fcremap'dB: Audiovisual Re-mapping, Animated Notation, and Embodied Electronics

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ABSTRACT

fcremap'dB is the final installment in the author's six-piece cycle fcremap (2014-2016), to be commercially released on recording in November of this year. All pieces in the cycle derive their materials from the author's animation piece Future Creatures (2013). Composed for the Decibel New Music Ensemble (Perth, Australia), fcremap'dB utilizes the ensemble's ScorePlayer iPad app to translate video elements into animated graphic notation—visual cues for structured improvisation. Via an image-to-sound processing program, properties of the Future Creatures visuals are employed to generate the electronics. In the interest of blurring the boundary between not only audio and visual sources, but also electronically- and instrumentally-produced sound, the electronics are projected through tactile transducers onto the percussion. The aesthetic, technical, and practical issues surrounding the compositional procedures applied to fcremap'dB are addressed. As there are important relationships between the methods and materials associated with fcremap'dB and fcremaperc—the first piece in the cycle, for solo percussion and live electronics—an analysis of the former is preceded by a discussion of the latter. Subsequently, the other works in the fcremap cycle are briefly outlined.

1. INTRODUCTION: *FUTURE CREATURES*

In 2013, the author collaborated with the Korean visual artist Eunjung Hwang on an animation piece entitled *Future Creatures*. Spanning a duration of ca. 9:30, the work is divided into three segments: "Bubbles," "Sleep," and "Home." The frenetic, multi-layered nature of the visuals is echoed in the audio, which was generated primarily via applying concatenative synthesis techniques. Over the past few years, *Future Creatures* has been presented at numerous international festivals, conferences, institutions, and venues. [1]

At around the time of completing *Future Creatures*, the author wrote a piece for two voices, ensemble, electronics, and video, entitled *epiglottis*. In this piece, both audio and visual elements of the film *Spring* by Croatian artist Damir Ocko,[2] to which the author contributed to the soundtrack, served as the basis of not only the video and electronics materials, but also the harmonic content of the vocal and instrumental parts. The primary motivations behind data mining the video in service of informing musical dimensions were a) to invert the collaborative process behind the production of *Spring*, in which the audio that the author provided functioned as raw material for the soundtrack and b) in employing image-to-sound processing, to take a more objective approach to adapting the film to a performance context, as opposed to relying exclusively upon surface or subjective semantic associations in the compositional process.

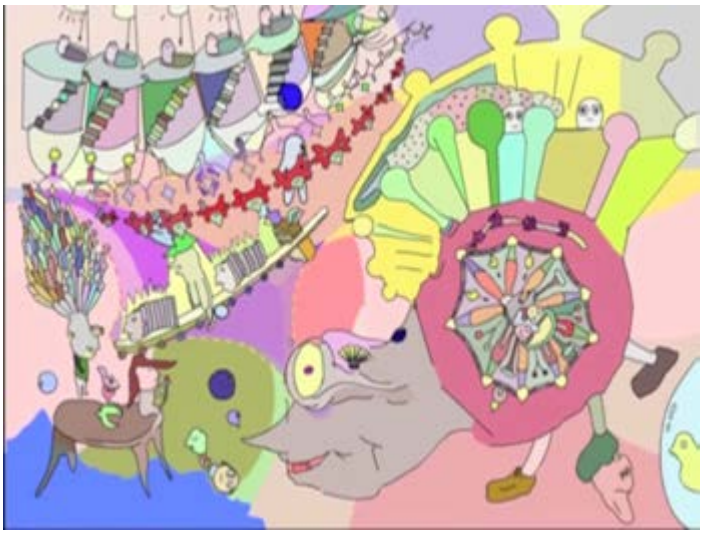

Figure 1. Still from *Future Creatures*

In so doing, the software PhotoSounder,[3] SPEAR,[4] and IRCAM's OpenMusic [5] were employed for the purposes of image-to-audio conversion, spectral analysis, and chord sequence generation, respectively. It would become of interest in the composition of *fcremap* to further develop and extend the image-to-audio mapping techniques and approaches introduced in *epiglottis*.

