

## Rautavaara Symphony no 6

TECHNICAL SPECIFICATIONS: FM8/Ableton, Kontakt 5

### Background

Einojuhani Rautavaara's Symphony no. 6 (*Vincentiana*) was completed in 1992, and draws on material that the composer had used in his opera *Vincent* (1982-87), based around the life of Vincent van Gogh. Both the opera and symphony feature the use of a Yamaha DX7 synthesizer.

The Yamaha DX7 – the first commercial, digital synthesizer - was first manufactured in 1983, and quickly became ubiquitous in the pop music of the 1980s. The DX7II was introduced in 1986, and there were further variants which, for example, incorporated a floppy drive. Production lasted until 1989, by which time some 200,000 units had been sold. Its use wasn't limited to the pop world, and many classical composers also became interested in the possibilities of FM synthesis as offered by the DX7.

*Vincentiana* was first performed on 29 October 1992, by the Helsinki Philharmonic Orchestra conducted by Max Pommer, in Helsinki. In 1996 a studio recording was made by the same personnel. Until 2017 the Symphony had not been played in public since the first performance. There appear to be no records of who was playing the DX7 for the Helsinki Philharmonic in the performance and recording, though it is a fairly safe assumption that they were playing the composer's own instrument. However, while it is not known which model of DX7 the composer owned, the composition date suggests it may have been one of the later models.

During the course of the recording the publishers relate [email dated 1 September 2016] that the DX7 crashed, which would doubtless have caused considerable difficulties in the recording. The DX7 and its software were generally fairly reliable, though it had a reputation for being slightly unstable when using imported patches. This crash seems to have been very serious, and with hindsight it would appear that it may well have irreparably damaged some of the performance data. In hindsight it would seem possible that there was no backup of the data. Certainly none has come to light since the recording.

It is difficult to know the extent to which the recording itself might have been compromised by the DX7 crash. On one hand it may be that the original performance data used some sounds which were lost, and that the recording used sounds which were put together during the recording, simply to allow the recording to be completed. On the other hand it may be that the sounds heard in the recording were entirely those prepared by the composer, but that the crash forced the recording engineers to use takes with which they were not entirely satisfied. Certainly one or two edits seem less than satisfactory, so may point in this direction, though the reality is that we will almost certainly never know.

The publishers (Fennica Gehrman) report [email dated 30 August 2016] that in around 2014 the entire data from the DX7 was extracted via sysex dump, and saved for archive. A subsequent transfer was made to FM8 software. FM8 (produced by Native Instruments

GmbH) is a computer-run software emulation of a DX7, able to open and store DX7 sounds in (generally speaking) their original format. However it later became clear that the FM8 transfer had – unsurprisingly – simply perpetuated the damage from the DX7 crash. One patch in particular was damaged beyond use, and as this patch is used for a significant cadenza in the third movement it was impossible even to consider a performance of the Symphony. Several other patches suffer from distortion and crackling on the recording (though this was probably not caused by the crash of the DX7, indeed they may have been an unfortunate part of the way the original sounds had been built; or even caused by the unfortunate setting of output levels during the recording). Certainly the recording was compromised.

In 2016 the English conductor Andrew Gourlay – feeling that he had found a piece that would resonate well with both orchestra and public – decided to programme Rautavaara’s 6<sup>th</sup> Symphony with the Orquesta Sinfónica de Castilla y León. He asked me to perform the electronic keyboard part with the orchestra, and Fennica Gehrman sent me the FM8 materials for checking. After some initial puzzlement and careful listening to both recording and FM8 sounds (“patches”), it became uncomfortably evident that some of the electronic materials bore no resemblance to the recorded sounds.

My point of contact at Fennica Gehrman was Jari Eskola, who recounted the performance history of the piece over a number of emails. Sadly, at this important stage in the process the composer died, and thus the only definitive source of information was lost. The publishers were left with a large number of sound files which came from the composer’s DX7. Some were clearly named *Vincentiana*; some clearly had their roots in the opera *Vincent*; others were related to other pieces; others still had been on the DX7 and were saved as part of the sysex dump made after the recording but were not used in any work, as far as can be known.

