Start Up Your Lab Bench:
If things don’t work, you can contact the TAs and Prof. Haken (copy all of us on any email you send for quickest results).
1. If the computer is not on the login screen, get to the login screen, and log in.
2. Make sure the Paca is on. The Paca is mounted under the tabletop. If the Paca display is dark, touch the Paca’s strip; the display will show a menu (if it is already running) or it will ask you to “hold finger on strip” to start it up.
3. Run Continuum Editor (C:/Continuum Editor 850/Continuum Editor.exe) and wait for it to appear on screen.
   - If Windows asks security questions, click “OK”. The Editor takes about 20 seconds to start up.
   - You must run the Continuum Editor, even if you do not plan to use the Continuum Fingerboard.
5. Look at the Continuum Editor, and verify the areas circled in the screen shots on the next page.

Continuum Editor:
The Continuum Editor routes the Midi Keyboard and Continuum Fingerboard data to Kyma. The Continuum Editor also allows you to select and modify Continuum Fingerboard’s built-in sounds using the EaganMatrix. The EaganMatrix is a unique modular digital synth (you are welcome to experiment!) – but your lab assignments do not use the EaganMatrix; instead, your lab assignments use the Kyma environment.

Working in Kyma:
Take turns “driving” – let everyone in your lab team type and use the mouse and get familiar with Kyma.
All lab assignments (tutorial materials) and reference documentation are in Kyma X Revealed.
On-line documentation is available under Kyma’s File menu, after Kyma is running.

When you save files in Kyma: In the standard Windows Save File dialog, you must select “Computer” in the left panel, and then select the path for your file in the right panel.

The disk space on the lab workstations is shared by all ECE402 students. Keep all of your lab team’s files in a directory you create on your workstation’s C drive, and save changes only in your directory. Because of network latency and throughput limitations, network storage is not reliable for real-time use with Kyma; but it is a good idea to back up your team’s Kyma directory to network storage at the end of each lab session.

Use descriptive names for files you save during lab sessions. Keep track of any interesting results and things you might want to investigate further for your final project!

Devices at each Lab Bench:
- The Paca, Kyma’s sound computation hardware
- The Continuum Fingerboard, which has an internal audio DSP to produce audio as well as Midi
- A Midi Keyboard, which produces Midi but no audio
- The Windows PC, which runs Kyma and Continuum Editor
- The Mackie Mixer, which has a separate GAIN knob for each of its analog audio inputs:
  1. Stereo audio from Kyma’s Paca sound computation hardware via SaffirePro14
  2. Stereo audio from the Continuum’s internal DSP
  3. Stereo audio from the PC
  4. Audio from the microphone
  5. Audio from a device you bring in, if you like
The Mackie routes each audio input to one of two destinations, based on the input’s MUTE button:
  1. Stereo audio to speakers, called Main Out (MUTE button not pressed)
  2. Stereo audio to Paca’s audio input, called Alt3-4 (MUTE button pressed)
- Three USB-Midi cables connected to the PC (iConnectivity MIO, Roland UM-ONE, Yamaha UX16).
  - Note: USB-Midi cables have two 5-pin circular connectors labeled IN and OUT; IN connects to the output of another device; OUT connects to the input of the other device.
- The SaffirePro14, which does audio and Midi I/O for the Paca.

Never modify the lab bench cabling! Use the Mackie Mixer for routing. If you come to lab and find the cabling has been changed, please let Prof. Haken know, so he can have a word with the lab team that preceded you. Also, in Kyma and in the Continuum Editor, don’t change global setup parameters; please keep the standard setup intact for all lab teams.
Below are two screen shots from the Continuum Editor, and one from Kyma; it should look like this after you complete the “Start Up Your Lab Bench” procedure on the previous page.

“Midi and Global Settings” (in the Continuum Editor’s cogwheel menu):

Verify settings in red circled areas. Items written in red typeface (and lights with a red halo) are changeable; if they are incorrect, click them to change. Blue items are not clickable; blue items report current state.

You will see that Windows prepends numbers to “UM-ONE” and appends numbers to “Yamaha UX16”; you can ignore those numbers.

