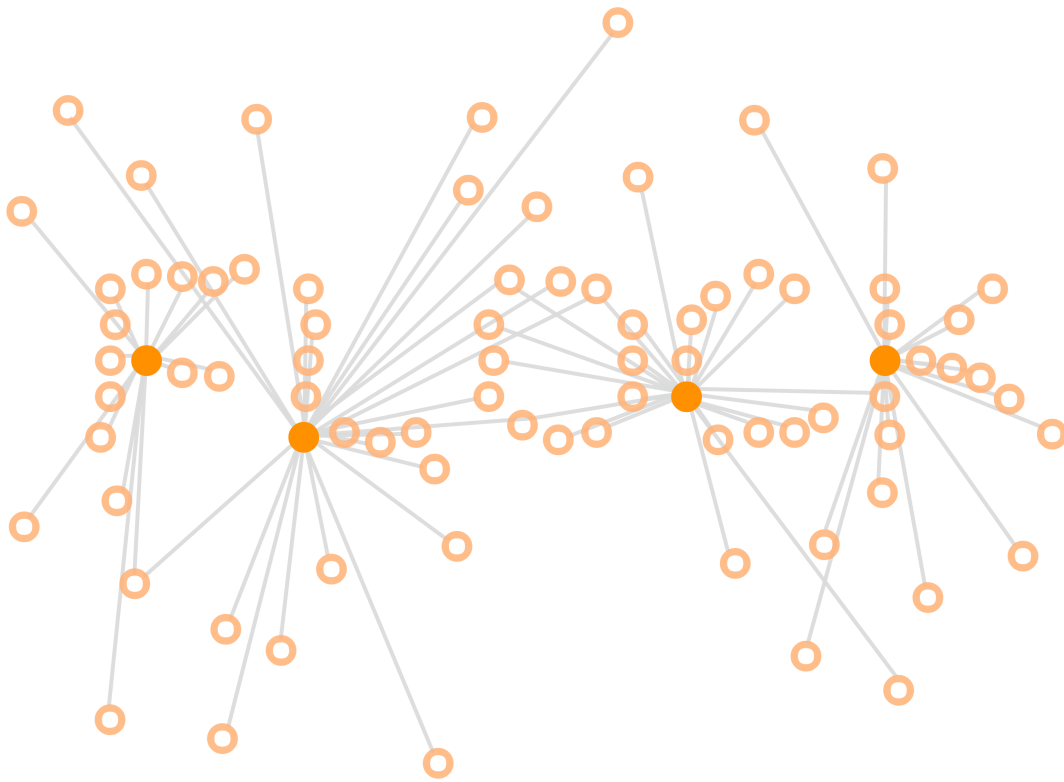




**for saxophone quartet,
video,
electronic sound,
and audience participation**

Score (San Jose version)

Flock (2007)

for saxophone quartet, video, electronic sound, and audience participation

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Special Thanks To

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1 About the Piece

Flock is a full evening performance work for saxophone quartet, conceived to directly engage audiences in the composition of music by physically bringing them out of their seats and enfoldng them into the creative process. During the performance, the four musicians and up to one hundred audience members move freely around the performance space. A computer vision system determines the locations of the audience members and musicians, and it uses that data to generate performance instructions for the saxophonists, who view them on wireless handheld displays mounted on their instruments. The data also drives the real-time generation of a multi-screen video animation and an electronic soundtrack.

1.1 Duration

Approximately 60 minutes.

1.2 Performance Personnel

Four saxophonists (soprano, alto, tenor, and baritone).

Four facilitators to lead the audience's participation in the piece and be featured in their own "solo" section with the saxophone quartet. These facilitators may have training in music, dance, or theater but this is not required.

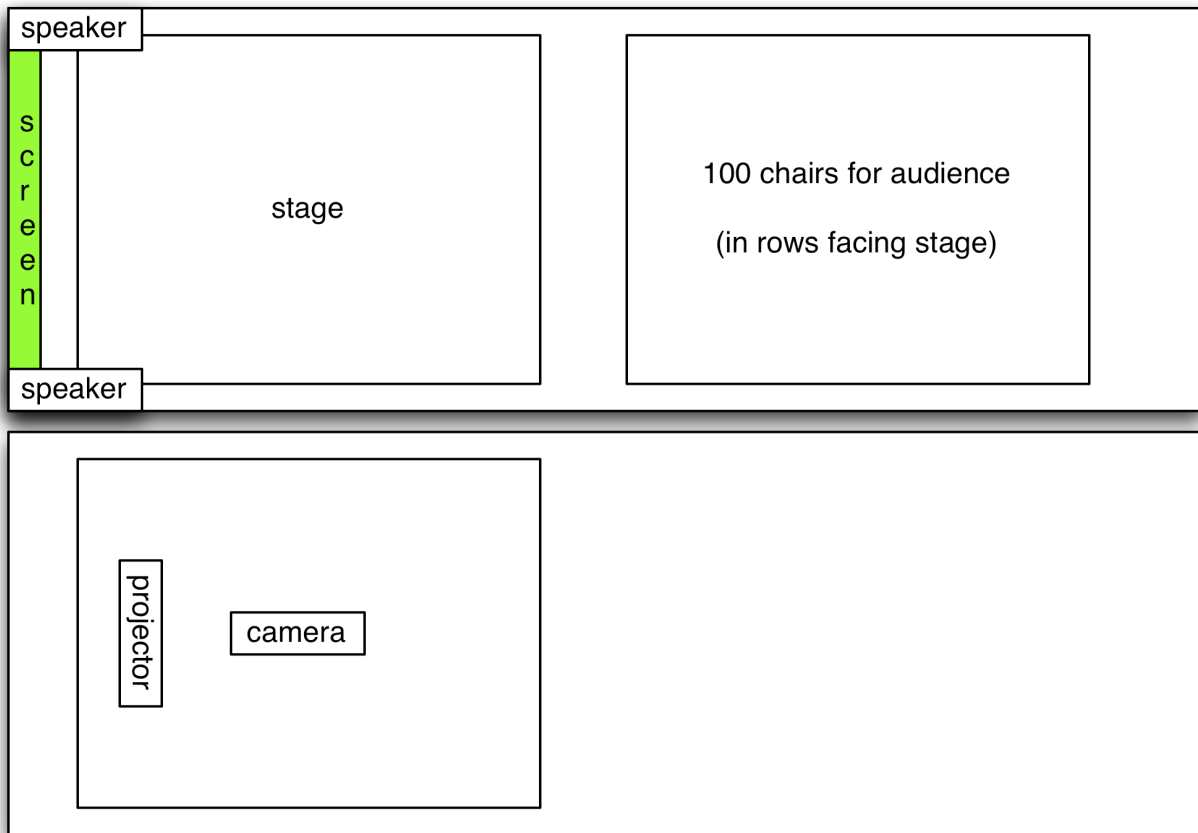
Two or three personnel to oversee the computer vision system, notation system, and audio and video generation.

Minimal stage, house, lighting, and sound crew.

2 Technical Setup

Flock is performed in an indoor venue with flexible layout such as a blackbox theater, an art gallery, or the stage of a large concert venue (with audience and performers all on stage). There cannot be any natural light in the space. Minimum dimensions are 30x30 feet. We must be able to mount equipment — cameras, projectors, network routers, and cabling — on the ceiling.

2.1 Venue Layout



These diagrams show layout specific to the MACLA space in San Jose (20 x 60 feet). Other venues may vary. The upper diagram shows space layout. The lower diagram shows the items that must be ceiling-mounted.

2.2 Audio Setup

The audio system is used to create electronic sound in response to position data during several sections of *Flock*.

2.2.1 Equipment

- 1 audio mixer (digital or analog).
- 2 powered PA speakers.
- 1 wireless mic
- 1 audio computer (Mac mini) running Max/MSP.
- 1 Firewire audio interface.
- Balanced audio cabling for all above.

2.2.2 Setup

The speakers should be wall-mounted or placed on stands.

All remaining audio equipment, except for mics, is in the control area.

2.3 Video System

The video system projects animation generated in real time from position data.

2.3.1 Equipment

- 1 ceiling-mounted projector
- 1 large projection screen (or alternately, scrim or bare wall to project onto).
- 1 VGA distribution amplifier.
- VGA cabling for projectors to reach back to control room.
- 1 video computer (Mac mini) running Max/Jitter.