While some of the sounds saved as *Vincentiana* or *Vincent* (in both cases, plus a digit to identify the patch number) were obviously very close to those heard in the recording, one sound file – patch 7 (used from bar 211 to the end of the third movement) bore no similarity at all to the recording. The condition of patch 7 was a particularly serious problem as this was used in a section which featured solo synthesizer. Clearly, without the correct sound this passage could not even approximate to that of the recording. (Technically, all of the six operators of FM8 had been returned to zero, producing a sound very like slow, uneven footsteps). The electronic materials held by the publisher could not be used in performance, so Jari Eskola took the decision to have the damaged materials recreated using FM8 in order to make future performances of the work a realistic possibility.

### Reconstruction process

The process of reconstruction of the electronic sounds was necessarily complicated, and there were few principles of established practice with which to work, so it was necessary to devise a careful plan.

The first step was to identify any source material which could be regarded as accurate representations of the composer’s intentions. The primary source was inevitably the

facsimile full score (published by Fennica Gehrman). The secondary sources all have limitations, but are:

1. The studio recording (ODE8192). This is the commercially available recording. Studio masters might have revealed more detail but were not available. However this commercial recording – with all its problems and limitations - has to be accepted as “authorised” by the composer.
2. The DX7 part used by the player in the performance and recording; and a clean copy.
3. The DX7 patches sourced from the composer’s instrument and subsequently transferred to FM8 format. We cannot be certain that these are all exactly the same patches as used in the recording, though they are very similar and may provide an insight into the composer’s way of working. It would appear that some editing was done during the rehearsals or recording which was not saved before the DX7 crashed, so - for example - some decay times are slightly different. As already noted patch 7 was damaged beyond use. Furthermore the sysex dump contained several versions of these patches along with a great deal of apparently unused material, all of which was provided by the publisher.

The next part of the process was to compare the various copies of the multiple FM8 patches to see if some could be ruled out as duplicates. Thankfully it was possible to compare the contents of each set of files by computer, and this revealed that all of the FM8 Vincent files had matching parent files. These parent files were used as the starting point for the reconstruction of the most of the patches.

The DX7 is only used in distinct blocks with the Symphony, as listed below. Some of the patches are used with modulation wheel settings indicated as percentages in the score and part (though some of these in fact have no apparent assigned function).

Movement	Bars	Patch numbers	Modulation wheel use (%)
1	1 - 30	1, 2	0, 25
2	1 - 44	3, 4, 3, 4, 5	100 indicated at start, and as there are no opportunities to change it the level must be held throughout the movement. However it appears to have no effect.
3	186 - 241	6, 3, 4, 5, 3, 7	0, 100 to end (as above).
4	84 - 92	8	75 (changed to 50 in the part).

Additionally, patch 7 has several phrases which call for the use of the DX7 transpose function. This was necessary on the 60-key DX7 in order to create the full range of pitches required by the composer. When performed on an 88-note keyboard this can be avoided altogether (see below).

By comparing the FM8 patches with the recording it was possible to recognise that the patches had been saved in FM8 with incorrect numberings. Once corrected, direct comparison with the recording could be made more simply.

## Editing the FM8 patches

The following adjustments were made to the patches to match the recording more closely.

- Voice 1 - Decreased sustain level on Ops D and F to match recording.
- Voice 2 - Reduced LFO1 rate and adjusted Op A envelope.
- Voice 3 - Unchanged ("modulation 100%" in score is not required as the modulation wheel has no use in this voice).
- Voice 4 - Transposed up to match recording and reduced level of Op D going into Op F in FM matrix.
- Voice 5 - Disabled Op D, reduced Op E in matrix, adjusted attacks for Op envelopes. Assuming the crackling noise at bar [99] in the recording is not intentional.
- Voice 6 - Inaudible on recording, assumed to be correct.
- Voice 7 - See below.
- Voice 8 - No changes.