For the past few years, the author has been exploring strategies for integrating instrumental and electronic sound

[1] For more information on *Future Creatures*, please consult the following article: http://data.jssa.info/paper/2015v07n02/4.Sigman.pdf (accessed 20 July 2017). The piece may be viewed here: https://vimeo.com/70344676 (accessed 20 July 2017).

[2] http://www.damirocko.com/works/videos/spring/ (accessed 08 July 2017).

[3] http://photosounder.com/ (accessed 08 July 2017).

[4] http://www.klingbeil.com/spear/ (accessed 08 July 2017).

[5] http://repmus.ircam.fr/openmusic/home (accessed 08 July 2017)

material. It is all too common in electroacoustic performance scenarios that there emerges a cognitive chasm between the sound universes of (mechanical) instruments and electronics, exacerbated by the invisibility and dominance of the source of the electronic emissions. In affixing tactile transducers to the instruments themselves or other surfaces, the electronics undergo filtration and distortion, and become embodied, physicalized, and reveal acoustic properties of the instruments and objects to which they are attached that further enrich a work's sonic palette. Three pieces in the author's *VURT* cycle (2014-2016), and four in *fcremap* incorporate transducer projection, in isolation or coupled with PA speakers. [6]

2. *FCREMAP*: HISTORY AND CONTENTS

The percussionist Eric Derr,[7] after attending a screening of *Future Creatures* in 2014 at the University of California, San Diego, requested a new solo percussion/electronics work that would somehow incorporate visual and audio elements derived from the animation piece. This led to the composition of *fcremaperc*, for percussion and live electronics (discussed below). Thereafter, the premise of adapting the animation piece to solo instrument and ensemble settings was extended to five additional works. Together, these comprise the *fcremap* series.

fcremap (2014-2016)

1. *fcremaperc* (2014) for percussion and live electronics (ca. 9'30): I. "Bubbles" (ca. 3'30); II. "Sleep" (ca. 1'45) ; III. "Home" (ca. 4'15)

2. *fcremapno* (2014) for piano and live electronics (ca. 9'30)

3. *fcremapercremaflvln* (2015) for alto flute, violin, electronics, and video or improvisor, electronics, and video projection (ca. 5')

4. ホーム (2015-2016) for koto and optional live electronics (solo koto version: ca. 4'15; koto + electronics version: ca. 7')

5. *fclremap* (2016) for clarinet and electonics (ca. 5'30) (6 30-second segments, separated by pauses)

6. *fcremap'dB* (2016) for flute(s), clarinet(s), violin, percussion, animated score, and electronics (ca. 10'45) (6 100-second segments, separated by pauses)

Figure 2. *fcremap* series contents, with instrumentation and durations indicated.*fcremapno* and *fcremapercremaflvln* are played continuously; all other pieces are divided into sub-segments.

As Figure 2 indicates, the durations of *fcremaperc*, *fcremapno*, and *fcremap'dB* reflect that of *Future Creatures*. The other three pieces are of compressed duration, for reasons that will be described below. *fclremap* makes use of a graphic score, consisting of modified still images derived from *Future Creatures*. In *fcremap'dB*, animated notation is employed. As such, these two works call for some level of structured improvisation. In addition, there exists an "alternate version" of *fcremapercremaflvln* scored for any number of improvisors, in which a projected video is to be interpreted as an animated score, according to a set of specific instructions.

In contrast to other large-scale cycles that the author has previously composed, the pieces contained within *fcremap* are not intended to be performed consecutively on the same event. Rather, they constitute alternate perspectives on, and realizations of, the same objective—namely, the adaptation of video animation source-material to instrument and electronics performance scenarios.

fcremaperc and *fcremap'dB* represent not only contrasting instrumentation (solo percussion vs. ensemble), but also divergent relationships to *Future Creatures*. However, there do exist important connections between the two works, which are described below.