2.3.2 Setup

The video computer sends VGA signal out through the VGA amplifier to the projector. The projector is ceiling mounted. The projection screen should be high enough so that the video images are not blocked when people walk past the screen.

2.4 Vision System

The vision system generates positioning data that describes the location of audience members and performers within the space.

2.4.1 Equipment

- 1 Imaging Source DFK 21AF04 ¼" CCD Firewire cameras.
- 1 Fujinon YV2.2X1.4A-2 1/3" CS-Mount 1.4-3.1mm F1.4 lenses
- 1 Panavise CCTV Mounts 883-03
- 4+ GWC FW-106 6 Port IEEE 1394 FireWire Repeater Hubs
- 4+ 15-foot Firewire cables
- 4 musician identification hats
- 100+ audience identification hats

1 vision computer (Mac laptop) running Max/Jitter

2.4.2 Setup

The camera is attached, using the Panavise mount, to the ceiling of the performance space, in the center of the room. Camera angle, zoom, focus, and iris must be manually configured once the camera is installed.

The camera draws power from a single AC-powered firewire hub/repeater that is located next to the cameras on the ceiling. That hub is connected to additional, unpowered hubs at intervals of 15 feet to reach the video computer in the control room. On some Mac laptops, the hub that plugs directly into the laptop may need to be powered as well.

Each musician wears a plain, black baseball cap with a lighted tracking ball velcro-mounted on top of the hat. The ball is simply a hollow, white plastic softball with 5 super-bright LEDs inside, attached to a 9V battery. Soprano wears red, alto wears yellow, tenor wears green, and baritone wears blue.

Each audience member wears a baseball hat with a white tracking hemisphere mounted to the top. The hemisphere consists of an Ontel LED “Stick and Click” tap light, enclosed by a half (hemisphere) hollow, white, plastic softball. Everything is attached with Velcro.

2.5 Network Setup

The network facilitates communication between the vision, audio, video, and notation/control systems.

2.5.1 Routers and Placement

1+ wireless 802.11b/g network routers connect all the computers to each other and to the musicians’ PDAs. While any router capable of running DD-WRT firmware is acceptable, we have been using the Linksys WRT54G (with the optional high-gain antenna) and the Buffalo WHR-HP-G54 (which has excellent range with the built-in antenna).

One router is placed in the control room, and the four computers (audio, video, vision, and control/notation) are physically connected to it (an external switch may be necessary). The second router (if necessary) is mounted on the ceiling towards the opposite end of the space from the control room (near the cameras). In larger spaces, additional routers may be necessary.

The control room router is the *master router*. The remaining router(s) act as repeaters and are linked to the master router. Preferably, they are linked via physical Ethernet cables (connected to one port of the switch on each end, never to the “WAN” port of any router). In a pinch, they can be bridged wirelessly via WDS (LAN mode) but this impacts available bandwidth and latency.

Routers use standard WEP (shared) encryption with a 10-digit HEX key. See the cvs server for the key.

Router ssids are all named “flock”. Internal router reference names are “flock1” (master), “flock2”, “flock3”, etc. All routers are fixed to wireless channel 9.

Router settings and firmware are stored in settings backup files on the CVS server.

2.5.2 Static IP Assignments

There is no DHCP server running. You must manually assign IP addresses to each machine. Subnet is always 255.255.255.0 and Default Gateway is 192.168.0.1. Here are the IPs:

192.168.0.100	control/notation computer
192.168.0.101	audio computer
192.168.0.102	video computer
192.168.0.103	vision computer
192.168.0.200	soprano PDA
192.168.0.201	alto PDA
192.168.0.202	tenor PDA
192.168.0.203	baritone PDA

Router IP addresses are hard-coded as follows:

192.168.0.1	flock1
192.168.0.2	flock2
192.168.0.3	flock3
etc.	

2.5.3 Reserved Ports

The following TCP ports are reserved for Flock:

6665	position data from vision to control [strings]
6666/6667	notation data from control to PDAs [bytes]
6668	timing data from PDAs to control [strings]
57110	data from control to audio (except for covey) [OSC]
57111	data from control to video [OSC]
57112	data from control to audio (covey only) [OSC]
57113	reserved port (dummy port for OSC return)

The protocols are documented mostly through Java source code. The video protocols are documented through the jitterOsc.txt file in cvs.

2.6 PDA Setup

Each musician views music notation on a PDA attached to his or her saxophone. The PDAs are connected wirelessly, over 802.11, to the control/notation computer, from which they receive notation data and time sync messages.

2.6.1 Software Environment

Windows Mobile 2003 or later.

IBM Websphere Everywhere Micro Environment (WEME) 6.1 or later. (This Java virtual machine supports Personal Profile 1.1, a nearly complete implementation of J2SE 1.3.1.)
Standard Widget Toolkit (SWT) Java Libraries for PocketPC
Our custom Java software (FlockPocket.jar) and JNI library (FlockJNI.dll).

Windows Mobile must be configured so that the PDA never goes to sleep and the display backlighting never dims.

2.6.2 Hardware Environment

4 HP iPAQ 5450 or equivalent PDAs. Relevant specs:

- 320x240 resolution.
- 400 Mhz+ processor.
- 802.11b WiFi.
- Backlit display.
- 64+ MB RAM.
- 2 hours+ battery life with full backlighting and WiFi. We use the BPA-111H high-capacity batteries for the HP 5450 to achieve this.

The PocketPCs are attached to standard-issue marching-band flip folders using Velcro. The flip folders are mounted on each saxophone using a standard lyre.



2.6.3 Installation Procedure

A backup image of the PocketPC install is available on our CVS server (under the FlockPocket project). To restore the image to a device, simply attach its dock to a Windows machine and use the restore command in Microsoft ActiveSync.

For installation from scratch, refer to the document in cvs (FlockPocket project).

For smaller updates (such as a new FlockPocket.jar file), use a standard FTP client to connect to the PocketPC. Noisette's Share-it FTP server is installed on each PocketPC.

To set up the IP address of a PocketPC, open Network Settings->Advanced->Network Card->Network Adapters->iPAQ USB Wireless Adapter.

2.7 Control Area Setup

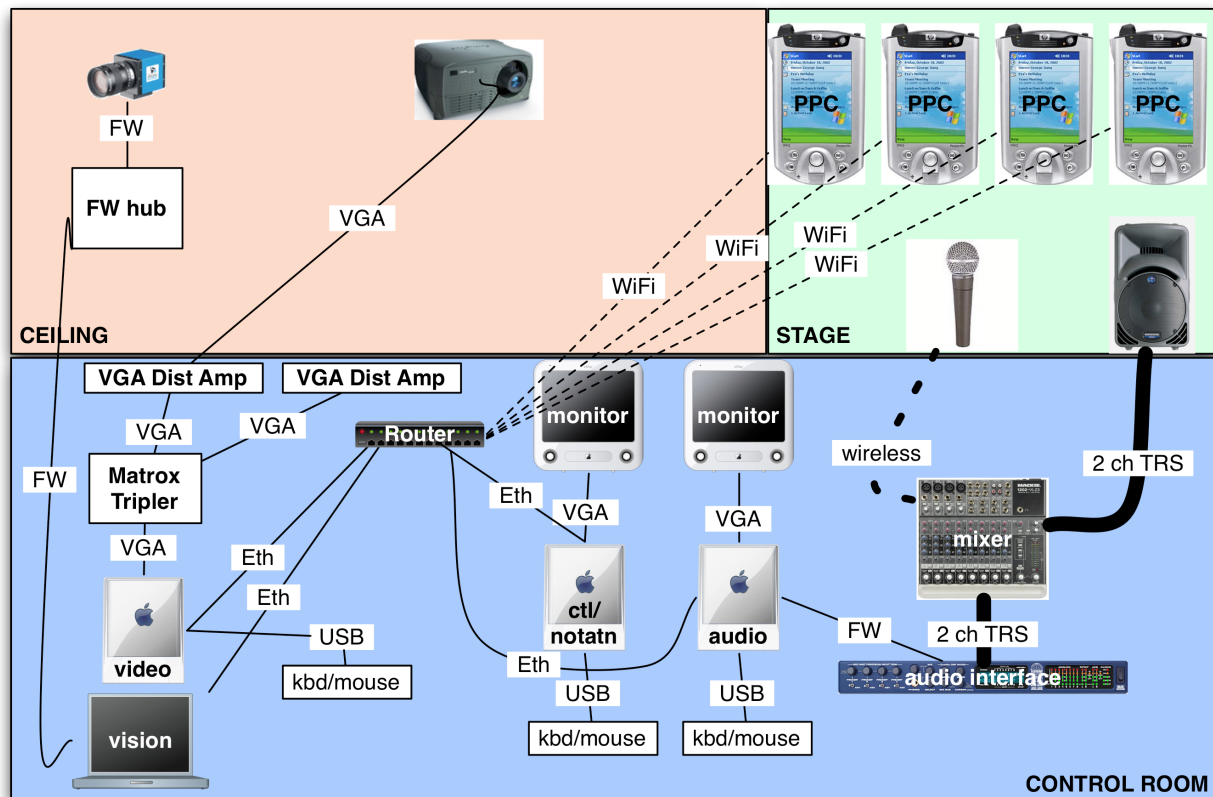
The control area is just to the side of the stage area and contains all computers and ancillary equipment from which we can control and monitor software systems throughout the show.

