# Contemporary Electro-acoustic Fusion Enabled by Csound and Cabbage

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**Abstract.** With its vast array of opcodes along with its endless explorative possibilities, Csound is highly conducive to deep creative, algorithmic and sonic discoveries. Through my experiences with Csound during music production, sound design, composition and live performance applications, one such discovery has been the ability to bridge the worlds of computer music and the avant garde with modern jazz fusion and improvisational music. This paper will present the use of Csound as an orchestrational catalyst for production and live performance purposes. It will also showcase a suite of custom plug-ins made with Cabbage to enhance this role of Csound. Lastly, it will examine the design, organization and real-time gestural midi control of these plug-ins within a live performance context.
(124 words target 150 words)

**Keywords:** Csound, Cabbage, Plug-ins, Live-performance

## 1 Introduction

My journey with Csound began by using it as a sound design and digital signal processing tool. By using some incredible models from the Floss Manual and the McCurdy collection, I processed field recording, synthesizers, percussion, vocals etc with techniques such as spectral blurring, stretching, shifting, morphing, digital spectral integration and cross synthesis to name a few. I used these processed sounds in several pieces to create soundscapes, enhance dramatic moments, create tension and release and emphazise lead elements. The powerfully emotive and immersive results that this process yielded, led me to compose my piece *Hope* .

*Hope* has two versions. The first one is a soundscape for the poem *Hope Is The Thing With Feathers* by Emily Dickinson. DSP techniques using Csound models, the Cabbage collection and Puremagnetik Plugins (made with Csound) were used to create an underscore for the poem and support the flow and impact of the composition.

The second version is a modern Jazz-fusion piece. This is an amalgamation of three worlds: 1. An emotional world highlighted by enchanting melodies, explorative harmony and captivating lyrics. 2. An immersive sonic world created

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by the use of DSP techniques in an organic and orchestral way. 3. An exciting improvisational world driven by ever-evolving, reactive and dextrous drum-set, keys and vocal performances. The use of Csound DSP is the glue that brings these worlds together. Some examples of the techniques and ideas used in this piece are as follows:

- The ethereal, atmospheric intro starts with the sound of a vibraphone cross-synthesized, using the pvscross opcode, with the sound of birds chirping. This establishes the connection with the poem's theme, gently invites the listener's attention and texturally foreshadows the production in which the vibraphone is an important supportive element.
- The intro evolves with the addion of texturized drone and vocal layers made with the pvsblur and stretch opcodes along with puremagnetik's Csound-based spectral plugins such as Splitch and Fathoms. This introduces the listener to the harmonic content of the piece but maintains ambiguity and intrigue at the same time.
- The intro concludes with the main keyboard ostinato emerging from the dense drone layers, once again done with cross synthesis. This establishes the feeling of the ostinato being the textural guide for the listener as it is a constant presence across all the evolutions of the piece.
- One of the most important sounds in the piece is a pluck-synth sound. This was made by using Csound's Universal Convolution model to spectrally integrate a wavetable synth sound with the sound of a space ship whooshing past along with the sounds of the buttons in a spaceship. This gives it an evolving texture and motion. Space travel represents the epitome of wondrous exploration so I did this to create the subtle psychological feeling of venturing into the unknown.
- Vocal processing is also extremely important for the piece. I used DSP effects such as pvsblur, spectral delay, Puremagnetik Eidolon and Fathoms plugins etc to enhance, reflect, shadow, foreshadow and texturize various musical moments in the piece. The intuitive and reactionary sense in which the vocals are thrown into these effects creates synergy with the improvisational performance of the piece and its roots in the Jazz idiom.

## 2 Further Exploration

My experience with creating *Hope* inspired me to further explore the possibilites of creatively merging different worlds with Csound as the catalyst. I was also inspired to delve deeper into these DSP techniques. Coming from a live performance, percussion background, I wanted to expand into that context. Moreover, with the amazing real time processing capabilities of Csound's opcodes, especially the phase vocoder opcodes, this seemed like the most fitting next step.

