

Spem in Alium

The Virtual Choir

An Interactive Qualifying Project Report

submitted to the Faculty

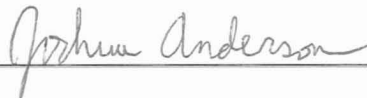
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The History of *Spem in Alium*

“In Queene Elizabeths time there was a songe sent into England of 30 parts (whence the Italians obteyned the name to be called the Apices of the world) which beeing songe mad[e] a heavenly Harmony. The Duke of _____ bearing a great love to Musicke asked whether none of our English men could sett as good a songe, & Tallice beeing very skillfull was felt to try whether he would undertake the Matter, which he did and mad[e] one of 40 p[ar]ts which was songe in the longe gallery at Arundell house which so farre surpassed the other th[a]t the Duke hearinge of the songe tooke his chayne of gold from of his necke & putt yt about Tallice his necke & gave yt him.”
(Steel 1).

This is the story of the famous 40 voice motet known as *Spem in Alium*. *Spem* was composed by the renaissance musician Thomas Tallis. Tallis was born sometime around 1505 which is not known for sure and neither is his place of birth known for sure either. During most of his life, however, he lived in England and during these times he saw many religious changes between Catholic and Protestant faiths. Tallis himself was born a Catholic by faith and some of his music that he created may have possibly been influenced by the fluctuation between Catholicism and Protestantism and also how the new Protestant England was persecuting the Catholics.

“The first definite date marking the start of Tallis' musical career is 1532, when he was appointed organist of Benedictine Priory in Dover. The year 1537 found him at his second job, organist at St Mary-le-Hill in Billingsgate, London, and then on to Waltham Abbey in London until its dissolution in 1540 under Henry VIII. The unemployed Tallis then set out to find work, which he did in 1541 at Canterbury Cathedral as a lay clerk.

Finally, he settled into the King's service, appointed as a Gentleman of the Chapel Royal in 1543. He sang with the Chapel Royal, played the organ, helped in running the choir, and continued to compose. In 1575, with William Byrd, Tallis secured a monopoly on printing music and music paper in England. Tallis remained with the Chapel Royal until his death in 1585, while finding time to marry his wife Joan and taking on the young Byrd as a pupil (both probably around the same time, in 1552).”

(Hickey 1).

Tallis was very well known for his adaptability and creativity in his work. Some of his most famous works that he was known for were *Lamentations of Jeremiah*, *Suscipe quaeso*, and *Miserere*. But perhaps his most well known masterpiece of all time was that of which we worked on the virtual choir for, *Spem in Alium*. *Spem in Alium* is a 40 voice piece that consists of eight choirs of five voices that are both polyphonic and chordal. *Spem* is thought to allude to an allegiance to Roman Catholicism, but as he was seemingly good at writing for both the Catholic and Protestant churches he managed to not be persecuted for this.

The piece itself has an interesting story behind it and while it cannot be totally confirmed to be true, it is one of the only known histories of the piece. It was thought to be brought on by a challenge from the fourth Duke of Norfolk, Thomas Howard, a Catholic, who was very much in support of Tallis' ideas. *Spem* was to challenge a piece called *Ecce Beatum Lautam* produced by Striggio an Italian man. Tallis was to challenge this piece with the honor of England in mind as it was a very creative piece written by an Italian the English wanted to have their own. When he completed the piece it was performed at the palace of Nonsuch also known as the Long Hall which was owned by

Henry Fitzalan, the 12th Earl of Arundel. Supposedly when the performance of *Spem in Alium* was finished Thomas Howard who was one of the supporters of Tallis was so moved by the piece that he took a gold chain from around his neck and placed it around Tallis' neck.

The earliest evidence of when *Spem in Alium* was created was in a catalog in the library at Nonsuch Palace that was dated in 1596 and made a reference to “a song of fortie partes, made by Mr. Tallys” (Steel 1). This would be further evidence to support the basis that Tallis was creating this piece in response to Striggio's *Ecce Beatum Lautam*. Since this is a debated subject as to whether or not he was influenced by Striggio's piece, this is some reasonable evidence to support that it was in fact influenced.

The History of the Virtual Choir Project

Joel Lofgren

The forty-part motet, *Spem in Alium Nunquam Habui*, written by Thomas Tallis, is quite a large choral work. The original goal of the *Spem in Alium* Virtual Choir Project was to devise a method to allow choral singers from multiple universities and colleges over the internet in order to harmonize in real time. In 2003 and 2004, at Worcester Polytechnic Institute, this massive undertaking began taking form.

