

Pea Soup (1974; software version 2011)

Nicolas Collins

Instructions for set-up and performance

Pea Soup is a self-stabilizing network that creates architecturally-specific patterns of audio feedback. Left to its own devices a balanced system will generate a sort of “architectural raga”, different in every room. The pitch patterns can be influenced by body movement and performed sound. Originally built from a simple but elegant network of hardware devices (most critically the Countryman model 968 Phase Shifter), the current version employs software written in Max/MSP and compiled to run on any Macintosh, so as to be more easily distributed for performance.

The technical set-up is quite straightforward: three microphones routed through an audio interface into a computer, then back out to three loudspeakers. The required software boots in a state suitable for most performance situations, but contains a large number of variables that can be adjusted – some during soundcheck, others in the course of the performance – to optimize *Pea Soup*'s behavior. This document describes the hardware setup and the details of the software. The technical information is followed by guidelines for performance.

REQUIREMENTS

- *Pea Soup* software (a run-time application built in Max/MSP).
- Macintosh computer running OSX.
- Multi-channel audio interface, minimum 3 input channels with good microphone preamplifiers, and 3 or 4 output channels.
- 3- or 4-channel sound system; matched loudspeakers are not necessary, but feedback demands a strong speakers with wide, smooth frequency response.
- 3 omnidirectional microphones, preferably dynamic rather than condenser (i.e., ElectroVoice 635a, AKG D230, Beyer M58 or M101, Sennheiser MD-42, Audio-Technica AT 8004, Shure SM63 or VP64, Sony F112). **Cardioid or other unidirectional or bi-directional (figure-8) microphones are not suitable.**
- Microphone stands and cabling.
- 1-3 performers with portable acoustic instruments capable of producing sustained tones, such as: clarinet, trombone, double bass, accordion, voice, musical saw, etc.
- A technician to set up the system and control audio and software during performance.

SETUP

AUDIO HARDWARE

Speakers can arranged symmetrically, as is typical for house sound systems (i.e., two on either side of the stage, two more in each rear corner of the hall), or placed in odd locations within the space. Mount microphones in stands at some distance from the speakers. The area between the speakers and microphones is the active performance zone, through which players will move; please bear this in mind when configuring the sound system.

Connect each microphone to one audio input of the digital interface for the computer; if the preamps in the audio interface are not adequate it may be necessary to use additional stand-alone microphone preamplifiers or the direct outputs from microphone channels of a mixer.

Connect each output channel of audio interface to one amplifier channel and speaker, typically through a mixer so that a technician can set the levels during sound check and adjust them during the performance as necessary. You will be using three or four output channels from the interface, depending on the number of discrete channels of amplifiers and speakers that you have available. **It is essential that each audio output from the interface is routed to its own amplifier and speaker, and not be mixed down to fewer channels (i.e., to stereo or mono) or distributed amongst several speakers (i.e., 1 mike split into 2 speakers) -- in *Pea Soup* 1 mike = 1 speaker.**

Connect the audio interface to the Macintosh computer before running the *Pea Soup* software. You may need to install software drivers for the audio interface if it is being used on a computer for the first time – this software comes from the manufacturer of the interface, and is not provided with the *Pea Soup* program.