Some small "improvements" have been incorporated into the new material.

- Patch 1 is very slow to speak (because the sustain component of the patch is reached only once the note has been held for about three seconds), so the speed of the notes in the long run into bar 20 means that the notes would simply not sound. It seems inconceivable that the composer intended this. To solve this, a separate patch (called 1b) is provided. Patch 1b is identical to patch 1 except that it has been adjusted to speak quicker (about 0.25 seconds), and may therefore be more suitable for this passage. If it is not required, it can safely be ignored. Patch 1b has NOT been numbered in sequence with the other patches. It can be selected by typing the letter "q" on the computer keyboard.
- Patches 1 and 1b have been re-tuned to A=440. The original sounds for these patches were about 12-15 cents sharp. If required, to revert to the original tuning it is necessary to open the FM8 VST for these patches, select "Master", then under "Pitch" select "Master Tune": this should be returned to zero, and the Ableton file should then be saved. The nature of the tuning of the other patches makes it impossible to detect any discrepancies in intonation.
- With the software of the original DX7 it was not possible for sounds to overlap. Any patch change would result in an immediate cessation of the preceding patch. The composer would have been aware of this, yet on several occasions Rautavaara instructs the player to change patch during a sustained chord or where there is very limited time for a patch change (e.g. 1<sup>st</sup> movement, bar 19, 2<sup>nd</sup> movement four instances up to bar 35, 3<sup>rd</sup> movement bar 194 to bar 211). FM8 allows for an overlapping of textures in such places, and where it seemed musically appropriate a small overlap is provided. These points are usually covered by orchestral texture, but nonetheless it seemed worth building the overlaps formally into the patches.
- A gain control has been added to each of the FM8 patches to allow for greater flexibility in performance. This can be easily disabled in Ableton.
- All modulation wheel settings have been saved as part of the FM8 patches, and no changes need to be made by the player.

## Patch 7

As already discussed patch 7 was damaged beyond use, and reconstruction could only be satisfactorily done if a suitable source patch could be found which might then be edited to match the recording. Among the materials sent by Jari Eskola from the FM8 files was the complete library of patches from the composer's DX7 (sysex "dumps" exported all of the materials in internal storage by default). Some of these working patches had evidently been used in the Symphony, so there was a strong reason to hope that there might be a suitable source file for patch 7, and indeed there was one such patch. It is now impossible to know if this "discovered" material was the sound intended by the composer, or was a substitute found (one must assume, hastily) during the recording sessions to allow the recording to be completed. However, the patch found is highly complex in its evolution which might suggest it was the intended sound, not the result of on-the-spot editing; if it was not the intended sound, it was very close to the recorded sound and to that extent we must assume it had the composer's implicit approval. The one troubling aspect of this found material was that it did not respond to the modulation wheel in any way. However this was the case for some of the other patches too. This sound was used as the basis for patch 7's reconstruction, work done by Jonathan Green, who notes that:

- *"Voice 7 - Uses pitch envelope to modulate pitch and only falls without repeating the pattern. Modulation wheel has no affect."*

*Polyphony of 32 seems to work."*

Patch 7 has been split into two parts using the split keyboard capabilities of Ableton (which the DX7 lacked): one is played by the right hand, and the other by the left hand. With an 88-note keyboard, and the pitches written by the composer there was an overlap between the hands requiring some of the sustained right hand notes to be replayed by the left hand. This created unfortunate changes in the envelope of the sustained sound which were not intended by the composer. This has been solved in the following way.