Thus, I made a suite of 6 plug-ins using Cabbage to fullfil this goal. My idea was to create complementary processing tools that worked well in combination with one-another or on their own and helped enhance live performances

in any idiom of music and sound. I then composed and performed various pieces and etudes across different setups such as solo percussion, percussion and voice, modular synthesizer processing etc. These plug-ins were hosted in Ableton Live and MIDI mapped to controllers such as Ableton Push 2, Arturia Keystep and Korg Nano Control. To further amplify the expressiveness of the performance, gestural control of the plug-ins was done usig MiMu gloves and the leap motion controller.

## 3 The Plug-ins

The ability to efficiently create and export vst plug-ins with Cabbage is extremely beneficial in seamlessly integrating Csound into the contemporary DAW-based music creation and performance process. Furthermore the extensiveness and flexibility of the UI design process in Cabbage enables greater possibilites of creative control and expression. After exploring various models in the Cabbage collection, exporting and experimenting with them as plug-ins and using them in my pieces as mentioned above, I was greatly inspired to make my suite of plug-ins with Cabbage. A description of the plug-ins is as follows:

### 3.1 Spectral Effects

This plug-in combines various Csound spectral opcodes such as pvsblur, pvsclale and pvsbufread into one device, allowing the user to scale, stretch, delay, freeze, blur or glitch audio. Some interesting aspects of this plug-in are:

- The ability to combine these different techniques in unique ways. For example, the audio can be spectrally delayed and then blurred, stretched and blurred or scaled, delayed and glitched.
- The freezing aspect is implemented not as a statiic freeze but a dynamic one driven by an LFO that samples and holds between the frozen and unfrozen buffer. This can be synced to the hosts tempo.
- The glitch is implemented by dividing the audio signal to different frequency bands and randomizing the delay times of the pvsbufread opcode for each of them.
- This plug-in harnesses the power of the Csound phase vocoder opcodes to create a wide range of textures ranging from vast ambiences to gritty and glitchy sounds while being relatively easy to use. This makes it a good introduction into spectral DSP techniques for less-experienced users.

### 3.2 Time-based Multi-Fx

This plug-in contains delay, flanger, envelope following filters, bitcrush, ring modulation, waveshaping and reverb effects. Each of these have creative modulation possibilites. For example, the ring modulation can be controlled by an envelope follower as well as an lfo and the bitcrush, sample rate reduction can be modulated by an lfo, resulting in interesting dynamic processing. Additionally, I used

the chnget and chnset opcodes to create a routing system between the effects. The user can use global channels to route in and out of the different effects and create their own custom effect chain, making the plug-in similar to a patchable pedal board.

### 3.3 Drone-maker

This plug-in takes any sound and converts it into a drone. This was made using the flooper opcode to loop a constantly updating sample of the incoming audio, creating evolving wavetables that feed into the poscil opcode. The drone is further enhanced by using multiple instances of the streson opcode to add harmonics. If additional pitch quantization is required, there is the possibility to cross synthesize the resultant drone with a saw wave oscilator. The blend amount of the cross-synthesized signal can be adjusted as well. Additionally, there is independent filtering of each of the drone, saw wave and cross synthesized signals, allowing deep textural control. This plug-in is very useful in creating sound beds during live performance.

### 3.4 Granular-processor

This plug-in creates granular textures using the syncloop opcode. It includes multiple options for the window function of the grains, has controls for density, grainsize, pitch and buffer read rate. There is also the possibilty to freeze the granular signal and randomize the pitch and read-rate at a user-definable frequency.

### 3.5 Rhythm Generator

This plug-in uses the bbcut opcode to generate interesting rhythms from incoming audio. The user is able to control the length of phrases that are produced, the amount of stutter as well as randomized band-pass filtering.

### 3.6 Percussion Trigger

This plug-in converts percussion transients or impulses into MIDI data, allowing enhanced expression during percussion performance as well as the control of the other plug-ins through percussive gestures. The amplitude of the incoming percussion signal can be tracked to generate MIDI notes that play synths or samples. The pitch of the incoming transient can control the octave of the MIDI notes being produced. Furthermore, the amplitude and the pitch of the incoming impulse can be mapped to send out MIDI cc messages. The pitch detection was done using the centroid opcode.