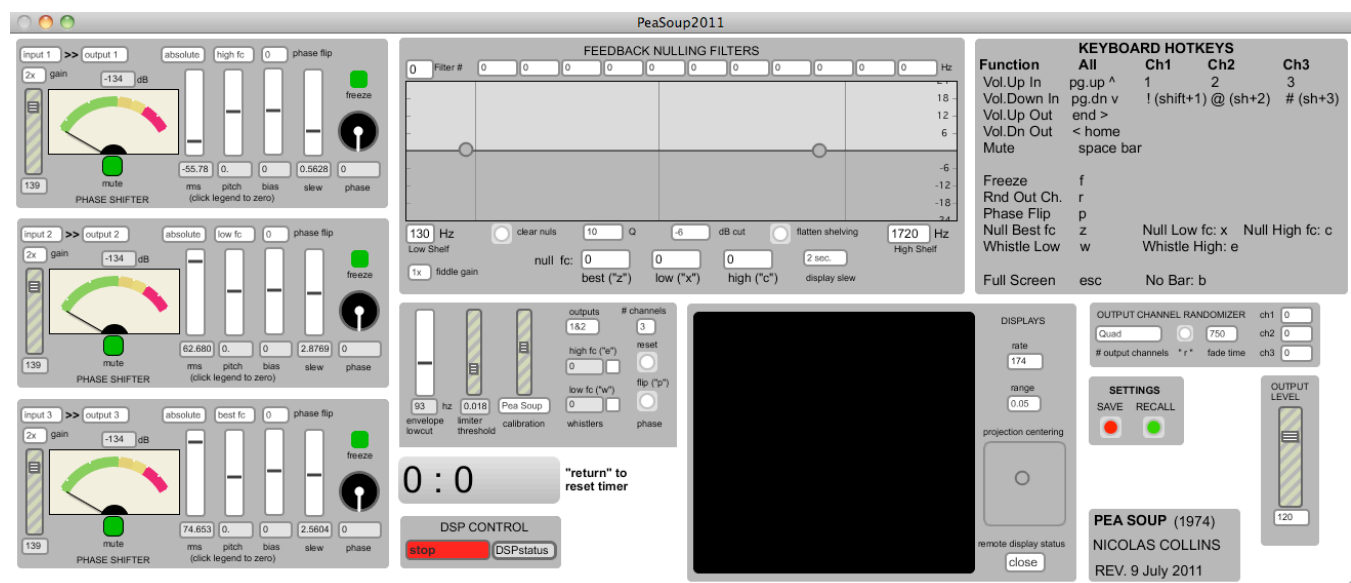
SOFTWARE

The *Pea Soup* program and related documentation can be downloaded from my web site at: <http://www.nicolascollins.com/software.htm>. The “Pea Soup” folder contains a subfolder labeled “Pea Soup Documentation”, as well as one marked “Pea Soup Software”. “Pea Soup Documentation” contains the PDF you are reading, as well as program notes, a short performance score for musicians who prefer not to read all these technical details, and some additional related text files. “Pea Soup Software” contains the run-time Max/MSP application (“PeaSoup2011.app”), along with a file titled “soupsettings.xml”.

The program is ready to run as soon as you download it to your computer, but you may wish to drag the “Pea Soup Software” folder onto your desktop or Application folder for easy access. **The two software files – “PeaSoup2011.app” and “soupsettings.xml” must be kept in the same folder, regardless of where you place it.**

FAMILIARIZING YOURSELF WITH THE SOFTWARE

Boot the program by double-clicking the icon “PeaSoup2011.” **Remember: the audio interface must be connected before starting up the software.** You should see a screen like this:



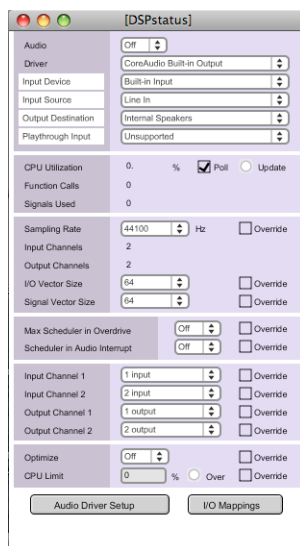
Don't panic! I will walk you through the details....

DSP CONTROL



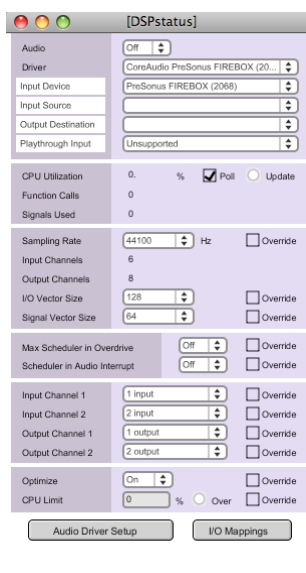
At the bottom of the window, near the center, is a small panel marked **DSP CONTROL**. This is used to specify the settings for the audio interface, and to turn on and off the program.