2.7.1 Equipment

Some of this equipment is already listed above in other sections.

- 1 audio mixer (digital or analog) with 12+ inputs and 8+ outputs.
- 8+ channel Firewire audio interface.
- 1 VGA distribution amplifier.
- 1 vision computer (Mac laptop) running Max/Jitter.
- 1 video computer (Mac mini) running Max/Jitter.
- 1 audio computer (Mac mini) running Max/MSP.
- 1 control computer (Mac mini) running Java software.
- 1 802.11b/g network router/switch.
- 3+ external keyboard/mouse.
- 3 external monitors (minimum resolution 1280x1024).
- 4 battery chargers for PDAs.
- 1 PDA USB dock.
- 2 tables for equipment.
- 3+ chairs.
- VGA, audio, and firewire cabling.

2.8 Wiring Diagram



2.9 Lighting Setup

We need a consistent level of white, diffuse light to cover the entire performance space for the duration of the performance. The lighting needs to be bright enough that audience members can safely walk around, but dim enough so that the video projections can easily be seen. Please: no colored gels, no spots, no fluorescent tube lights, and *no changes to lighting during the performance*. This will confuse the computer vision system.

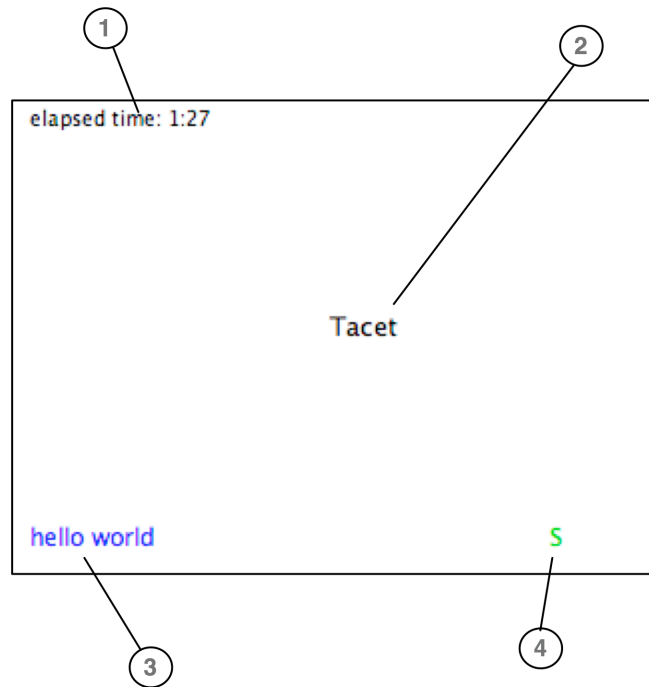
3 Saxophonists

3.1 Music Notation

Music notation is generated by computer software in real time, based on the positions of the musicians, facilitators, and/or audience members. Saxophonists view it on wireless, battery-operated PDA displays mounted to their instruments.

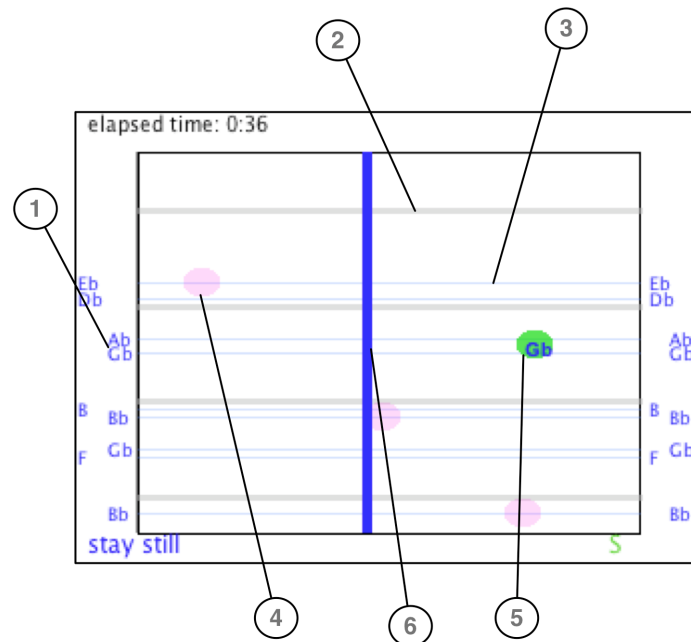
All notation is displayed in the written range of each instrument.

3.1.1 Notation Basics



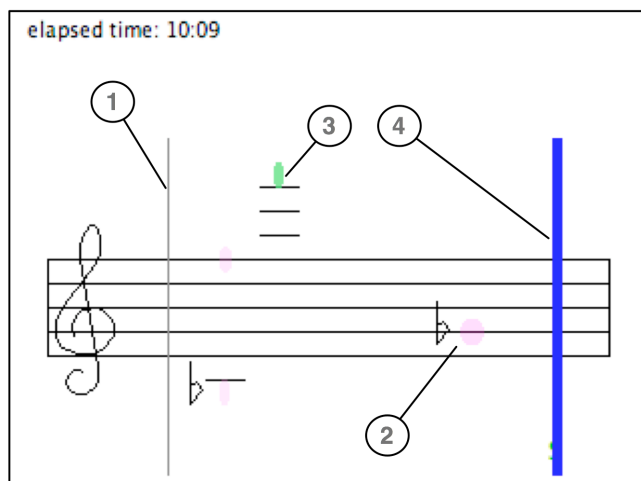
1. Time, in minutes and seconds, since the performance began.
2. When “tacet” is displayed, do not play and stay offstage. When “get ready” is displayed, come onstage and prepare to play.
3. Short text messages give cues and communicate specialized instructions and information.
4. The letter (S,A,T,B) of the saxophonist for whom this notation is intended. This insures that each player has the correct PDA device.

3.1.2 Graphical Notation



1. The active pitches are displayed on the left and right margins.
2. Gray horizontal lines indicate successive octaves in the saxophone's range. Each dotted line is a written C, starting with the lowest C on the instrument on the bottom and working up to altissimo C at the top.
3. Blue horizontal lines indicate the pitches in the active pitch set.
4. The saxophonist does not play pink notes. These are notes played by other saxophonists. For display purposes, they may be transposed up or down an octave if necessary to fit within the display area.
5. The saxophonist plays the green notes. Some notes are labeled with the pitch name.
6. A scrolling vertical blue bar shows position within the measure. Measure position is always synchronized among all four players.