3. *FCREMAPERC* (2014): RESONANCE, EXCITATION, FEEDBACK, ADAPTATION

3.1 Instrumentation and Overall Structure

As is shown in Figure 2, *fcremaperc* is divided into three movements. Each movement is assigned a unique instrumentation. The first ("Bubbles") is scored for tam-tam (activated by various implements) and resonating metal sheet and snare drum; the second ("Sleep") for three bowed cymbals, pedal-activated tambourine, and resonating snare drum; the third ("Home") for microtonally-tuned zither and resonating metal sheet and snare drum.

3.2 Electronics Production and Projection

The electronics material consists of audio generated via converting ten still images from *Future Creatures* into (audio) spectral data in the image-to-sound processing program Photosounder over varying durations and frequency bandwidths, as well as extracted segments or layers from the animation. In a few cases, the selected animation audio has been further modified using the concatenative synthesis software AudioGuide. [8]

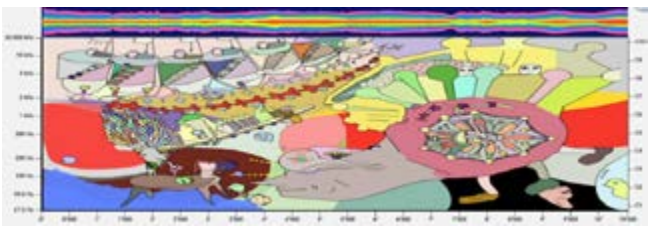

Figure 3. Screenshot of PhotoSounder Interface. *Future Creatures* still, analyzed as/converted into spectral data over a given duration and frequency range.

Scheduling/triggering, filtering, reverberation, pitch shifting, and other operations are performed on the audio files in a Pure Data (Pd) [9] patch. Live input from the tam-tam, cymbals, and zither is also processed, and used to control amplitude, bandpass filter bandwidths, and pitch-shifting extent of the electronics material.

[6] In *down the bottle* (2012) from *VURT*, for instance, transducers are attached to a glass panel across which shards of glass are distributed, thereby setting the panel/fragments in vibration: https://vimeo.com/44553886 (accessed 21 July 2017).

[7] http://www.ericderr.com/ (accessed 09 April 2017).

[8] http://www.benhackbarth.com/audioGuide/ (accessed 09 April 2017).

[9] https://puredata.info/ (accessed 09 April 2017).

In an effort to further integrate electronically- and instrumentally-produced sound, and to corporealize the audio, tactile transducers (such as the one illustrated in Figure 4) are attached to a metal sheet, snare drum, and the zither. As such, the percussion instruments function as natural resonators, activated by the *Future Creatures*-derived sounds. In the third movement, given that the zither is set in vibration by both the performer and the transducers, and the zither output is both processed in real time and controls the transformation of the audio files, a feedback loop between zither input and output is generated.

Figure 4. Tactile transducer attached to percussion instrument surfaces in *fcremaperc*.

3.3 Compositional Techniques and Materials

A set of six basic contours, associated with the typical repertoire of six car alarm sounds,[10] is applied in various ways not only in this piece, but also in other works within the *fcremap* series. (A spectrogram of these contours is given in Figure 5.) Within *fcremaperc*, the contours control: 1) tam-tam scraping rate and direction in "Bubbles"; 2) cymbal bowing patterns, tempi, and the alternation between producing single pitches and multiphonics in "Sleep"; and 3) zither bowing/scraping and glissando directions, spans, and registers in "Home." In the first and third movements, each contour is paired with a unique implement, selected by the performer, and two contours are superimposed upon each other at one time. These contours were selected for three primary reasons: 1) the use of car alarms as source-sounds in *Future Creatures*; 2) their contrasts in direction, inter-onset interval (IOI) duration, and (by extension) number of iterations per unit time; and 3) the association between the fleeting, hectic environments depicted in *Future Creatures* and human responses to auditory warnings, as well as the scenarios in which auditory warnings are emitted. [11]

[10] As may be heard here, in this amusing interpretive dance rendition: https://www.youtube.com/watch?v=1Li3mNl2-EM (accessed 20 July 2017).