Double click the button labeled **DSPstatus**. This will open a control panel for system-level audio parameters. When you first boot the software it might look something like this:



The topmost pull-down menu turns on and off the **DSP Audio** engine for the program (which we will do this from another location) and indicates its state. Immediately below it is a menu for selecting the specific audio **Driver**. When you run this program for the first time it might indicate “CoreAudio Built-in Output” as shown here. Beneath the **Driver** menu are additional pull-down menus for **Input Source**, **Output Destination**, etc. If it is necessary to do a stereo (rather than 3- or 4-channel) performance of *Pea Soup* you can adjust these menus to select “CoreAudio Built-in Output”, “Line In” and “Internal Speakers”; then wire directly between the Macintosh’s built-in stereo audio interface and an external mike preamp and sound system. **But it is highly recommended that you use an external multi-channel interface.**

If you have installed correctly the drivers for your external interface the device should show up on the **Driver** pull-down menu, as shown here for a “Presonus Firebox”:



The **Sampling Rate** can be set at 44100 Hz. The **I/O Vector Size** and **Signal Vector Size** should be kept as small as possible to minimize latency. Try setting each to **64**; then increase the size of the **I/O Vector** to **128** or larger if you hear distortion in the audio.

The rest of the settings on this panel are not critical (in my experience), but if the audio performance of your computer seems compromised you might re-open this panel and experiment with various settings.

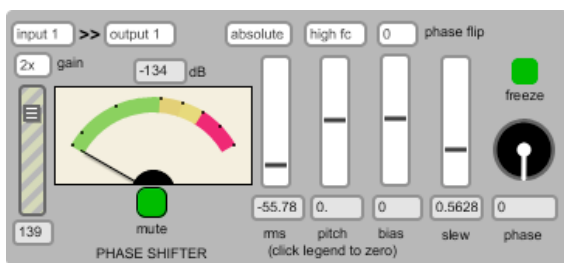
This panel can be left open and hidden behind the main window, or you can close it by clicking the red button in the upper left of the bar, as per usual Macintosh protocol.

Once you have adjusted the interface settings you can return to the **DSP CONTROL** panel in the main patch and use the multi-color left pull-down menu to turn on and off the **DSP**. When the **DSP** is *off* the panel is red and says **STOP**. Normally select **START** (green) to run the software – **you may have to turn the DSP on and off twice to get the program running correctly**. The **START WINDOW** option (yellow) is only relevant if you are running other Max/MSP programs on the same computer at the same time and wish to run *Pea Soup* without starting the other programs.

IF THE COMPUTER MAKES NO SOUND WHATSOEVER IT IS PROBABLY BECAUSE YOU FORGOT TO TURN ON THE DSP.

PHASE SHIFTERS

At the left of the main window are three identical **PHASE SHIFTER** panels:



These panels are responsible for the moment-to-moment behavior of the feedback; each one emulates a *Countryman Phase Shifter*. The primary function of each **PHASE SHIFTER** is to insert a very short, phase-dependent audio delay into the audio path. This delay is controlled by the *loudness* (and optionally the *pitch*) of the audio signal: in emulation of a nervous sound engineer who jerks the mike

away from a speaker after it starts to feed back, this module “moves” the mike in imaginary space in response to the swell of the feedback, thus forcing its pitch to break to another harmonic of the room’s resonant frequencies. **Trimming audio levels and adjusting the response of the loudness detection are the most critical factors in obtaining a pleasing response from this software.**

At the top left of each panel are two pull-down menus for **input** and **output** with which you can link each **PHASE SHIFTER** to an appropriate input and output channel on your audio interface – i.e., to the specific input channels to which you have connected microphones, and to the output channels feeding the house sound system. The program initially boots with **Phase Shifter #1** routing **input 1** to **output 1**, **PHASE SHIFTER #2** routing **input 2** to **output 2**, and **PHASE SHIFTER #3** routing **input 3** to **output 3**, but you can reconfigure this to suit the needs of your interface.

Below the **input** menu are a **gain** pull-down menu and an **input level fader**. These are set, in conjunction with the **OUTPUT LEVEL** (see below), just high enough to allow feedback. The **gain** menu sets an overall boost of the incoming audio (“1x”, “2x”, “3x”, etc.) while the **input level fader** is used to make continuous adjustments. Beneath the fader is a numeric readout of its precise setting. Optimum performance is usually obtained when this fader is set in the range of 100–130, so the **gain** and the settings on the external audio devices (preamps, interface, mixer, amplifiers, etc.) should be adjusted for moderate feedback at these levels.

To the right of the **input level fader** is a **meter** and numeric readout of the **dB level**. The meter may show only minimal movement during feedback, but the meter and readout can help you align the levels of the three channels during soundcheck.