A sufficiency project was planned out, involving creating and editing new scores for Tallis' piece to be used by singers in a performance that was to be held in D-Term 2004. Professor John F. Delorey advised this project, whose main aim was to create one hundred new copies of *Spem in Alium* on eleven by seventeen inch scores. As the history of this piece is shrouded in mystery, these scores were based off the Oxford edition of the work from 1928, with various minor changes and editions made in order to modernize the notation.

One major dilemma was a result of the actual size of *Spem in Alium*, particularly the fact that, since it is a forty-part vocal piece, written for forty different voices, all forty voice parts would have to fit and be displayed on each page. After analyzing costs and deciding upon various attributes related to the paper the scores were to be printed on, such as "paper color, paper caliper, paper opacity, paper surface finish, cover materials, cover design, and margins" (Jinno 5), the most cost-efficient printing method was chosen. The *Spem in Alium* scores were laid down on eleven by seventeen inch paper, in a traditional black and white color scheme.

A Finale course held at Worcester Polytechnic Institute during C-Term of 2004 evaluated the final version of the Tallis score, further correcting any errors they came across. After this final editing stage, the music was reformatted so that it could fit most efficiently in the given eleven by seventeen inch layout, and then exported and saved as a .pdf file (Portable Document Format). The final release of the score was printed by a printing company known as Curry Printing, and ended up being twenty two pages long, with four to nine measures per page (Jinno 5).

James Haupt

Once the scores were set, the next steps in the project involved a large amount of people and work. “There were nearly 15 individuals working at any one time on various parts of the project” (Jinno 6), and the manager of the project, James Haupt, clearly had a gigantic task on his hands.

First, the entire *Spem in Alium* piece needed to be recorded in a way that would suit the goals of the project. Several vocalists involved in Worcester Polytechnic Institute’s music program (but much fewer than forty of them) were rounded up to sing and record all forty parts (all eight five-part choirs) for all one hundred forty measures or so of Tallis’ work. Each voice part was recorded in a “simulated studio environment” (Jinno 6), and the parts were sung and recorded independently of one another so that the entire piece could be recorded with only the several aforementioned vocalists. The forty individual parts could then be combined in various ways, forming *Spem in Alium* as Tallis had written it. Each vocal part was also not recorded straight through. The parts were broken up to allow the singers several takes for each section of music and to reduce the amount of sight reading they would have to do in one stretch. Sight reading all one hundred plus measures of one of the parts of this piece without error would be quite the undertaking and would be completely unnecessary.

The next stage in the process involved taking these recorded sound clips, normalizing their volumes, and converting them into a format recognizable by the computer software to be used for the next stages of the project. In this case, this software was Mark of the Unicorn’s Digital Performer Version 3. The fact that a number of people were working on this portion of the project created some dilemmas at this point, in

that multiple computers needed to be used to store the clips. Each student working on the project began working on essentially the same tasks, and duplicate versions of the clips ended up being created on the computers, all of which were slightly different and contained missing sound clips or incorrect normalization.

Once normalization was completed, the sound clips for each voice part were to be cut up so that one clip existed per syllable of the text. This needed to be done in order to eventually have the clips correspond to a MIDI sequencer file and be played back in correct tempo and rhythm by this file. A couple of problems arose in doing this, as cutting often resulted in clips with a sharp attack, or high velocity for a split second at the beginning of these clips. This eventually had to be fixed using the sampling devices that will be discussed a short time later in this paper. Another dilemma occurred due to the fact that some of the singers had made it difficult to discern individual syllables in the recordings, and errors in the cutting ensued, perhaps because some of the students doing the cutting weren't following the scores previously discussed. As a result, some segments of the voice parts were not accurately clipped for every individual syllable, and some clips ended up not existing, or even missing.

From there, the sound clips had to be transferred from the computer to sampling devices, or samplers. The EMU E5000 was the model of sampler chosen. This proved to be more difficult than it seemed, and required several students to carry it out. Each clip had to first be renamed (for easier identification by the students) then dragged and dropped onto a sampling device using an interface in Digital Performer. Various problems were encountered in doing this and will be discussed in more detail in the Jeremiah Jinno section of the project, and the consequence was that the sound clips had to

be transferred one by one over to the sampling machine to keep the machine from crashing. Once on the sampler, each clip had to be set to correspond to a specific note of the scale, increasing chromatically, so that each syllable could only be played by one specific MIDI note in the sequencer file. Another difficulty arose due to the fact that the sampling devices could also store no more than one thousand sound samples per bank, so, in some cases, even one entire choir couldn't be stored at the same time on one device.

The sequencer file, as previously stated, consisted of a MIDI file run on a computer using Digital Performer. It was used to call sound clips off of the sampling devices according to the rhythm of the piece, laid down in the sequencer file. A computer interacted with a sampler via a MIDI controlling device, the MIDI Express. Since several sampling devices would need to be used to store the entire forty part piece, these devices would have to somehow be "switched between" (Jinno 7) in real time during the playback of the piece.