[11] The interpenetration between *fcremap* and the author's ongoing artistic/scientific collaborative research project *alarm/will/sound*, which deals with the design and implementation of modified car alarm systems, and the perceptual and cognitive issues surrounding auditory warning development, is also worth mentioning here. An overview of this project may be found here: http://forumnet.ircam.fr/tribune/alarmwillsound/ (accessed 21 July 2017).

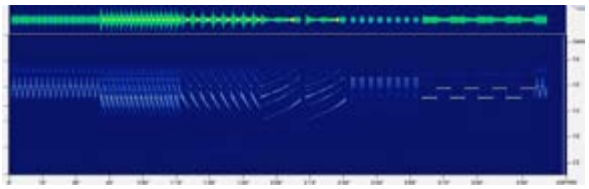

Figure 5. Spectral analysis of six car alarm repertoire contours.

4. *FCREMAP'DB* (2016): ANIMATED NOTATION, IMPROVISATION, AND (RE)CYCLING

4.1 Decibel New Music Ensemble and the ScorePlayer

fcremap'dB was composed for the Decibel New Music Ensemble (Perth, Australia),[12] who performed at the Tokyo Wonder Site and various other institutions in Tokyo in December 2016. Active as performers, composers, and software designers, and known for their collaborations with musicians and artists spanning genres and disciplines, Decibel developed an app for the iPad called the ScorePlayer.[13] The ScorePlayer allows for synchronizing of multiple performers (via a "Networking" function), aligning multiple parts, varying the scrolling speed through the score, and synchronizing of score scrolling and electronics, thus obviating the need for page-turns, stop-watches, click-tracks, and other encumbrances to performance. Although suitable for any type of score, the app is especially useful for the interpretation of graphic scores, or any notation in which temporal information is non-specific, or entirely absent.

4.2 Instrumentation, Structure, and Score Generation

Given the functionality and potential of the ScorePlayer, the author decided to take a quite literal approach to developing a relationship between *Future Creatures* visuals and the notation.

The piece is divided into six sections of equal duration. Scored for any members of the flute and clarinet families, violin, viola, and/or cello, and percussion, for each section, each performer (with the exception of the percussion) is provided with a unique still image from *Future Creatures*. For each of the three segments of *Future Creatures*, two stills are extracted. While the flute part consists of a *rectus* ordering of images (from scenes 1-3), the clarinet part reads the images in reverse, and the string part ordering is non-linear. Furthermore, the sequencing of images *within* a given scene varies from one part to the next. As such, each part effectively represents a scanning of (or cycling through) the video in a different direction. Besides undergoing basic manipulations (e.g., rotation, color inversion, and compression/expansion), one of the six contours employed in *fcremaperc* is "carved" into each image, resulting in white or black patches. For each part, there is a discrete contour-to-image pairing, thereby guaranteeing that no two parts contain identical images.

These images were then imported into Photosounder, and compressed into the pitch range of the respective instru-

[12] http://www.decibelnewmusic.com/ (accessed 09 April 2017).

[13] http://www.decibelnewmusic.com/decibel-scoreplayer.html (accessed 09 April 2017).

ment. [14] As is shown in Figure 6, the Photosounder interface, in which duration, frequency, and approximate pitch are indicated, would be used to generate the score itself.

The percussion part—scored for three bowed cymbals, pedal-activated tambourine, and resonating kalimba and snare drum—derives from *fcremaperc*. Despite the parallels between the instrumentation of the "Sleep" movement of *fcremaperc*, there is no literal quotation of the solo percussion piece. Rather, in a manner similar to the scanning of *Future Creatures* and manipulation and mapping of isolated visual elements onto the flute, clarinet, and string parts, *fcremaperc* is scanned is various directions, and passages are extracted and read for particular information, such that each of the six percussion sections constitutes a gloss of a unique segment of *fcremaperc*. Due to the nature of the mapping between *fcremaperc* and the percussion part of *fcremap'dB*, the use of multiple percussion instruments, and the inappropriateness of a frequency axis, conventional staff-based percussion notation, as opposed to graphics in Photosounder interface, was employed.