Below the meter is a **mute** button: clicking it **mutes** the audio running through that channel, and the button turns *red*; click again to toggle off the **mute** and return the button to *green*.

To the right of the **meter** are several controls for adjusting the response of the *Phase Delay*. The first fader adjusts the sensitivity of the Phase Delay response to the **loudness** envelope. At the center point on the fader's travel loudness has no effect (and the numeric display below it read "0"); raising the fader cause the delay to *increase* as the loudness of the feedback increases, while lowering the fader below the center point causes the delay to *decrease* with increasing volume. The menu above the fader sets the **response** characteristics of the loudness envelope detection circuit to either "absolute" or "rms" level measurement; this is usually not a critical factor in the response of the system, but you may develop a preference for one curve or another.

The next fader to the right similarly maps the **pitch** of the feedback to a control signal for changing the Phase Delay. In the original analog version of *Pea Soup* the only control of the delay was derived from **loudness**, via an "envelope follower" circuit built into the Countryman Phase Shifter; the **pitch** follower is a recent software addition. I normally leave the **pitch** follower in the center-zero position, but adding a little can help when the feedback tends to lock up on a small number of pitches. The menu above the fader selects which **voice** of a polyphonic pitch tracking algorithm is applied to this control fader: in the event of more than one feedback pitch occurring at the same time, the channel can be set to respond to the *higher* pitch ("high fc"), *lower* pitch ("low fc"), the *loudest* pitch ("best fc"), or none ("off").

The third fader sets the Phase Delay **bias** – the default amount of Phase Delay to which the **loudness** and / or **pitch** envelopes are added or subtracted in amounts set by faders described above. Clicking the number box above this fader **flips** the overall **phase** of the channel by 180 degrees (as indicated by the number in the box) -- an easy way to get rid of a persistent pitch of feedback.

The fourth fader, labeled **slew**, adjusts the response time of the Phase Delay changes. At fast settings the feedback acquires a burbling sound, while increasing the **slew** by raising the fader slows down the system to a more languid pace.

Clicking the label below each number box returns its fader to a **zero** value.

The rotary knob at the extreme right of the panel, with the numeric readout below, indicates the current amount of Phase Delay, in degrees of **phase**. Clicking the green button above it **freezes** the Phase Delay at its current settings (and turns the button red); clicking it again toggles off the **freeze**. The **freeze** control can be used to sustain the currently sounding feedback pitches.

The three panels represent three independent audio paths through the software and hardware; the settings on one **PHASE SHIFTER** have no effect on any other one.

The software settings most commonly adjusted during soundcheck and performance have been mapped to specific keys on the Macintosh keyboard, to facilitate making changes without having to look closely at the screen. These are summarized in the **KEYBOARD HOTKEYS** panel in the upper right of the main panel (see below), but the ones that are relevant to the **PHASE SHIFTER** panels are as follows:

- “Page ^” (“page up”) *increases* all **input level** faders by 1dB. “1” increases the **input level** of **PHASE SHIFTER 1** by 1dB. “2” increases the **input level** of **PHASE SHIFTER 2** by 1dB. “3” increases the **input level** of **PHASE SHIFTER 3** by 1dB.
- “Page v” (“page down”) *decreases* all **input level** faders by 1dB. “!” (“shift” + “1”) decreases the **input level** of **PHASE SHIFTER 1** by 1dB. “@” (“shift” + “2”) decreases the **input level** of **PHASE SHIFTER 2** by 1dB. “#” (“shift” + “3”) decreases the **input level** of **PHASE SHIFTER 3** by 1dB.
- The “space bar” toggles on/off the **mute** function for *all* channels (useful for silencing feedback without changing any audio settings).
- “f” (lower case) toggles on/off the **freeze** function for all channels.
- “p” (lower case) toggles the **phase flip** 0°/180° for one randomly selected channel each time you hit the key.

Nudging levels up or down by small increments can help keep the system in balance or introduce gradual changes in its response.

The default settings in the program are good starting points for *Pea Soup*, but it is well worth spending some time experimenting with the different settings on the **PHASE SHIFTER** panels.