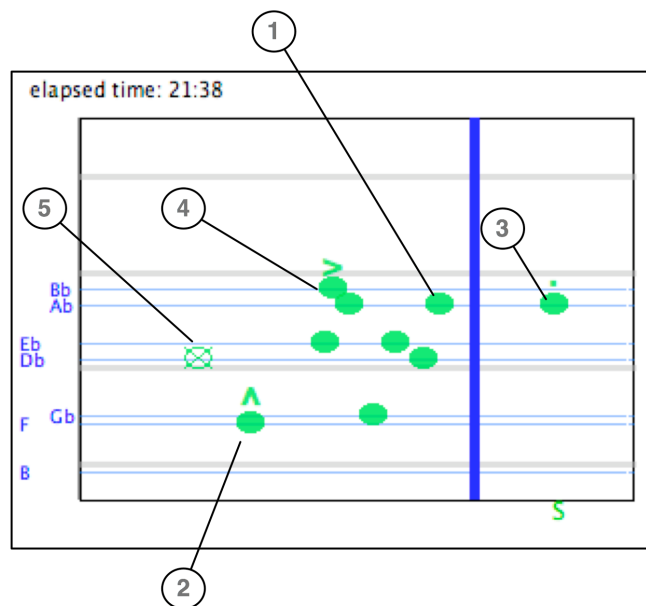
3.1.3 Staff-based Notation



1. A thin black vertical line indicates the starting point of the measure.
2. The saxophonist does not play pink notes, when displayed. These are notes played by other saxophonists. For display purposes, they may be transposed up or down an octave if necessary to fit within the display area.
3. The saxophonist plays the green notes.
4. A scrolling blue bar shows position within the measure. Measure position is always synchronized among all four players.

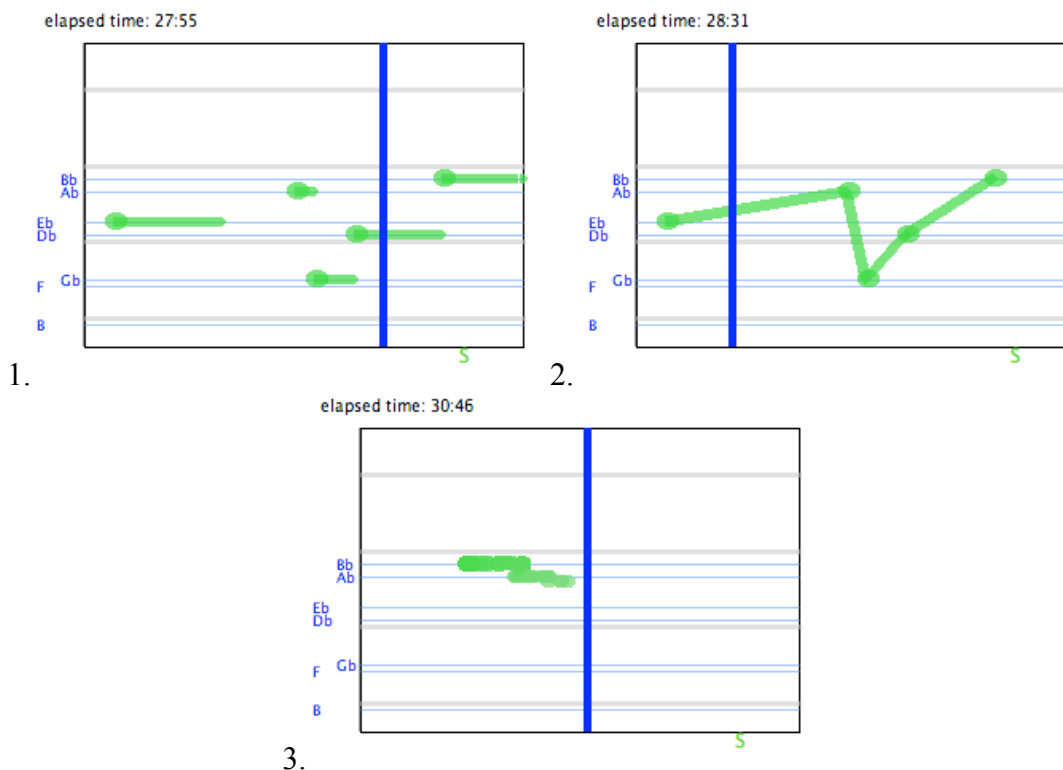
There is never a key signature or time signature. Time is proportional; there is no traditional notation for durations and rests. Accidentals hold for the duration of the measure, across both green and pink notes, but only in the octave in which they first appear. Courtesy accidentals are provided whenever possible; they are not enclosed in parenthesis.

3.1.4 Articulations



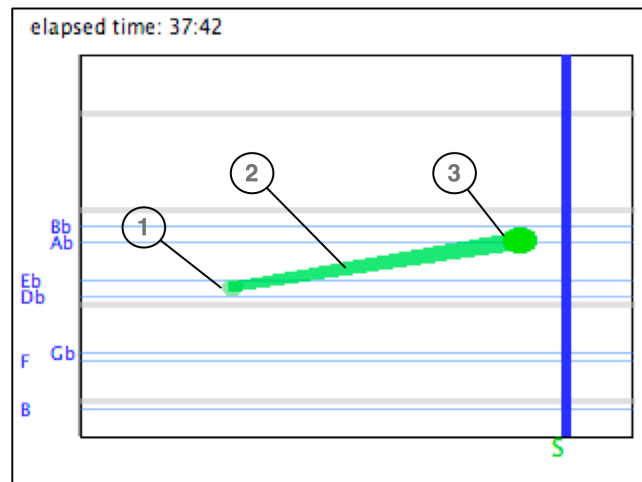
1. Normal articulation: no special marking.
2. Hard accent.
3. Staccato.
4. Regular accent.
5. "Special effect" articulation, such as a slap tongue or key click.

3.1.5 Lines and Curves



1. Horizontal lines are added onto the end of each note to indicate its approximate duration.
2. Diagonal lines connect successive points from left to right in the measure. Players use these to guide their improvisation, capturing the general melodic contour of the line rather than playing it as precisely as possible.
3. The movement of a person or group of people over time creates a gestural curve. Again, players use these to guide their improvisation, capturing the general melodic contour of the line. It is often, in fact, impossible to play the gesture precisely, as these contours can “fold back” over themselves. Players use their judgment in interpreting these polyphonic sections of the notation, either ignoring some elements, alternating between them, or utilizing multiphonics.

3.1.6 Dynamics



1. Pianissimo noteheads have a small area and a light color shade.
2. As the thickness of the line grows, the music crescendos.
3. Fortissimo noteheads have a large area and a dark color shade.

3.1.7 Measure Updates

Measures are updated in two ways:

- In continuous update mode, the contents of the measure are updated several times per second. Simply read whatever notes appear under the scrolling blue bar at any given moment.
- In fixed update mode, the contents of the measure are frozen at the beginning of each measure. As the scrolling blue cursor moves across the measure, the area behind it is updated for the following measure so you can read ahead in the notation.

3.2 Rehearsal

3.2.1 Individual Practice

- Read through this score carefully in order to fully understand how the piece works and how the performance is structured.
- Use the practice notation videos on the companion web site to practice playing with the real-time notation and develop strategies for responding to it.
- Study the harmonic structure outlined in this score.

3.2.2 Quartet Practice without PDAs

- Use the practice notation videos on the companion web site to practice playing the real-time notation in an ensemble context and to develop group strategies for creating compelling music in response to it.
- Discuss the performance structure as a group and brainstorm strategies for movement through the space, eye contact with other ensemble members, and interaction with the audience.

3.2.3 Quartet Practice with PDAs

Using software to simulate audience and musician position data, a single laptop and wireless router can simulate a performance of the piece and generate real-time notation on the PDAs for rehearsal purposes.

- Make sure you can securely mount the PDA on your instrument in a position suitable for viewing the display.
- Practice responding to the real-time notation as a group, reading it from the PDAs.
- Run through simulations of entire sections and eventually of the entire performance.

3.2.4 Quartet practice in performance space

- Practice moving around the performance space to develop a solid mental map of how positions map to video and notation in various sections of the work.
- Practice individual sections of the performance, especially those without audience participation, with a focus on developing movement strategies that produce interesting visual and musical results. For sections with audience participation, a small group of volunteers will be on hand to serve as the audience.
- Run through the entire performance.

3.3 Dress

Please wear all black to performances; this will help the computer vision system more accurately locate you as you move around the performance space. (You will also be given a special hat to wear to facilitate this tracking.)

4 Facilitators

The facilitators guide audience participation in the piece by arranging people in particular configurations on stage, distributing and collecting instruction cards, and influencing audience behavior through their own actions. They are also featured during part of the performance when the audience remains in their seats.

4.1 Rehearsal

4.1.1 Individual Preparation

- Read through this score carefully in order to fully understand how the piece works and how the performance is structured.
- Watch the simulation videos on the companion web site.

