Sursa Organ Sampler

An Honors Thesis (MUMET 495)

by

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Abstract

The Sursa Family Concert Organ is a beautiful instrument designed and built by the Goulding and Wood Company. The Music Instruction Building, which houses Sursa Hall, was built for performances and instruction in 2004. The organ, however, came to Ball State in 2006, and organ students have given their recitals on it since that time. Unfortunately, they have had to practice on a different organ because the Sursa Organ is large, slightly difficult to set up, and very loud. This is why I have created a computer program that will allow organ students to practice on the organ without the pipes being turned on or the organ being set up. They will hear the sound of the organ, which I recorded, through headphones. This will allow them to practice more often on the organ that they will give their recitals on. I hope this will help them feel more prepared and confident for their recitals.

Acknowledgements

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I would also like to thank Dr. Kirby Koriath for his support. He answered many questions I had about the organ and helped me understand how I could best help his students. I hope this project will be a great resource for him and his students.

Lastly, I would like to thank my beautiful wife Jennifer. She has been a patient encourager during the many hours I put in for this project.
Author's Statement

This project would be difficult to discuss without some preliminary explanation of the Sursa Family Concert Organ, Musical Instrument Data Interface (MIDI), samplers, and a few sound editing processes. I will, therefore, give a cursory explanation of these topics before I discuss the project.

The Sursa Family Concert Organ is a pipe organ in Sursa Hall at Ball State University. The organ has four sections, which are called the Swell, Great, Positif, and Pedal. The Swell, Great, and Positif are each played by their own keyboard, and the Pedal is played by a series of foot pedals. Within each section are many ranks. A rank is a set of pipes containing one pipe for each key (or foot pedal) on that section’s respective keyboard. Ranks can be turned on and off with the use of stops. A stop is a knob which can be pulled out or pushed in by a performer. If the performer pulls out a stop, the corresponding rank of pipes will play when the correct keyboard is played. When the stop is pushed in, it stops the rank from playing. The pipes for the organ are housed in a room about twenty-five feet above the stage in Sursa Hall. The pipes are controlled electronically by a large console which contains the three keyboards, the foot pedals, and the stops described above. The Sursa organ console is also equipped to send and receive MIDI.

MIDI is a specialized computer language which allows electronic instruments like synthesizers and keyboards to communicate with one another and with computers. It is used by nearly all such devices. MIDI data can tell a synthesizer (or computer) when to turn a certain note on or off, how loud to play, and many other pieces of musical information. The Sursa organ has the ability to record MIDI data during a live performance. This is not to be confused with recording sound. MIDI data is not sound; it is information that can be used to tell a synthesizer or computer (or any other instrument equipped with MIDI) how and when to play certain notes. For instance, one could record the MIDI data of a live performance on the Sursa organ, and if that data was sent back into the organ, the organ would play (by itself) what had been played during the performance.

A sampler is a type of electronic instrument which commonly uses MIDI. A sampler plays a previously recorded sound, called a sample, when it is told to (usually by MIDI data). For instance, one could record the note C being played on a piano. This sample could then be loaded into a sampler, and when one pressed C on the sampler, the previously recorded note would play.

Sounds must be prepared for use in samplers, and in this paragraph, I will briefly discuss some of the preparatory processes I used. The sound must be “cut” so that it begins directly at the beginning of the recorded note. Because organ notes can go on indefinitely, I had to use a process called looping. A loop causes a certain section of a sound to play over and over again until told to stop. I created a loop within each of my organ samples that plays until the note is released by the performer. Another process I needed was pitch shifting. Pitch shifting allows a note to be played at a different pitch than it was originally. For instance, a recorded C note could be made to sound like an E. This process generally only works well over a small range of notes. The final process I used was filtering. Most sounds do not have only one pitch (or frequency) that they produce. They produce many simultaneously. Filtering is the process of emphasizing or
deemphasizing certain pitches (or frequencies) within a sound. With all of this explained, I can now discuss what my project is and why it is important.

For my project, I recorded individual pipes of many ranks in the organ and put the sounds into a computer based sampler named Kontakt. I then wrote computer code in Kontakt and used another computer program (MaxMSP) to make it possible for the Sursa organ console to play the sampler. The end result is that the organ console can be plugged into a computer, and the sound of the organ can be heard through headphones as the organ is played. The organ console will also be able to do this independently from the physical pipes of the organ. This was the major key for this project’s usefulness.