OUTPUT LEVEL

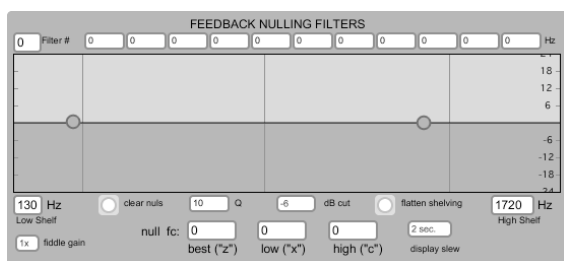


This fader, at the lower right side of the main panel, adjusts the **OUTPUT LEVEL** of all **PHASE SHIFTER** channels. Its value is indicated numerically in the box below the fader, and – as with the **input level faders** – a good range of settings is **100-130**. Although it may seem counterintuitive to anyone but David Tudor, shifting the balance of gain between the **input** and **output level** controls (i.e., raising one while lowering the other) can significantly alter the response of the system. If the performer/technician does not have access to a mixer between the computer and the house sound system, this **OUTPUT LEVEL** fader is the simplest way to fade in and out the feedback at the beginning and end of the performance.

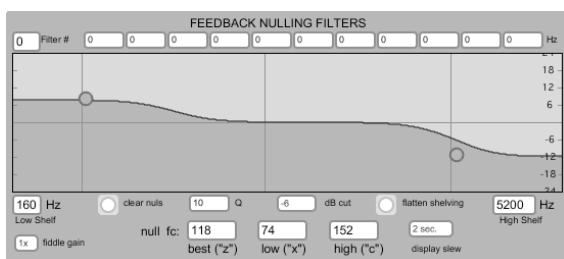
Hotkeys are mapped to the **OUTPUT LEVEL** fader: “end >” *increases* the level by 1dB; “< home” *decreases* the level by 1dB. As with the **PHASE SHIFTER** hotkeys, a little nudging can help steer the system back on track or subtly shift its behavior.

FEEDBACK NULLING FILTERS

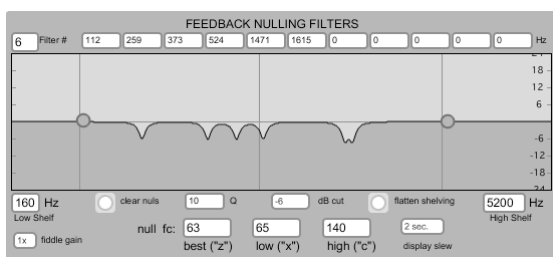
In the old analog days (1974) I relied upon the simple EQ available on amplifiers or mixers for adjusting the overall tonal balance of *Pea Soup*’s feedback: turning back the treble to avoid strident piercing, increasing the bass to bring in more low pitches. If I was lucky enough to have a graphic equalizer at hand I could try, by ear, to locate and dip specific pitches that were monopolizing the feedback. While I miss certain charms of the old analog circuits, the software environment has considerably expanded the equalization tools at my disposal.



The horizontal band across the **FEEDBACK NULLINGS FILTERS** panel displays the frequency spectrum of two types of EQ. First, with the mouse one can move the two **open circles** up/down and left/right to adjust the boost/cut and corner frequencies of high and low shelving equalization, and in this way shift the overall frequency response of the feedback to favor high or low pitches.



This picture shows the bass response boosted, and the highs rolled off. The number boxes under either end of the graphic display indicate the corner **frequency** of each filter, while the amount of boost and cut are referenced to the dB scale at the right end of the display. The shelving EQ can be reset to flat by clicking the button marked **flatten shelving**.



The second EQ system consists of eleven **notch filters** and a pitch following algorithm. If a particular frequency of feedback is locking up or otherwise dominating the sound texture, a notch filters can be triggered to find, dip and null that frequency. This form of adaptive equalization can either be used as part of the *tuning* of the basic system during sound check or the beginning of the

performance, as a way of maximizing the number of available pitches; or filters can be triggered over the course of the entire performance as a way to subtly shift the harmonic balance as the piece progresses.

Number boxes along the bottom of the panel indicate the **high**, **low**, and **best** (loudest) pitch detected by the pitch follower; pressing the "c" (lower case), "x" (lower case), and "z" (lower case) hotkeys use the respective data to locate and **null** that fc (frequency). The **frequency** of each filter is indicated in a number box along the top of the display, while the **number of filters** active is displayed in a box at the upper left.