4.1.2 Group Preparation

- Discuss and practice movement strategies for the section of the performance featuring facilitators and saxophonists.
- Depending on your background (music, theater, dance, or none of the above), discuss general character, tone, beats, or personality with which you will all facilitate the performance. Will each of you project individual personalities? Will you approach your tasks with seriousness, humor, intensity, or something else entirely? Will any of this change over the course of the performance?
- Walk through the performance structure in detail and decide (and notate) exactly which facilitator will do each task.
- Discuss what the facilitators will wear. Dress should be at least somewhat coordinated so that facilitators are easy for the audience to identify.

4.1.3 Rehearsal In Performance Space

- Practice moving around the performance space to develop a solid mental map of how positions map to video and music in various sections of the work.
- Practice individual sections of the performance, especially those without audience participation, with a focus on developing movement strategies that produce interesting visual and musical results. For sections with audience participation, a small group of volunteers will be on hand to serve as the audience.
- Run through the entire performance.

5 Audience

Through marketing materials and the program booklet, the audience knows in advance that they will participate in the performance of *Flock*. They are also introduced to the piece (and their role in it) via a short verbal introduction before the performance begins.

No audience member is required to participate in the performance. Facilitators encourage every audience member to participate but respect the wishes of those who are unwilling or unable to do so.

As audience members walk into the performance space, ushers give them a program and a tracking hat. Ushers must also collect the hats as the audience leaves.

There is, obviously, no rehearsal for the audience before the performance.

5.1 Program Note

Here is the text to be printed in the program booklets:

The music for this performance of Flock does not yet exist. I want you to help us to create it.

If you are tone deaf, do not despair: you will not have to sing or even tap your foot. We will simply ask you to stand up and move around. As you interact with the other audience members, the musicians, and the dancers, your location and movement will be captured by overhead cameras, analyzed by computer software, and used to shape the music you hear and the video you see.

— Jason Freeman

6 Structure

6.1 Entrance Music: Covey

Duration: 10 minutes.

The house doors open at the scheduled performance time, and this section runs as the ushers let people into the space little by little. It involves the audience, video, and electronic sound; the saxophonists and facilitators do not participate. Covey also exists as an interactive sound and video installation separate from Flock.

6.1.1 Concept

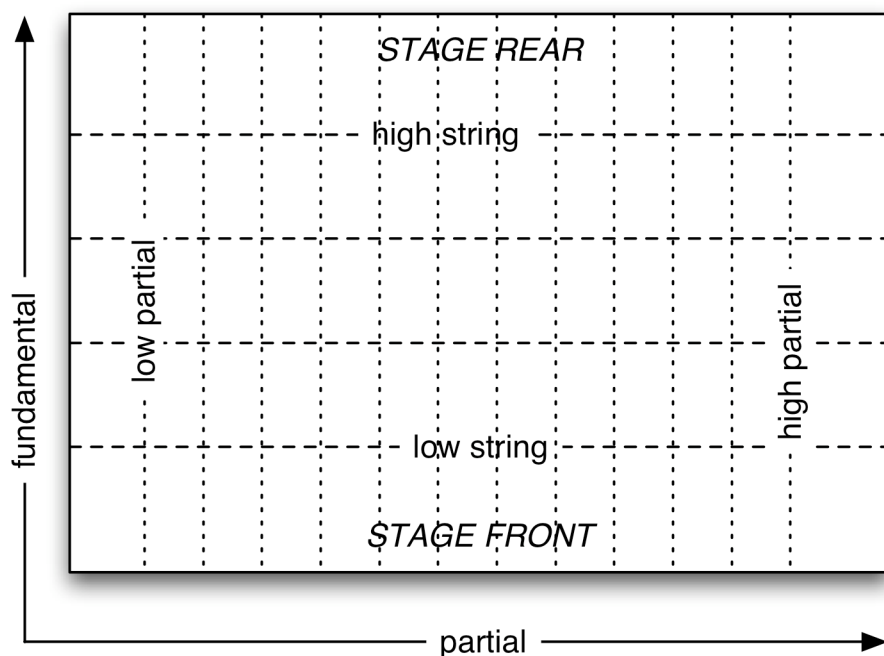
Inspired by the Aeolian harp, an instrument "played" by the wind, Covey is based on the rich timbre and fluid gestural control of the harp. Computer vision technology tracks participants' locations and movements, translating them into "wind energy" to play a synthetic harp. In the same way that a force of nature excites the man-made Aeolian harp, humans are the force driving the virtual, technological instrument in Covey.

Virtual strings span the width of the space, and as an audience member approaches a string, it is increasingly excited and sonically emerges from the ongoing bass rumble (something of a wind noise-floor). The position along the string at which it is excited emphasizes a particular partial. These timbral changes all occur continuously and allow for a flowing, meditative aural landscape.

As audience members walk into the performance space, they must walk through the space to get to their seats. They are encouraged to linger before they sit down and explore how their position in and movement through the physical space transforms the sound of the virtual harp and affects the complex timbral space.

Within Flock, Covey serves both as atmospheric, ambient background entrance music and as an introduction to the audience's role in shaping the performance.

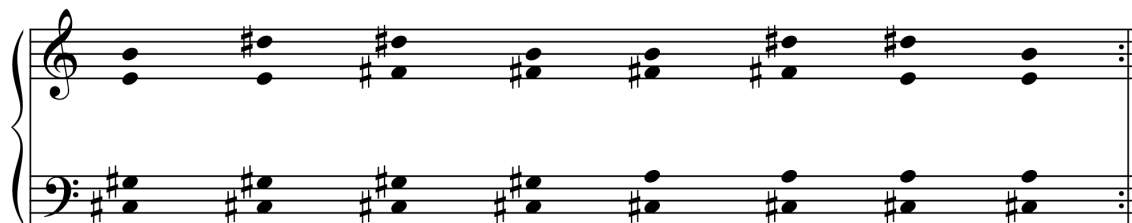
6.1.2 Interactive Design



Four virtual longitudinal strings and twelve virtual latitudinal partials are placed in the space. As audience members approach a particular partial of a particular string, it grows louder, peaking when they are standing directly on the intersection point on the virtual grid. When an audience member stands between multiple strings or multiple partials, each one is activated, but at a lower amplitude. When multiple audience members activate the same partial on the same string, its amplitude is higher.

The intrinsic timbral micro-changes, drawn from spectral analysis of Aeolian harp recordings, are globally controlled by the total amount of movement in the space. The higher the average velocity of audience members through the space, the faster these timbral micro-changes proceed. If all audience members come to a stop, the timbre is frozen to a static moment in time.

6.1.3 Harmonic Structure



Three of Covey's four strings gradually change their tunings over time by slowly crossfading between strings tuned to two different fundamental frequencies. (Each crossfade takes up to a minute.) The fourth string, the bass, remains constant throughout.

The harmonic structure explores permutations of the opening chord of Flock’s main harmonic structure, iterating through 4-note combinations of the 7-note chord using a gray-code, common-tone circular progression.

6.2 Verbal Introduction

Duration: 5 minutes.

We briefly explain and demonstrate the basic modes of interaction: cartesian and polar mappings, instantaneous points and motion trails, audio, video, and notation, and the roles of saxophonists, facilitators, and audience members.

The baritone saxophonist assists in the short demonstrations that are part of the introduction.

The audience is also invited to stay after the performance for a short Q&A session.

6.3 Opening

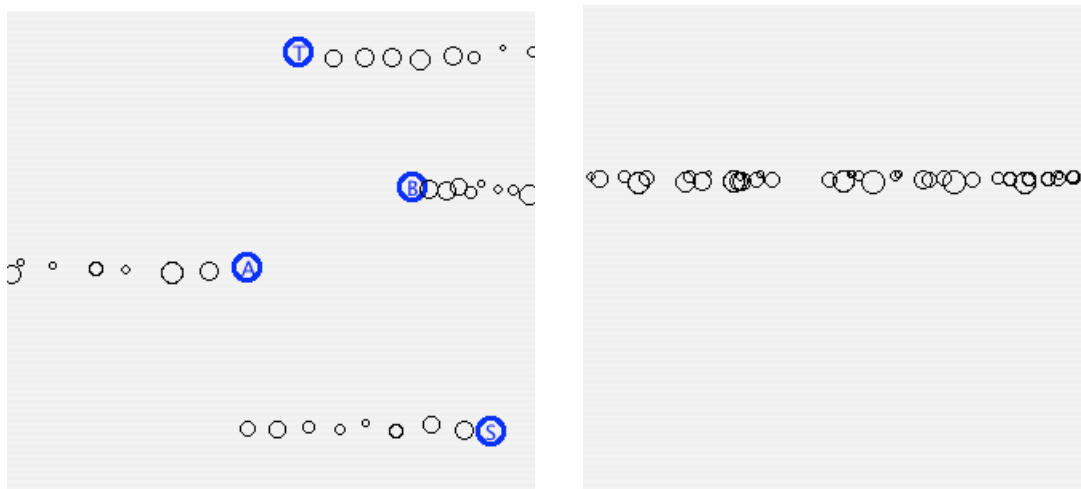
Duration: 15-20 minutes.