The project was then to be demonstrated, using a mixing board and speaker setup. Each voice part required use of its own MIDI channel, which later proved to be another dilemma. The piece was played back using the sequencer file, but various problems resulted in the project sounding terrible at this point. These fixes were to be made in future terms as parts of other students' projects (Jinno 6-7).

Jeremiah Jinno

In 2004 and 2005, the *Spem in Alium* Virtual Choir project continued under the direction of new project leader, Jeremiah Jinno, with Professor John F. Delorey again advising. The main goal of this Interactive Qualifying Project was originally to get all eight choirs (the entire piece) loaded onto the sampling machines so that the piece in its entirety could be played back. The project also focused on fixing errors and attempting to make the entire piece sound presentable.

However, it soon became apparent that this task would be quite daunting. First, since the sampling devices only have a limited amount of disk space, many of them would be required to store all eight choirs. A setup with eight samplers would be the ideal situation, one for each choir, but a scheme would have to be devised in order to switch seamlessly between the samplers in real time during playback. It was soon realized that it would be impossible to acquire this many sampling devices, and the goal was now to do whatever was possible using four samplers.

This was quickly becoming a less than ideal situation, as the project essentially was cut in half, and only four choirs would be able to be stored on sampling machines. Due to another dilemma, there was not that much difficulty choosing which choirs would require the least amount of editing in order to sound satisfactory. Looking through the sound clips on the computer, choirs two, three, six, and seven were discovered to be missing clips, cut improperly, not entirely cut, or some combination of the three. Choirs one, four, five, and eight began to be prepared to be transferred to the four sampling devices. Another problem that was already known at this point would start rearing its ugly head again.

Choir one had already been partially transferred onto the first sampler, and moving the sound clips over was a very tedious and repetitive job. As noted before, the first file transfer attempt involved moving a large number of clips to the sampler, and the device ended up crashing. The amount of files being transferred kept being reduced until clips were being moved one by one, which proved to be the only method that avoided the crashing of the sampler. This was unfortunate, as transferring the audio clips from the computer to the samplers would require much more time and effort than originally thought. The four choirs that were going to be put on the sampling devices only ended up being partially transferred, due to time constraints and the fact that only two students were working on the project at this point.

At this point, the focus shifted almost entirely from quantity to quality, and the project was narrowed down to only choir one and making this smaller portion of the piece sound good. However, since this choir came in at the very beginning of the piece, it was the largest one in the amount of sound clips required. One sampling device would only store about one hundred of the one hundred forty measures of the choir, and this is what was decided upon.

After this portion of choir one was completely transferred over to the sampler, other errors needed to be corrected using the sampling device. Since each voice part was split up into six or seven sections, because the chromatic notes associated with the clips would run out and need to be repeated, a preset was created. This preset would be set up to make these correlations between the sound files and their corresponding notes in the sequencer file, since the notes always were arranged in order (from C0 to C7). The preset could then be copied and used for each segment of each voice part. However, a couple of

chromatic notes were unintentionally skipped or doubled, and the preset was copied before fixing that problem. During playback soon afterwards, these errors were discovered one by one and had to be repaired in multiple presets. Another problem was that some clips would default to being associated with an entire range of notes, and these ranges all had to be shrunk down to the one corresponding note for each sound clip.

Once this step was complete, the focus shifted again, this time to the MIDI sequencer file on the computer, which, for some reason, had been created incorrectly and had many rhythm errors. The only way to solve this problem was to repeatedly play back the piece while reading through the scores, identifying rhythmic mistakes (or even more mistakes with the sound files themselves). The main problem besides this was the fact that every note in the sequencer file was very short, and each note needed to be extended right up to the occurrence of the following note to assure that each clip would be played in its entirety. This newly edited version of the sequencer file was saved as a different file, and the older version would be used later in a performance for comparison purposes.

Due to time constraints and all of these other problems, the performance of the Virtual Choir at the TechFest in Spring 2005 was reduced to twelve presentable measures of choir one. The pre-editing version of the sequencer file was also used to play back the piece, to better present the work that was done over that year.

Josh Anderson & Chris Cooper

During the 2005-2006 school year, Professor John F. Delorey again was advisor to a *Spem in Alium* related project. The goal of this year's project was again to get all eight choirs up and running and performance-ready. Again, this meant that the entire piece would have to be loaded onto samplers and edited to sound presentable. However, another vast number of shortcomings occurred, limiting the amount of work that could be done.

