches would include basic OSC communication examples for sending and receiving data between other devices in the Orgelpark. In other words, the new organ, the digital consoles and other devices on the network. The programmed patches would also include a simple setup for playing the new organ using MIDI and receiving and recording MIDI that is sent from either the consoles or from the new organ.

The Manual

Another point to be considered is the user manual for the new organ. I propose that the Orgelpark invests in a team of experts that create a manual that it can be used by composer / performers at all levels.

1. The manual would explain how to use of the software and hardware.

2. It would explain the organ mechanism and the digital and analog paths to produce sound from the pipes.

3. It would describe how the new organ produces a sound including the mechanical mechanism, where the microphones are fixed and the flexible areas where other microphones can be placed.

3. It would show the audio signal path from the microphones, through the digital stage boxes to the mixer(s) and then how the signal is transferred out through the loudspeakers or to digital signal processors, computers or analog audio processors.

4. It would show the network communication system of the building that includes audio and video and how the patchbay works.

5. It would explain the OSC and MIDI communication between the organ, the console and computers with Supercollider, Max and Ableton and give examples for basic operations including sending and receiving pitch and registration data.

Placement of fellow musicians

Designing the balcony space to feature a small ensemble where the musicians have close contact with the organist is a priority. The audience is a major consideration in this configuration. The seats in front of the organ that offer room for a choir is be a space that could easily be converted into space for an ensemble or in some cases, the audience.

A place for a small ensemble near the new organ is critical since many acoustic and electronic performers base their ensemble interaction on visual and aural response. There is a significant difference between hearing the attack, the timbre and the release of a musical sound close by as opposed to far away. Also, most musicians react to one another using a range between subtle and grotesquely large physical movements. Organists have their own special movements that they use for communicating with other players and the closer the musicians are to one another, the more means they have for communication, especially since the mechanism of the organ is such that the actual sound speaks considerably later than when the keys are pressed. I prefer close physical contact with the musicians I play with and I feel much more involved when I can see the arms or even hands of the organist I am playing with.

Temperament

The main concern with the tuning of the new organ is that it can play baroque music in the most authentic tuning possible with options for extended temperaments such as Kirnberger, Vallotti, Werkmeister. I would like a combination of temperaments where, if combined, there are as many pure fifths, fourths and thirds as possible.

The composition and improvisation benefit of working with an organ with unequal temperaments is enormous, especially if one can set different ranks to different tunings simultaneously. The consequent availability of virtually infinite timbres will inspire not only use of unique microtonalities but it will hopefully enable limited but pristine just-intonation possibilities. The benefit of unequal temperaments is that there will be a gamut of pure intervals. Thus providing composers / performers the chance to use micro-pitch combinations. To use these pitch combinations where subtle "critical band" deviations can be used and juxtaposed with pure intervals is a gift.