- **Quartet entry:**
 - *Script:* Each saxophonist (alto, then tenor, then soprano, then bari) comes out on stage, moves around freely for a short time, and then freezes in a location of their choice.
 - *Notation:* Staff-based notation, continuous updates. Each saxophonist generates a single note per measure for himself based on current position (x is measure position, y is quantized pitch).
 - *Electronic Sound:* None.
- **Facilitator entry:**
 - *Script:* Three of the facilitators, one by one, come on stage, move around freely for a short time, and then freeze in a location of their choice.
 - *Notation:* Same as above, plus each facilitator generates a note for whichever saxophonist is closest to him. Notes generated by a saxophonist for himself are accented; notes generated by facilitators are not. Switches to graphical mode.
 - *Electronic Sound:* None.
- **Audience entry:**
 - *Script:* The fourth facilitator acts as a “controller” and brings four audience members onto stage, one by one, placing each in a location of his choice and instructing them to stay still.
 - *Notation:* Same as above, plus each audience member generates a note for whichever saxophonist is closest to him.
 - *Electronic Sound:* None.
- **Common-tone motion:**
 - *Script:* The “controller” facilitator moves one person at a time (saxophonist, facilitator, or audience member) to a new location on stage and instructs them to

- remain still. Instead of moving an audience member, they may also instruct them to sit down and then replace them with a new audience member.
- *Notation:* Note extensions are added to each note. These extensions gradually grow longer and eventually wrap around the full duration of each measure.
 - *Electronic Sound:* None.
 - ***Build up:***
 - *Script:* A second facilitator becomes an additional “controller” so that participants are moved more frequently than before.
 - *Notation:* Switches to fixed update mode. Diagonal lines connect successive points instead of note extensions.
 - *Electronic Sound:* None.
 - ***Climax:***
 - *Script:* The “controllers” instruct all participants to move freely around the stage and continue to “swap” audience members by instructing one audience member to sit down and bringing another onto stage to replace them.
 - *Notation:* In addition to participant’s current locations, their recent locations on stage also generate notes to play. Gradually, the music incorporates a longer and longer history of participants’ movements to generate denser and denser textures.
 - *Electronic Sound:* None.
 - ***Transition:***
 - *Script:* Soprano, then alto, then tenor, then bari saxes stop playing and leave the stage. Meanwhile, the facilitators organize the four participating audience members into a horizontal line in the middle of the stage.
 - *Notation:* Audience members and facilitators stop generating notes for the saxophonists; they only generate electronic sound. Then the history of movements is gradually eliminated, and then the connecting lines are removed, leaving only a single note for each saxophonist per measure.
 - *Electronic Sound:* Electronic sound begins almost imperceptibly and becomes more prominent by the end of the section. Each audience member and facilitator generates a single note per measure on a modal-bar percussion instrument based on his current location (x is quantized measure position, y is quantized pitch).

6.4 Horizontal Lines

Duration: 10 minutes.

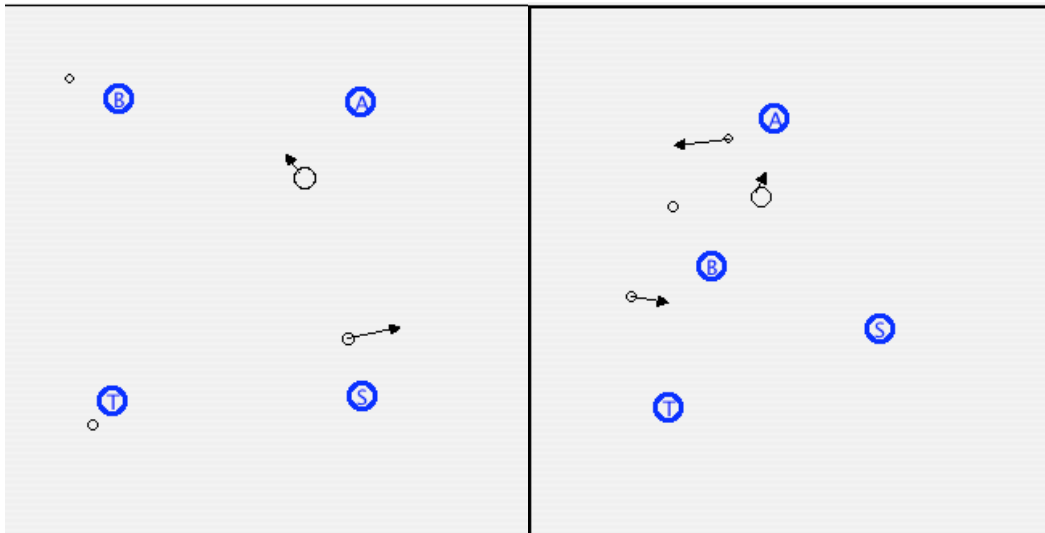


- **Building Lines:**
 - *Script:* One facilitator remains, still, with the horizontal line of audience members that ended the previous section. One by one, each of the other three facilitators build their own horizontal line of audience members, bringing 4-6 people on stage, one by one to form the line.
 - *Notation:* None.
 - *Electronic Sound:* Each audience member and facilitator generates a single note per measure on a modal-bar percussion instrument based on his current location (x is quantized measure position, y is quantized pitch).
- **Saxophonists Return:**
 - *Script:* Baritone, then tenor, then alto, then soprano sax come back on stage, each joining a different one of the audience lines.
 - *Notation:* Staff-based notation, continuous updates. Each saxophonist generates a single note per measure for himself based on current position (x is measure position, y is quantized pitch).
 - *Electronic Sound:* Same as above.
- **Moving Lines:**
 - *Script:* Each facilitator remains with his line and guides their movement around the stage. Lines can move “marching” style (moving along the y-axis standing side by side) or “snake” style (turning to face a leader and following them around). Saxophonists remain with their lines as the lines move.
 - *Notation:* Note extensions are added to each note. These extensions gradually grow longer and eventually wrap around the full duration of each measure. Then a short history of recent locations begins to generate additional notes, and the notation switches to graphical mode.
 - *Electronic Sound:* Gradual crossfade from modal bar to plucked string sound.
- **Merging Lines:**
 - *Script:* Facilitators direct all four lines to merge into a single, large line that spans the entire horizontal width of the space.

- *Notation:* The history and note extensions are gradually removed, returning to a single note for each saxophonist per measure.
- *Electronic Sound:* Crossfade to plucked string sound completes.
- **Transition:**
 - *Script:* Facilitators instruct audience members, one by one, to sit down. Each saxophonist goes to a separate quadrant of the stage and freezes.
 - *Notation:* Single note per saxophonist per measure.
 - *Electronic Sound:* Plucked string sound until audience sits down, then nothing.

6.5 Polar Coordinates

Duration: 15-20 minutes.



6.5.1 Script

- **Facilitator Entry:**
 - *Script:* Saxophonists remain still in their quadrants. One by one, facilitators come on stage and each one dances around a different saxophonist.
 - *Notation:* Graphical notation, continuous updates. Each saxophonist is the center of a polar coordinate system, and facilitators generate notes for any saxophonist within a maximum radius based on their position relative to the saxophonist: theta maps to measure position and radius maps to quantized pitch. A very short history of positions generates contours and squiggles instead of isolated notes.
 - *Electronic Sound:* None.
- **Audience Entry:**
 - *Script:* Each facilitator gets 2-3 audience members to join him moving around his saxophonist.
 - *Notation:* Same as above but switches to fixed update mode, and audience members generate notes for the saxophonists as well.
 - *Electronic Sound:* None.
- **Freer Movement:**
 - *Script:* Facilitators may “jump” from one saxophonist to another; their audience members follow them when they move. At any given time, multiple groups may

be around the same saxophonist, and some saxophonists may not have anyone near them. Facilitators may instruct their audience members to sit down and may bring up additional audience members at their discretion. Eventually, the saxophonists begin moving freely around the stage.