The high, sustained chord should be played and held by the right hand in the very top octave of the keyboard (ie one octave higher than notated). The upper perfect fifth of the patch is set to transpose to the correct sounding pitch. All other material should be played by the left hand. The first phrase should be played by the left hand alone one octave higher than notated; the next phrase should be played also by the left hand at notated pitch; and the final phrase should be played by the left hand one octave lower than notated. This is possible on an 88-note keyboard controlled by Ableton Live, and dispenses entirely with the need for the changes in digital transposition indicated in the score.

The indications to fade the high sustained sounds at the start of this section have been replaced by changes to the envelope of the FM8 patch used for this part of the keyboard. The player needs simply to play the sounds at the indicated pitch and the fading will be done automatically.

For clarity, a new version of the keyboard part for the final section of the third movement is attached.

Final adjustments to both the FM8 patches and the setup of the Ableton Live 9 file were made during rehearsals in Valladolid in April/May 2017 by myself, with the guidance of Andrew Gourlay, and with the invaluable assistance of Jonathan Green.

#### Technical details.

NB Please read Addendum below, dated January 2018, for additional details relevant to using Kontakt 5 materials.

Provided for performance are a number of files bundled into a folder, ready to be decompressed and loaded onto a computer. The sounds require a computer with FM8 software (Native Instruments GmbH) and Ableton Live (at least Live 9), and they are played as VSTs within Ableton Live 9. It would be possible to perform the work using just the FM8 files, though this is not recommended as it would still be necessary to provide a performance-friendly interface for the player. Similarly, it would be possible to build a suitable performance interface using another VST host.

The player will need an 88-note keyboard with midi-out, in-line volume pedal (not a midi volume pedal), and sustain pedal. The midi-out will need to be routed through a midi-interface to the input of the computer. The audio output will need to go via a sound interface and a volume pedal to a local amplifier of suitable power.

It was understood from the composer's indications that there should be no need for the use of a PA system, as the musical intention is that the electronic sounds should blend into and be part of the orchestral texture. However in a large hall (*Auditorio Miguel Delibes*, in Valladolid, Spain) the conductor Andrew Gourlay found that the addition of some (discreet) PA allowed the electronic sounds to be better integrated with the orchestral sound, and filled the space more richly. It is the conductor's preference whether this practice should be followed.

On the computer locate the folder <Rautavaara Sym 6 Ableton Live 9 FM8 Project> and nested within it is the file <Rautavaara Sym 6 Ableton Live 9 FM8.als>. Launching this file will load the Ableton performance interface and the FM8 patches. [NB it will also be necessary to select the midi-interface and sound-interface in Ableton Live's preferences.] It should be noted that the software has been tested and used on a Mac, but not on a Windows computer.

The relative volume levels of each patch can be adjusted and saved within Ableton Live. Changes of patch can be effected using a computer keyboard keys 1 to 8, with patch 1b selected with the letter "q" if required. Alternatively, the patch changes can be mapped to keyboard controls on the midi-keyboard, or to other computer keys. As the full range of the 88-note keyboard is used it is not appropriate to map patch changes to midi notes.

To clarify the transposition indications in the score, the system used by Yamaha for transposition on the DX7 worked as follows. The player would hit the "Key transpose [31]" button, then a note on the keyboard to indicate which button should be treated as middle C. It is important to note that Yamaha identified C3 as middle C. Other manufacturers (and

general practice) identify C4 as middle C. [[http://faq.yamaha.com/us/en/article/musical-instruments/keyboards/synthesizers/dx7/720/1846/key\\_transposition\\_on\\_a\\_dx7](http://faq.yamaha.com/us/en/article/musical-instruments/keyboards/synthesizers/dx7/720/1846/key_transposition_on_a_dx7)].