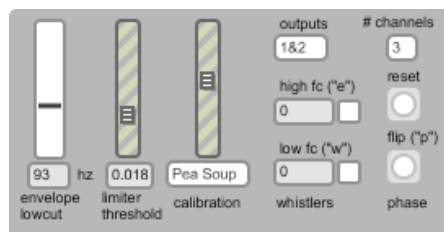
Immediately below the filter graph are number boxes that can be adjusted (by a click and drag of the mouse) to set the **Q** (or sharpness) of each filter, as well as the severity of the **cut**, displayed in **dB** -- you should not need to change these, but feel free to experiment. Pressing the **clear nulls** button returns all the notch filters to a flat response and resets the filter counter to zero.

The **display slew** box at the lower right adjusts the speed of the response of the pitch tracking. At the lower left is a number box to adjust **fiddle gain**, the level of the signal feeding the pitch tracker; this only needs to be changed if for some reason your feedback is so quiet as to not appear in the pitch display boxes on this panel, in which case you can boost it here for control purposes without affecting the audible feedback.

Although there is only a single panel for the FEEDBACK NULLING FILTERS, its controls and displays apply to all three channels of audio.

In my experience when the audio levels of *Pea Soup* are well balanced there is relatively little need for “drastic equalization”. A slight cut of the extreme high frequencies prevents the feedback from getting irritatingly shrill (although this can often be accomplished by equalization on the mixer for the sound system as well.). Sometimes **nulling** a recurring or dominating frequency will open up the sound field to new pitches, and introduce something akin to harmonic motion. But as a matter of course this panel is best used sparingly.

GENERAL SETTINGS & WHISTLER



This panel, below the **FEEDBACK NULLING FILTERS**, controls some general settings for all three **PHASE SHIFTER** modules, some soundcheck tools, and a pitch-following **whistler**. The leftmost fader adjusts the cut-off frequency of a **lowcut** filter at the input of the **envelope follower** that drives each **PHASE SHIFTER**'s delay time. Excessive low frequency sound (even when inaudible) can induce jitters in

the envelope, which is reflected in a tremulous quality in the feedback. **This often happens when one uses condenser microphones instead of dynamic ones**, which is one reason why I prefer dynamic microphones for this piece. This fader should not need adjusting.

The secret of smooth sinusoidal feedback is a good **limiter**. Each **PHASE SHIFTER** module has one, and the limiting **threshold** for all three is controlled with the second fader from the left on this panel. Raising the **threshold** will raise the overall level of the feedback, to the point that it may start to distort; conversely, lowering the **threshold** can reduce the feedback to a whisper-soft level. Aside from experiments of this sort, this fader should not need adjusting.

The third fader and the pull-down menu below it can assist in **calibration** of the sound system. In the default position this menu indicates that the “Pea Soup” audio is feeding the output channels of the computer. The “Calibrate” position on the menu selects a bank of sine wave test tones that are sent to all output channels at the level set by the **calibration fader**. This is a convenient tool for matching the levels of the three **PHASE SHIFTER** inputs and the balancing the three/ four channels of house sound system. Usually the calibration mode will not be necessary to align the system, but if you use it **always return the pull-down menu to the “Pea Soup” position when you have finished calibration**.

The **whistler** consists a pair of sine wave oscillators that track the pitch of the feedback. Using hotkeys and the mouse you can mix the oscillators in with the feedback and detune them to produce beating patterns with the feedback. The two number boxes above the legend “**whistlers**” indicate the current high and low frequencies of feedback: pressing the “w” key will tune the oscillators to the **lower** of the feedback pitches, hold that pitch, and fade them in gently; the “e” key tracks and holds the **higher** pitch instead; the square to the right of each frequency display indicates an “x” when that pitch is locked in. The *vertical* position of the cursor on your computer screen (as controlled by a mouse, trackpad, etc.) adjusts the **loudness** of the whistling sine waves: higher = louder. The *horizontal* position adjusts the **tuning**: when the cursor is fully to the *left* of the screen the two sine wave are in perfect unison with the locked pitch; as you drag the cursor to the right one oscillator is detuned *above* the original pitch, while the other one is detuned *below* it; the detuning increases as you move further right. Each oscillator goes to one output channel of the computer; the pull-down menu above the frequency displays sets which pair of output channels is used.

The **whistler** is a useful performance instrument, if used sparingly, especially when there is no player of an acoustic instrument available. At low volumes the whistle itself is almost inaudible, and is heard primarily in its effect on the feedback as you detune the oscillators to create beating patterns. Sometimes this beating will “cancel” a feedback pitch, or induce a new pitch to emerge. Toots Thielman on tap, a portable Ilsa Werner.