During the first two terms of this project, access to the equipment proved to be quite limited. The entire project needed to be moved in order to attempt to use a newer, better computer to synch up with the sampling devices. However, due to a couple of errors on the part of the Humanities office, keys to provide access to the equipment took six weeks to arrive, and, upon arrival, turned out to be the wrong keys. The correct keys came in about a week later, and work on the project was resumed, starting with fixing up problems that still existed in the first twelve measures of choir one, which were presented the previous year.

The next obstacle to overcome occurred some time over the break between the first two terms. Upon return, the entire project, which had been set up and was ready to go, turned up missing except for the computer that contained the sequencer file and the audio clips. A few weeks were needed to track down the sampling device that contained choir one, the MIDI express, a rack mount, screws, MIDI cables, stereo cables, two speakers, a mixer, and a monitor. Once everything was re-obtained, the project was set back up in its new location (the tower), where the newer computer was.

However, the newer computer was never able to be used, since it didn't have the SCSI interface needed to communicate with the sampling device, and both computers weren't able to be networked in order to transfer the sequencer file and sound clips to the better computer. Work continued on with the old computer being used.

Next, an attempt to obtain at least three more samplers failed, and the project was stuck using one sampling device again. The goal at this point was to get all eight choirs for as long as possible loaded onto the device, preferably up to measure forty eight. However, since each sampling device only allows for sixteen audio channels, and each voice part requires one channel, this was a nearly impossible task to complete using only one sampler. There were parts in the music where many more than sixteen channels would have been needed.

The scope of the project was then narrowed down to choirs one, two, and three for as many measures as possible. However, it had been forgotten that choirs two and three were not two of the choirs that were going to be used the previous year, meaning they were either not completely cut, had clips missing, or both. The next step was to check into this issue, and, on first inspection, choirs two and three definitely did not appear to be cut. Rumors were going around about clipped versions of both choirs existing somewhere on the computer, but those were never proven to be true, so the task of cutting the two choirs up to measure forty eight began.

Digital Performer was used for this audio editing. Once the choirs were both cut, they were to be transferred to the sampler. However, again, the sampler began crashing upon attempted transfers, but, this time, it would crash even when only one file was moved over to it. This file transfer was to be fairly large, and almost impossible under

these conditions. Focus again had to shift to quality over quantity, as the project was again narrowed down to just choir one.

The task was now to make choir one sound as good as possible with the remaining time. The sound clips on the sampler still contained glitches, some bigger than others, mostly at the ends of clips, which is almost unavoidable when cutting audio like this. However, the fact remained that this problem still had not been addressed, so the sound clips were repaired on the sampling device by using the taper utility on the machine. The last nine (approximately) milliseconds of audio for each clip that contained a glitch at the end would be tapered off, volume-wise, so that the glitches could no longer be heard. Running through this process for all of the loaded clips from choir one actually created quite a noticeable difference in the sound quality during playback.

Next up was running through the music while reading through the score again, for as long as possible, to fix more problems with the sequencer file. Some rhythm issues were still apparent, and most of them were fixed for all five parts of choir one up to around measure twenty five or so. This synchronized and lined up the voice parts much better, and the project was starting to sound much better up to this point.

The final step before sending the project off to New York to be presented was to add reverberation to the audio. After doing a little bit of research, it was found that this could be done directly on the sampling device. Various styles and levels of reverb were tested out, and a suitable one was chosen. The project was demonstrated briefly, then placed in the hands of the people who would be presenting it in New York. At the presentation, the first twenty five or so measures of choir one were played back with and

without the reverb and also using both sequencer files, the up to date version, and the older, lousier sounding one.

The Future of the Project

The next stage of this project will most likely be to continue along this path, but hopefully using better, more modernized equipment. Also, a little extra man-power couldn't hurt, as having only two people working on this massive project at one time may not be enough. I have already thought of a few ideas for enhancing this project and similar projects by using better technology.

“Overall, there were many problems encountered throughout this project that hindered our ability to successfully complete it, and I believe there are alternative ways of creating this virtual choir without using all this old equipment. There are other feasible ways of creating a digital choir that can be dynamically tempo controlled. Several new pieces of software have been put on the market recently that would provide, in my opinion, more effective ways of completing this project.

One such product is Steinberg's Cubase SX3. This software, which has been released for both Windows and Macintosh platforms, provides many audio and MIDI related options, but, most importantly, features “Audio Warp: Real-Time Timestretching.” This clever feature allows audio files to immediately adapt project tempi and also respond to real-time quantization and tempo changes. The product also contains a feature to perform pitch shifting on audio files, which would be an excellent way to better “fake” the missing audio clips that we found in some of the choirs. As long as we found something with the correct syllable sound being sung by the appropriate voice, we could pitch shift it to the correct pitch, and save it as a new audio clip. This would make the overall work sound much better than it does at the moment with the way

we currently “faked” some of the missing audio (“Steinberg Cubase SX3”)” (Anderson 8).

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