- *Notation:* Same as above.
- *Electronic Sound:* None.
- **Build up:**
 - *Script:* Saxophonists gradually move towards the center of the stage, where they form a tight clump with each other. Facilitators and audience members continue as above, but naturally move towards the center as well to follow the saxophonists.
 - *Notation:* The length of the position history gradually increases and the notation becomes increasingly dense.
 - *Electronic Sound:* None.
- **Completely Free Movement:**
 - *Script:* Facilitators, saxophonists, and audience members move freely around the stage. Facilitators use their discretion to instruct audience members to sit down and to bring additional audience members on stage.
 - *Notation:* Same as above, with ample discretion to tweak the position history length in response to the performance. Eventually, the history should gradually decrease moving towards the end of the piece.
 - *Electronic Sound:* Each audience member's current (x,y) location generates a brief sine-wave partial in an ongoing "harmonic mush." x is mapped to measure position and y to the quantized harmonic. The fundamental frequency matches the lowest pitch of the active pitch set. There are initially ~20 harmonics but this number gradually increases to the end of the piece. Initially, the electronic sound should barely be audible, and should become more prominent as the acoustic texture thins out.
- **Audience is seated:**
 - *Script:* Facilitators instruct audience members to sit down, one by one.
 - *Notation:* Same as above, and position history length gradually decreases.
 - *Electronic Sound:* Same as above, and number of harmonics continue to decrease.
- **Conclusion:**
 - *Script:* Soprano, then baritone, then alto, then tenor sax stop playing and go offstage. Then the facilitators, one by one, leave the stage, as the lights fade to black.
 - *Notation:* Same as above until saxophonists leave stage.
 - *Electronic Sound:* Same as above until all saxophonists and facilitators leave stage. It will fade out naturally as this happens; there should be no need for a manual fadeout.

6.6 Q&A Session

After the performance, the audience is invited to stay for a brief Q & A session with the saxophonists, facilitators, and creators. The ushers must hand out written surveys and collect audience hats at this time. A volunteer provided by the presenter, or else one of the artists, moderates this session.

7 Harmonic Structure

The following pages outline the twenty-eight chords of *Flock*. (The separate harmonic structure of *Covey* is described in that section.) *Flock* completes a single progression through these chords over the course of the performance, ending back on the first chord. The software cues chord changes automatically at regular time intervals. If the show runs longer than expected and the progression ends early, then the software remains on the last chord for the remainder of the performance.

In the harmonic outline below, each measure represents a single chord, and each staff or grand staff shows a different voicing available for the same chord. Voicings particular to each instrument are designated S (soprano), A (alto), T (tenor), and B (bari). Sparse voicings are labeled “sp” and dense voicings are labeled “dn.” F (full) indicates a full voicing that is played by all saxophonists and/or rendered by electronic sound. (When a full voicing is used for multiple saxophonists, it is usually pruned to a subset of pitches that lies within the range of all saxophonists.)

In general, F voicings tend to be used for electronic sounds and S, A, T, and B voicings tend to be used for the musicians. In polar coordinate mappings, each saxophonist usually has a separate voicing (S, A, T, or B, respectively); in Cartesian mappings, they share the common range of a single voicing (S, A, T, or B). For more information on which voicings are used in which sections, refer to the information on notation and sound generation in the section descriptions above.

S and T voicings and A and B voicings are always identical, except for octave transposition.

Two versions of the chords and voicings follow. The first is in concert pitch, while in the second, the S, A, T, and B voicings have been transposed to written pitch for those instruments.

A final note about the harmonic structure: it is intended to help the saxophonists in various sections of the piece by giving them a framework within which to improvise. It should never be followed so slavishly as to become a burden. If it becomes distracting rather than helpful, it can be shut off entirely in sections of the performance.

7.1 Concert Pitch

This musical score, titled "7.1 Concert Pitch", is arranged for 11 instruments. The notation is organized into four systems. The first system contains the top four staves: S/sp (Soprano, Soprano), S/dn (Soprano, Descending), A/sp (Alto, Soprano), and A/dn (Alto, Descending). The second system contains the next four staves: T/sp (Tenor, Soprano), T/dn (Tenor, Descending), B/sp (Bass, Soprano), and B/dn (Bass, Descending). The third system contains the bottom three staves: F/sp (Flute, Soprano), F/dn (Flute, Descending), and a final staff. The score is divided into seven measures, numbered 1 through 7 at the top. Each measure contains complex, dense musical notation with many notes and accidentals, indicating a highly technical and complex piece. The instruments are labeled on the left side of each staff: S/sp, S/dn, A/sp, A/dn, T/sp, T/dn, B/sp, B/dn, F/sp, F/dn, and a final unlabeled staff.

8 9 10 11 12 13 14

S/sp

S/dn

A/sp

A/dn

T/sp

T/dn

B/sp

B/dn

F/sp

F/dn

15 16 17 18 19 20 21

S/sp

S/dn

A/sp

A/dn

T/sp

T/dn

B/sp

B/dn

F/sp

F/dn

This musical score page, titled "Flock — score — 29", displays measures 22 through 28 for a ten-part ensemble. The instruments are arranged vertically as follows: Soprano (S) in single and double staves, Alto (A) in single and double staves, Tenor (T) in single and double staves, Bass (B) in single and double staves, and Flute (F) in single and double staves. The key signature is one flat (B-flat), and the time signature is 4/4. The notation is primarily homophonic, with many measures containing whole or half-note chords. The score concludes with a double bar line at the end of measure 28.

7.2 Written Pitch

This musical score, titled "7.2 Written Pitch", is arranged for a large ensemble. It consists of ten staves, each representing a different instrument or voice part. The staves are labeled on the left as follows: S/sp, S/dn, A/sp, A/dn, T/sp, T/dn, B/sp, B/dn, F/sp, and F/dn. The first seven staves (S/sp through B/dn) are single-line staves. The last three staves (F/sp and F/dn) are grand staves, each consisting of a treble and bass clef staff joined by a brace. The score is divided into seven measures, numbered 1 through 7 at the top. Each measure contains a complex chordal texture. The first seven staves (S/sp through B/dn) play chords in a key signature of three flats (B-flat, E-flat, A-flat). The last three staves (F/sp and F/dn) play chords in a key signature of three sharps (F-sharp, C-sharp, G-sharp). The notation includes various accidentals (flats and sharps) and note heads, indicating specific pitches and intervals within the chords.

8 9 10 11 12 13 14

S/sp

S/dn

A/sp

A/dn

T/sp

T/dn

B/sp

B/dn

F/sp

F/dn

15 16 17 18 19 20 21

S/sp

S/dn

A/sp

A/dn

T/sp

T/dn

B/sp

B/dn

F/sp

F/dn

22 23 24 25 26 27 28

S/sp

S/dn

A/sp

A/dn

T/sp

T/dn

B/sp

B/dn

F/sp

F/dn

8 Printed Performance Materials

8.1 Saxophonist Cheat Sheets

Section	Cue (on PDA)	Info	Action
1. Covey	—	Electronic sound only	Stay backstage
2. Verbal Introduction	Come onstage Follow verbal instruct	Bari only	Come onstage and assist with intro
3. Quartet Entry	Go onstage	Staff notation	Come onstage
	Free movement	“	Move around freely
	Stay still	“	Settle in a spot and do not move
3. Facilitator Entry	Stay still until moved	Graphic notation	“
3. Audience Entry	“	“	“
3. Common-tone Motion	“	Note lengths increase.	Stay still until told to move by facilitator
3. Build up	“	Diagonal lines create melodic contours.	“
3. Climax	Free movement	“Motion trails” generate more notes.	Move freely around the stage
3. Transition	“	Electronic snd begins; texture thins out	“
	Go offstage		Stop playing and go backstage
4. Building Lines	Wait offstage	Electronic sound only	Stay backstage.
4. Saxs Return	Join an audience line	“	Come onstage and join one of the four audience lines.
	Remain with audience line	Staff notation	—
4. Moving Lines	“	Audience lines move. Switch to graphical notation.	Stay with your line as it moves around stage.
4. Merging Lines	“	Audience lines merge into one big line.	“
4. Transition	To quadrant, then stay still	Audience sits down.	Pick a quadrant of the stage, go there, freeze.
5. Facilitator Entry	Stay still	Facilitators enter, polar mappings.	—
5. Audience Entry	“	Audience members join facilitators.	—
5. Freer Movement	Free movement	Audience members and facilitators follow you as you move.	Move slowly around stage.
5. Build Up	Slowly towards center, then still	Notation becomes denser (motion trails).	Move to form clump with other

			saxophonists ctr stage.
5. Completely Free	Free movement	Climax of the show. Electronic snd begins.	Move around freely.
5. Audience is Seated	“	Audience sits down.	“
5. Conclusion	Go backstage	—	Stop playing and go backstage.