The last column of controls in this panel affects the **phase flip** function in the **PHASE SHIFTER** modules. As described in the **PHASE SHIFTER** section (above), hitting a lower case “p” on the keyboard will flip the phase between 0° and 180° in one randomly selected module; clicking the lower button in this panel, marked **flip**, will do the same. The button above it, **reset**, will reset the phase on all three **PHASE SHIFTERs** to 0°. The # **channels** pull-down menu selects whether you are using all three channels of **PHASE SHIFTER** modules (i.e., for the typical multi-channel performance), or presenting a reduced stereo version of the piece, in which case only **PHASE SHIFTER #1** and **#2** are active—this affects the **phase flip** randomization routine.

OUTPUT CHANNEL RANDOMIZER



Use this module to specify the number of channels of amplification available in the hall, and randomly re-assign **PHASE SHIFTER** outputs to the available channels. The pull-down menu at the left selects the **number of output**

channels: “stereo” (2), “3 Channels”, or “Quad” (4).

If only *stereo* amplification is available in the hall you will use only **PHASE SHIFTER 1** and **PHASE SHIFTER 2**. When you select “stereo” with this menu the outputs of those two modules will be routed to the *left* and *right stereo outputs* of your Macintosh, or outputs 1 and 2 of an external hardware interface. **For a stereo performance the input and output menus on the PHASE SHIFTER modules must be set to channels 1 and 2 only.**

If *three* channels of amplification are available you will use all three **PHASE SHIFTERs**. Set any combination of **input** and **output** channels 1-3 on the **PHASE SHIFTER** modules.

If *four* channels of amplification (*quad*) are available you will use all three **PHASE SHIFTERs**. Set any combination of **input** and **output** channels 1-4 on the **PHASE SHIFTER** modules.

Clicking the button to the right of the **output channels** menu, or hitting the lower case “r” hotkey, randomly re-assigns the outputs of the three **PHASE SHIFTER** modules amongst the 2, 3 or 4 available output channels of your audio interface hardware. The **fade time** pull-down menu adjusts the cross fade of the channel swaps (in msec), and the number boxes at the right edge of the panel indicate which **PHASE SHIFTER** is assigned to which output.

As you will discover when you set up and practice *Pea Soup*, the relative location of each mike and its speaker affects the pitches of feedback it produces. Re-routing a mike to a different speaker changes the available pitch set. A mid-performance tap of the “r” key can modulate the feedback into a new harmonic region.

SETTINGS



The software boots with all variables set to useful, generally applicable values. Once you have adjusted the settings to suit your specific needs, click the red **SAVE** button. When you exit the program this information will be saved in a file titled "soupsettings.xml" (the first time you try this you might be prompted to specify the file name and/or location.) The next time you run the *Pea Soup* software it will boot with the default values, but clicking the green **RECALL** button should retrieve your **SAVED** settings. You can **SAVE** and **RECALL** repeatedly, but the xml file will only hold the most recently saved settings. **IT IS ESSENTIAL THAT "PEASOUP2011.APP" SOFTWARE AND THE "SOUPSETTINGS.XML" FILE ARE IN THE SAME FOLDER ON YOUR COMPUTER, OTHERWISE THE PROGRAM CANNOT RETRIEVE THE SAVED SETTINGS.**

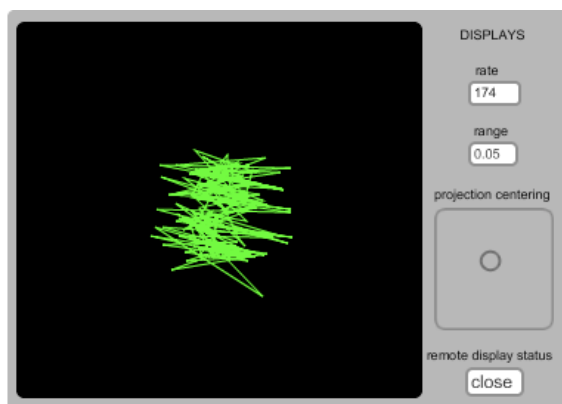
TIMER

24 : 53

"return" to
reset timer

This is a simple indicator of elapsed time, useful for knowing how long the performance has been going on. Hit the computer's "carriage return" to reset and restart the **TIMER**.