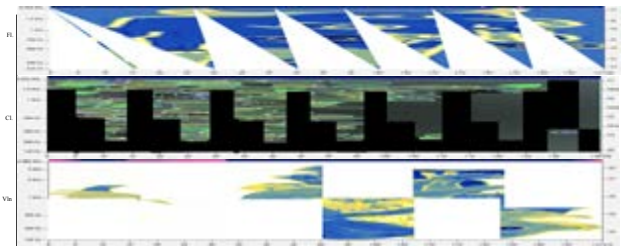

Figure 6. Page from *fcremap'dB* score, depicting flute, clarinet, and string parts.

4.3 Animated Score Interpretation Conditions and Strategies

It was not intended that the performers should freely interpret the images comprising the score. Just as the images have been "objectively" converted into audio data, and poetic associations between video elements (images and sounds) and musical material in the compositional process, performers of *fcremap'dB* are requested to focus on the *materiality*, on the visual properties of each image, rather than on implied semantic content. Each performer is asked to assign two physical parameters on their respective instrument, such as vibrato speed, flutter content (for winds), or bow pressure (for strings), to two selected visual parameters (e.g, color value, line thickness, or geometric shape), a mapping that is to remain constant throughout the entire piece. The selected physical parameters are to be articulated according to one of four possible attack categories: isolated points, collections of points (granular texture), pulsations, or continuous sounds. A new attack type is to be chosen by the performer at the beginning of each of the six sections. While solid colored portions of images may be sonically interpreted, white and black patches that clearly function as maskers are to be interpreted as silence.

[14] Given the somewhat variable instrumentation of the work, these ranges could be transposed accordingly for the instrumentation employed in a given performance.

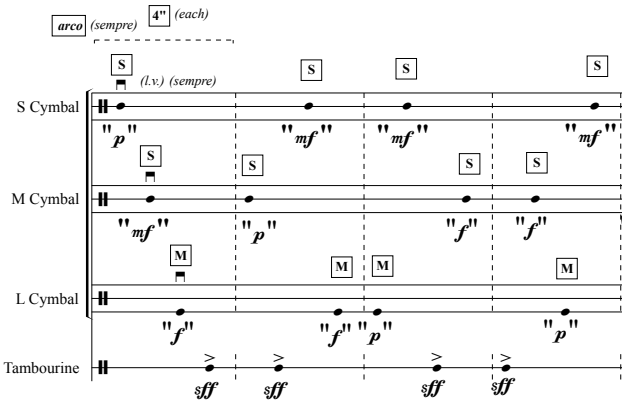

Figure 7. Excerpt from first page of *fcremap'dB* percussion part. The "S" and "M" indications over the noteheads refer to the production on the bowed cymbals of single harmonics and multiphonics, respectively.

4.4 Electronics Production, Function, and Projection

For each of the six sections, a unique audio track is designated. As in *fcremaperc*, *Future Creatures* stills were sonified in Photosounder. However, in this case, there exists a direct link between the score and audio generation. Complementing the image-derived audio are sounds with a strong, periodic rhythmic profile, each of which is assigned a clearly discernible spatial pattern or trajectory. These periodic sounds serve as sonic cues for the performers, with which they may choose to phase-lock, against which they may resist, or which may be ignored entirely. The electronics also reinforce the percussion part, in which attacks fall into regular (but shifting) temporal grids. The performers thus construct relationships with both the visual and auditory stimuli with which they are confronted, resulting in a sort of multi-modal score—not merely an animated one.