8.2 Facilitator Cheat Sheets

Section	Cue	Info	Action
1. Covey	—	—	Stay backstage
2. Verbal Introduction	—	—	“
3. Quartet Entry	—	Saxes come onstage.	“
3. Facilitator Entry	Contextual Cue: all saxes onstage.	Everyone frozen.	3 facilitators on stage, one by one, + freeze.
3. Audience Entry	Contextual Cue: 3 facilitators onstage.	Everyone frozen.	Last facilitator brings out 4 audience members, one by one, and freezes them.
3. Common-tone Motion	Contextual Cue: 4 audience onstage.	“	Last facilitator becomes “controller”, moving one person at a time.
3. Build up	Visual Cue: white.	“	Additional facilitator becomes a controller.
3. Climax	Visual Cue: yellow.	Everyone moves freely.	All facilitators move freely and instruct all audience to move freely.
3. Transition	Contextual Cue: Saxs leave stage.	4 audience members remain on stage.	Put audience members into a horizontal line and freeze them.
4. Building Lines	Contextual Cue: line formed.	Electronic sound only. Saxs remain offstage.	One facilitator remains with line. Other 3 facilitators each form a new horizontal line of 4-6 audience members.
4. Saxs Return	—	Lines remain still.	Do nothing.
4. Moving Lines	Contextual cue: all saxs back onstage.	—	Each facilitator leads his line around stage.
4. Merging Lines	Visual cue: Orange.	—	Four lines merge into one big horizontal line
4. Transition	Contextual cue: lines merged.	Saxes go to four quadrants.	Facilitators instruct audience to sit down,

			one by one.
	Contextual cue: audience seated.	—	Go offstage.
5. Facilitator Entry	Contextual cue: facilitators offstage.	No electronic sound. Polar mappings.	Facilitators come onstage one by one, each dances around a saxophonist.
5. Audience Entry	Visual cue: red.	Facilitators continue to dance around saxes.	Each facilitator gets 2-3 audience members to join him.
5. Freer Movement	Visual cue: blue.	Eventually, saxes start to move.	Facilitators (and their audience members) begin to “jump” from one sax to another.
5. Build Up	—	Saxophonists form a clump at center stage. Music becomes dense.	“
5. Completely Free	Contextual cue: saxes leave center stage.	Free movement for everyone. Electronic snd begins.	Facilitators instruct audience to move freely and move freely themselves.
5. Audience is Seated	Visual cue: green.	Music thins out.	Facilitators instruct audience to sit down, one by one.
5. Conclusion	Contextual cue: saxes begin leaving stage.	—	Facilitators continue interacting freely with saxes and each other.
	Contextual cue: all saxes offstage.	Only electronic sound remains.	Facilitators exit stage one by one.

8.3 Software Operator Cheat Sheets

Section	Cue	Notation	Audio
1. Covey	House opens	—	1.default
2. Verbal Introduction	Audience seated	1. BgetReady 2. Bactive-cartesian 3. addHist 4. polar	(wireless mic)
START GLOBAL HARMONY			
3. Quartet Entry	Intro done	1. default 2. AgetReady 3. Aactive 4. Afreeze 5. TgetReady 6. Tactive 7. Tfreeze 8. SgetReady 9. Sactive 10. Sfreeze 11. BgetReady 12. Bactive 13. Bfreeze	—
3. Facilitator Entry	First facilitator onstage	1. default	—
3. Audience Entry	—	—	—
3. Common-tone Motion	Controller begins moving people	2. short-exts <i>increase dist to 0.4</i> 3. long-exts <i>increase dist to 1.0</i> 4. fullwrap	—
3. Build up	(give cue: white)	5. diagwrap	—
3. Climax	(give cue: yellow)	6. histwrap <i>increase hist to 40</i> <i>remove mm sync</i>	—
3. Transition	—	1. default 2. noAudsForSaxes <i>decrease hist to 10</i> <i>add mm sync</i> 3. shortHist 4. noHist 5. noLines 6. STacet 7. ATacet 8. TTacet 9. BTacet	Transition/default <i>crossfade bar to L</i>
4. Building Lines	First line formed	0. default	1. midartic

			<i>increase artics to 4</i> 2. peakartic
4. Saxs Return	—	1. BgetReady 2. Bactive 3. TgetReady 4. Tactive 5. AgetReady 6. Aactive 7. SgetReady 8. SATBactive	—
4. Moving Lines	—	9. short-exts <i>increase dist to 0.4</i> 10. long-exts <i>increase dist to 1</i> 11. fullwrap 12. histwrap	—
4. Merging Lines	(give cue: orange)	13. singlePoints	<i>crossfade bar to R</i>
4. Transition	Lines merged	14. toQuadrants 15. noAudio	3. pluck
5. Facilitator Entry	Facilitators re-enter	0. default 1. shortHist	—
5. Audience Entry	(give cue: red)	2. non-continuous	—
5. Freer Movement	(give cue: blue)	<i>wait, then</i> 3. freemvmt	
5. Build Up	—	<i>increase hist to 15</i> 4. midHist 5. towardsCenter <i>increase hist to 20</i> <i>increase rad to 0.3</i> 6. peakHist	—
5. Completely Free	—	7. freemvmt 8. audioMush	Polar/0. Default <i>crossfade bar to R</i>
5. Audience is Seated	(give cue: green)	<i>decrease hist to 2</i> 9. shorthist	<i>decrease harms to 4</i> 1. harmwtend
5. Conclusion	Facilitators offstage	10. STacet 11. BTacet 12. ATacet 13. TTacet	—

8.4 Audience Instruction Cards

The facilitators carry these cards around with them at all times to help prompt the participation of audience members. The cards are printed double-sided (4 double-sided pages total) on cardstock.

8.5 Q & A Session Written Questionnaire

The audience is invited to fill out this written survey after each performance.

The rest of this page is intentionally left blank. The cards and the survey appear on subsequent pages to facilitate easy printout.

Come with me.

Stay right here.

**Return to
your seat.**

Dance.

Walk.

Roam.

**Lead someone
else.**

**Follow
someone else.**

Please circle the number which best describes your reaction to each statement.

	Strongly Disagree	Somewhat Disagree	Undecided	Somewhat Agree	Strongly Agree
I had fun.	1	2	3	4	5
I enjoyed participating.	1	2	3	4	5
I was creative.	1	2	3	4	5
I felt connected to the audience.					
I felt connected to the musicians.	1	2	3	4	5
I felt connected to the music.	1	2	3	4	5
I actively listened to the music.	1	2	3	4	5
I understood how I helped shape the performance.	1	2	3	4	5
The performance would have been different were I not here.	1	2	3	4	5
I regularly listen to experimental music.	1	2	3	4	5
I am trained as a musician.	1	2	3	4	5

Please share with us any further thoughts or feedback on the opposite side of this sheet.

Please circle the number which best describes your reaction to each statement.

	Strongly Disagree	Somewhat Disagree	Undecided	Somewhat Agree	Strongly Agree
I had fun.	1	2	3	4	5
I enjoyed participating.	1	2	3	4	5
I was creative.	1	2	3	4	5
I felt connected to the audience.					
I felt connected to the musicians.	1	2	3	4	5
I felt connected to the music.	1	2	3	4	5
I actively listened to the music.	1	2	3	4	5
I understood how I helped shape the performance.	1	2	3	4	5
The performance would have been different were I not here.	1	2	3	4	5
I regularly listen to experimental music.	1	2	3	4	5
I am trained as a musician.	1	2	3	4	5

Please share with us any further thoughts or feedback on the opposite side of this sheet.