DISPLAYS



This utterly gratuitous panel displays the phase relationship between the output of **PHASE SHIFTERS** 1 and 2. The feedback strands form Lissajous patterns. The size and shape of the image are affected by the **rate** and **range** pull-down menus. You have the option of projecting this Fillmoresque image on an external screen. Connect the video output of your computer to an appropriate projector or large monitor. Make sure "mirroring" is off on your computer. Use the **remote display status** pull-down menu to **open** the external display panel; drag it into the center of the remote display area. Hitting

the "escape" ("esc") key toggles the remote display between *full screen* and *small* format. "Close" shuts down the remote display. When in full screen mode, your mouse/trackpad on the circle in the **projection centering** control can move the Lissajous image into an appropriate location. Not an essential component of a *Pea Soup* performance, but occasionally entertaining.

KEYBOARD HOTKEYS

KEYBOARD HOTKEYS				
Function	All	Ch1	Ch2	Ch3
Vol.Up In	pg.up ^	1	2	3
Vol.Down In	pg.dn v	!	@	#
Vol.Up Out	end >	!	@	#
Vol.Dn Out	< home			
Mute	space bar			
Freeze	f			
Rnd Out Ch.	r			
Phase Flip	p			
Null Best fc	z	Null Low fc: x	Null High fc: c	
Whistle Low	w	Whistle High: e		
Full Screen	esc	No Bar: b		

An on-screen summary of the Macintosh keyboard **HOTKEYS** mapped to various controls in the *Pea Soup* software (and described in the relevant paragraphs above.)

PRACTICING & PERFORMING PEA SOUP

Boot the program (connect the audio interface first!). **Mute** all the **PHASE SHIFTER** channels but #1; adjust its **input** and **output gain** and **levels**, and the sound system settings, until you hear feedback. Experiment with the various controls on the **PHASE SHIFTER** module (see above) until it begins to create simple patterns from the feedback. **Mute** Channel 1 and repeat this process for Channels 2 and 3, one at a time. In the case of otherwise inexplicable distortion turn the **DSP Control** off and on again.

Once each module has been “tuned” lower the **output level** slightly and un-**mute** all the channels so they are all sounding. The multiple channels of feedback should interact to create more complex patterns. Trim the levels to balance the three voices as needed. Adjust the **Low** and **High shelving EQ** if necessary to contour the overall pitch range of the feedback.

The feedback should create short melodic sequences that drift over time. These patterns can be influenced by moving in the space between the speakers and microphones, or by producing pitched sound harmonically related to the feedback.

Ideally, once the software and audio system have been “tuned” there should be little need for further *electronic* performance, aside from the occasional **nulling** of a strident pitch. The performance should focus on the *acoustic* interaction of the feedback with sounds and movement of the players. Thus, whenever possible the system should be adjusted to optimum condition during soundcheck; the first few minutes of the performance can be used to tweak these settings in response to the inevitable changes in hall acoustics that accompany the entrance of an audience. A visual signal from the software-wrangler can then cue the performers to begin.

Pea Soup should end with a slow fade of the **output level** to the point that feedback is no longer taking place, then the fade can be faster until fully off. Performers should be cued to stop playing and moving before the fadeout begins.

PERFORMER INSTRUCTIONS

Pea Soup will respond to played or sung pitches, as well as to body movement within the space. Localized sources of heat or cold -- such as candles or kerosene lamps -- can be used to create movable acoustic lenses as well. All actions should be followed by pauses in which their effect on the feedback is evaluated. Since some of the feedback patterns have a long cycle (especially in reverberant spaces), pauses should be proportionally long.

Each instrumentalist should remain tacit at least 50% of the time if playing solo, 66% of the time in a duo, 75% in a trio, etc. Start with a very simple “probing” of the acoustics by long tones with long attacks. Play harmonically related pitches initially; detune to induce beating patterns. As the performance progresses you may increase the complexity of playing. Every five minutes or so walk slowly to a new location in the space; pause every few steps for the feedback to stabilize. Do not play while moving. If two or more instrumentalists: do not play at the same time until the last third of the performance.

Performers should wait for a signal from the technician that the system is fully “tuned” before beginning, and should not play or move during the fade out at the end.

The performance may be of any duration, preferably in the range of 8-30 minutes.