The electronics are projected through transducers. In this case, the transducers are attached the bottom of a small kalimba (near the sound hole), as well as a snare drum. The output of the transducers is mixed with the (amplified) instruments and electronics transmitted directly the PA system, thereby expanding both the range of percussive sonorities and electroacoustic material. Consequently, a bridge is constructed between instrumental and electronically-generated elements.

5. FURTHER RE-MAPPINGS: *FCREMAPNO* (2014), *FCREMAPERCREMAFLVLN* (2015), AND *FCLREMAP* (2016)

5.1 *fcremapno*

Taking as its point of departure the "Home" movement of *fcremaperc*, *fcremapno* is scored entirely for the strings and frame of the piano—a "transposition" of the zither onto the piano. As in the percussion solo piece, the performer is asked to activate the strings with six objects of contrasting material and dimensions. The electronics (derived from the video) are projected via transducers into the piano. Live input from the piano influences overall sound level of the electronics, but does not undergo live processing. In contrast to *fcremaperc*, however, the piece unfolds over a continuous 9:30 duration. In the electronics, the tim-

ing and number of events triggered varies with each performance.

5.2 *fcremapercremaflvln*

As the convoluted title would suggest, this alto flute and violin duo is also connected to *fcremaperc*. However, the relationship between the surface materials of the two pieces, with the exception of the underlying contours that the duo shares with the percussion solo. The violin is tuned scordatura to reflect the zither tuning in *fcremaperc*. For each performer, a pedal-activated tambourine part is indicated, as an optional component of the work. In tandem with the instruments, a video consisting of modified and montaged images and six discrete audio segments of equal duration is projected.

There exists as well as "alternate version" of the piece, scored for any number of improvising musicians. In this version, the video is treated as an animated score. In a manner similar to that prescribed in *fcremap'dB*, performers map physical parameters/playing techniques onto selected visual parameters. However, the performers may decide to either take a "still image parsing" approach (i.e., attending to visual elements within a fixed frame), or "movement detection" one (i.e., only playing when there is a change in the visual field, or a shift in camera perspective). In the former case, playing is triggered when intermittently-appearing elements emerge; in the latter, shifts in physical parameters correlate with shifts in camera perspective—it is the camera that shifting, rather than the performer's visual perception.

5.3 *fclremap*

fclremap operates according to similar principles as the improvisor version of *fcremapercremaflvln*, and is of the same duration. However, rather than reading the video as a score, the clarinetist is provided with six (static) images, which are to be interpreted using the techniques applied in *fcremapercremaflvln* and *fcremap'dB*. In addition, six audio segments of 46-60 seconds in duration (different from those employed in *fcremapercremaflvln*) are to be played in random order, and function as a sort of auditory score, complementing (and perhaps at times interfering with) the graphic score. That is to say: the performer is instructed to attend to one dimension of each audio segment (e.g., register, rhythm/morphology, noise content, relative dynamic, or harmonic density), and allow this dimension to inform or constrain the performer's sound materials. Unlike *fcremap'dB*, the performer does not have the option of ignoring or negating the electronics material entirely.

6. CURRENT AND FUTURE DIRECTIONS

At present, the author is further exploring the use of animated notation, the conversion and interpretation of visual data into sonic material, and notion of an "auditory score" in a new cycle of works entitled *paleoecology*. Rather than taking an artwork as its impetus, this cycle concerns itself with physical models—authentic or otherwise—of vocalizations of very old or extinct species, as well as morphing of behaviors and modes of communication amongst organisms in a changing environment. In the first piece in this series, entitled *paleoecology n/a*, performers attempt to reconstruct a set of vocalizations associated with direct descendants of dinosaurs by interpreting spectrograms of these vocalizations under prescribed harmonic and physical constraints, as well as reacting to processed/distorted recordings of the vocal utterances.

It is expected that the concepts and techniques developed throughout the composition of *fcremap*—signifying a radical departure, in some respects, from the author's previous work—will continue to inform subsequent projects.

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