## 4 Pieces Composed for The Plug-in Suite

The process of making these plug-ins inspired me to compose various pieces across different styles of music to explore their creative possibilities during live performance.

### 4.1 Avant Garde Percussion Etudes:

I made a series of avant garde performance etudes, each focusing on one percussional gesture such as scraping, tapping, shaking and water dripping. The idea was to make pieces that featured only a single gesture that would be transformed, morphed and woven into an evolving musical expression using the plug-in suite.

### 4.2 Untapped Impulse:

This piece is a real-time manifestation of Csound's ability to bring the worlds of computer music, the avant garde and more commercial modern jazz music together. This piece was written for percussion and voice and embodies the spirit of discovering and creating something new by being immersed in the moment. The concept of the piece is to use objects present in the performance environment, play them through percussion gestures and process them to create an accompaniment for a vocalist. Both the percussionist and vocalist improvise, while being guided by the processing to find their way to the pre-defined modern jazz fusion end section of the piece. Every time the piece is peformed, the jouney will be differnet depending on the the space and the objects present there, but the destination will be the same. I have made a video recording of this piece that features pots, pans, boxes, paper, cardboard etc that was present in the performance space along with whispers, chants and vocalisations being transformed into drones, textures, glitches as they make their way into tonality and reach the end section. The drone-maker plug-in and percussion trigger help transform the atonal to tonal, the unfamiliar to familiar, while the spectral effects, multi-effects and granular plug-ins create space, texture and tension.

## 5 MIDI Control

These plug-ins were hosted in ableton live, making them very easy to use in live-performance through midi mapping. The above mentioned pieces were performed with the plug-ins being controlled using the Ableton Push 2 and the Korg Nano Control. I also placed piezo sensors around the percussion set-up to capture impulses into the trigger plug-in that in turn enabled further control of the performance. However, to increase the expressiveness and impact of the performance, I subsequently added motion controllers to the setup. I experimented with the Leap Motion Controller as well as MiMu gloves along with their Glover software to control the plug-ins via MIDI. Different gestures such as pointing a finger, making a fist, raising or turning an arm etc. are defined in

Glover and each of them can be mapped to a MIDI CC number. These in turn can be mapped to the various parameters in Ableton Live. This gestural MIDI control was particularly effective in using the spectral processing tools. It also allowed me to play percussion and process at the same time, removing the need to juggle between playing and twisting knobs.

## 6 Live Concert

I performed a live concert at Berklee College of Music in April to showcase this plug-in suite. Pieces across different set-ups were performed, conveying the versatility of these tools.

These included:

- *Untapped Impulse*,
- a duo piece for modular synthesizer and processing with Piotr Garbaczonek,
- A solo piece for drum-set and synthesizers
- *Trapped with Dragons and Dinosaurs* by Dr. Richard Boulanger, a piece for processed percussion and Modular Synthesizer.

Once again, I was able to study, practice and highlight the ability of Csound to bring different worlds together as I used the plug-ins gestures and processing to react, improvise and evolve just like an instrumentalist would in a Jazz performance. For example, Spectral blurring and Granular processing created lush and atmospheric textures during calm moments in the pieces while spectral freezing, glitching along with stuttering and bitcrushing helped increase aggression and grit during more intense or energetic moments.

## 7 Conclusion

The explorative possibilites of Csound, enhanced by the efficiency of Cabbage create many opportunities for exciting new sonic discoveries that these plug-ins and pieces only scratch the surface of. By highlting the use of these techniques and plug-ins, this paper aims to have conveyed how Csound can revolutionize artistic creation like it has done for these pieces and performances.

The future directions for this project would be to add more effects to the plug-in suite, make the existing plug-ins more efficient and also to build a custom motion based MIDI controller for the plug-in suite. Additionally I would like to experiment with the use of these plug-ins across a wider range of musical styles by using them in future performances myself as well as by sharing them with other musicians and sound artists. [1]

## 8 Acknowledgements

These plug-ins were greatly inspired by Ian McCurdy's Models, Victor Lazzarini's *Spectral Music Design* book and the Floss Manual Models.

[1] If accepted, links to the plug-ins, videos and pieces on the author's website will be shared upon final delivery