### ADDENDUM January 2018

In discussions following the performances in Spain in 2017 Jari Escola agreed that the existing format for the sound files was somewhat complex and, arguably, dauntingly so; also, that it relied heavily on the continued availability of FM8 software. Regrettably the complexity of routing FM8 sounds through Ableton Live was necessary because of how the reconstruction work had to be done, and because of the limitations of FM8 as a live performance host. There is no reason to doubt continued support for FM8 by the developer (Native Instruments GmbH), but as a piece of what might be described as “niche” software its longer-term future could not necessarily be assured. These factors alone might prove enough to deter possible performers, so it was decided that the best solution would be to transfer the sound files to samples - a more common and user-friendly format - for playback in Kontakt 5 (also by Native Instruments GmbH).

By recording samples of the original FM8 patches any loss in sound quality would be minimal, and the sounds would behave in performance in exactly the same way as the original FM8 sounds. Inevitably, for some there may be a dilemma as this action took the electronic materials another step further away from the composer’s intended medium, the DX7. However, the advantages were deemed sufficient to outweigh the concerns.

In order to effect this transfer a number of samples (in general, between 11 and 21, evenly-spaced from across the entire range of the keyboard) were extracted from each of the original FM8 patches. These were then mapped in Kontakt 5 to evenly-spaced groups of pitches, and looped as appropriate.

The apparently complex nature of the sounds in FM8 belied their underlying simplicity. The modulation wheel settings had already been incorporated into the new FM8 patch structures, as outlined above. Luckily the modulation wheel settings were never adjusted while playing sustained sounds (only between sounds, at patch changes), and there was no use of aftertouch etc. This allowed for a relatively straightforward transfer of simple sustained sounds. This transfer, mapping and looping was done by Jonathan Green using custom-designed Max software.

One small adjustment was made to the opening patch before the transfer was made. In the FM8 version patch 1b was introduced to allow fast notes to speak adequately (see above). The notes in patch 1a were very slow to speak, so playing any material with short/fast notes - for example in the opening section, in the long run before patch 2 is selected - did not allow the sounds to reach any useful sustain level before keys had to be released.

The move from patch 1a to patch 1b needed to be done seamlessly, after all this was a patch change added for technical rather than musical reasons. However, the decay in patch 1a was immediate and, though arguably covered by orchestral sounds, in performance it felt potentially awkward. In order to achieve a smooth passage from patch 1a to 1b a longer

decay was added to 1a to allow time for patch 1b to start sounding, thereby bridging any possible gap.

At the same time, it was recognised that the incorporation of the extra patch (1b) into the materials would create anomalies in the numbering system when played in Kontakt which had been side-stepped in the FM8/Ableton version. One of the advantages offered by Kontakt is the ability to effect patch changes by pressing the program change buttons on the host MIDI keyboard, so to leave the numbering as it stood would entail selecting (notated) patch 2 with button 3 and so on. In use this would be confusing and unacceptable. Jari Escola agreed that the sensible course would be to renumber the patches sequentially. Accordingly, the Kontakt 5 performance material now has the numbering listed below. This table shows the equivalence between FM8/Ableton and Kontakt 5 numbering. Please see the note below to clarify the new numbering system.

<b>FM8/Ableton</b>	1a	1b	2	3	4	5	6	7	8
<b>Kontakt</b>	1	2	3	4	5	6	7	8	9

#### Additional technical details

The electronic material to be used in performance is a Kontakt 5 monolith file, called <Sym6 Multi v03 Monolith> (Monolith files contain all of the sounds required for performance, so there is only a single file, albeit a large one). There is no need for Ableton Live or for any software other than Kontakt.

The symphony uses the programmes stored in the single multi-rack within the Kontakt 5 monolith. Once the file is opened, and midi input and audio output selected in preferences, the sounds should work without further ado.

To reflect the re-numbering of the programmes and to show the origins of those sounds the voices have been renamed using the following model <sym6\_voice1a\_prog1>, where “voice1a” shows the old numbering, and “prog1” shows the new numbering.

Moving between programmes can be done by the performer either by using built-in programme change selection on the MIDI keyboard, or by using the computer interface, as desired.

All other technical details (sound projection, MIDI keyboard, pedals etc) are as discussed above, under “Technical details”.