This project is intended for use by organ students at Ball State. They are not able to practice very often on the Sursa organ console because it must be first rolled on stage, and it is very heavy and difficult to move. Also, the organ is very loud, and since the Music Instruction Building (which houses Sursa hall and the organ) is used for many purposes, noise must be kept to a minimum most of the time. This means that organ students have to practice on a different instrument than the one they use to give their recitals. My project gives them the ability to practice on the Sursa organ console without moving it on stage and without activating the pipes. They will, therefore, be able to practice much more often than they previously could. This will help them be much better prepared for their recitals. Also, they can use this sampler with a bare minimum of computer knowledge. Additionally, I created a user’s manual for students to help them use the program. All they will need to do is turn on the sampler, and they will be able to play the organ just as they normally would (except without every rank of pipes available).

The other purpose of this project was my own development as a Music Technology student. I recorded nearly 1700 pipes of the organ for this project and edited all of the sounds for use in the sampler. I also had to learn much more about MIDI than I previously knew, and I learned to use computer programming in a musical context. These types of sampling projects are frequently done by professionals, and I can now be a strong candidate for positions at companies that do this. I also had to learn about the pipe organ, which is not an instrument I have previously studied. This added to my general knowledge as a musician. Recording the organ was difficult, and I had to develop and experiment with many concepts I have learned in my recording classes at Ball State.

I would now like to discuss and analyze some of the most important decisions I made during this project. The first decision I made was to not record every pipe in the organ. There are over three thousand pipes, and recording them all would have been beyond the scope of this project. Dr. Kirby Koriath (the organ performance faculty member at Ball State) informed me of this when I told him my plan was to record every pipe. He gave me a list of the most important ranks for practice purposes. Even with the reduced number of pipes, I spent nearly thirty hours recording the organ. I believe this decision was crucial to the project. I would simply not have been able to finish if I had attempted to record every pipe.

Editing a single sound for use in the sampler takes about five minutes (sometimes ten for more difficult samples). I had 1700 samples, and I would not have time to edit them all. Dr. Kothman suggested that I use a common sampling technique involving pitch shifting. Instead of using every single sample, one uses only a select number of samples and then pitch shifts them to create the full number of notes. Kontakt has pitch shifting built in, and it is very easy to use. There are downsides to pitch shifting. The
further one shifts a note from its original pitch, the more unnatural it sounds. Within certain limits, it sounds fairly authentic, but it does not sound as good as if every note were sampled. I decided that because the project was for organ students to practice (not perform), functionality was more important than perfect sound quality. This decision allowed me to save time, and it also allows the computer program to run more smoothly since fewer samples need to be stored in memory.

Another crucial decision I made was to use noise reduction on my samples. Noise is a term used to describe unwanted sound on a recording. To reduce noise, I had to use filtering (described earlier). Unfortunately, when I filtered out noise, it also filtered out certain aspects of the sound of the organ itself. The recordings had a high level of noise for two reasons. First, individual organ notes are not very loud. This means I had to turn up the microphones very high in order to capture their sound. A microphone that has been turned up very high produces a large amount of noise on a recording. Also, the microphones had to be placed twenty-five feet in the air above the stage near the pipes. Sound from the air vents in Sursa was impossible to avoid completely and was another source of noise on the recordings. I decided to filter this noise out (noise reduction) as well as I could, rather than leave it. I did this because loops could be created more easily when noise had been removed from the recordings. I strove to find a balance between purity of the original organ sound and reducing noise. In the end, I decided to use noise reduction for the same reason I decided to use pitch shifting. As I stated above, I believe that for a practice instrument, functionality is more important than sound quality. Also, Dr. Koriath is quite pleased with the sound quality, despite the degrading effects of noise reduction and pitch shifting.

This project was an incredible learning experience for me. I performed work that could be done in a professional setting in my field, and I had to make several tough decisions about sound quality that prepared me for decisions I may have to make for projects in my career. I was able to see the effects of the decisions I made and evaluate their strengths and weaknesses. I also had to work independently and solve many problems on my own (with Dr. Kothman and Dr. Koriath’s generous support). I am excited by the final outcome of the project and so is Dr. Koriath. I hope it will be a great resource for organ students at Ball State for many years to come.