About the blue circle at left: You will not be able to select “Light Action” in the lab; only newer Continuums are able to respond to such low finger pressures. If you are interested in the Light Action, please talk to Prof. Haken.

Main Continuum Editor Page:

The large light at the upper left turns blue when the Editor is communicating with the Continuum Fingerboard. When the Editor is communicating with Kyma, six of the popup menus below the Continuum image turn blue. This blue text color indicates these items are controlled by Kyma; if these are not blue, verify Kyma is selected (at red arrow). The six Midi routing lights at the right should all be blue; if not, click them to toggle their state.

Most Common Problems (first correct any errors in “Midi and Global Settings,” as shown above):

No Sound: In Kyma’s “DSP Status” menu option, make sure options are set as shown at right. Check GAIN knobs on Mackie Mixer.

Editor Not Talking to Continuum (no big blue light in Editor): Exit all programs, find USB-Midi cable from PC to Continuum, unplug and replug it (at the PC end) to clear USB driver, restart Editor.

No Notes from Midi Keyboard: Power Midi Keyboard off and on. Unplug and replug Midi Keyboard’s USB-Midi cable (at PC end). Paca is running, but Kyma says “Make sure your signal processor is connected”: Gently unplug the plug labeled “Power” on the back of Paca; wait 10 seconds; then gently plug it back in.

If You Need Help: Please contact the TAs and Prof. Haken – copy all of us on any email for quickest answers.

Your First Lab Session:

During your first lab session, create your lab team’s directory on your lab workstation’s C: drive. Name the directory “ECE402_xxx_yyy” where xxx and yyy are the netids of the people in your team. Copy the “Kyma Sound Library” and “Timelines” directories from the Kyma CD in the lab (D:\Kyma) to your team’s directory. During the semester, only change your copies of these directories. The first week of lab sessions starts Thursday (after the second lecture). Feel free to visit the lab before the first assignment, and read the intro material in the Kyma X Revealed book.
Homework #0: Study this handout; this is the 3rd page covered by an in-class quiz given during the 3rd lecture. (Note: In addition to these 3 pages, the quiz will also cover the four bullet points on the page about the Continuum Fingerboard.)

This is an image of the Mackie Mixer used in the lab. You must know the locations of the green-tinted controls (MUTE, GAIN, MAIN MIX) in this image; those are the only controls you normally change during the lab.
This is the circuit diagram for the Mackie Mixer. The lab uses five of the mixer’s inputs: one of the Mackie’s four “MIC IN”, and three of the Mackie’s four “LINE IN L/LINE IN R”. The lab uses two of the mixer’s outputs: the “LINE OUT L/LINE OUT R”, and the “ALT OUT L/ALT OUT R”. Trace the lab’s connections through the mixer, from input to output – and notice the GAIN knob and MUTE switch (called MAIN/ALT on this circuit diagram) it passes through.
ECE402 Sound Design Lab (continued)
This page is part of the HW#0 assigned reading, but will not be included in the in-class quiz.

Lab Schedule:
During the first ECE402 lecture (before the lab begins), you will choose lab partners, lab times, and a lab bench. The lab team schedule will be on the web site; if you like you may use the lab when nobody else is signed up.

After Every Lab Session:
Make a backup of your team’s directory to network storage. Log off. Do not turn off individual devices; leave it all on.

Cabling of the ECE402 Lab Bench:

Audio cables connecting to **Mackie Mixer**:  
- Stereo Main Out: to speakers and headphones  
- Alt 3,4 Out: to Paca via SaffirePro14  
- Mono Analog Inputs: Microphone  
- Stereo Analog Inputs:  
  - From Paca via SaffirePro14  
  - From Continuum Fingerboard’s DSP  
  - From PC audio out  
  - From a device you bring in, if you like.  
  (Make sure Phantom Power is off!)

Audio and Midi I/O cables to the **SaffirePro14**:  
- Stereo Audio In: From Mackie Alt 3-4  
- Stereo Audio Out: To a Mackie input  
- Digital Audio Out: To Continuum AES3 input  
- Midi: Roland UM-ONE  
- FireWire to Paca  
- USB-Midi Cables connecting to the PC:  
  - iConnectivity MIO (to/from Continuum Fingerboard)  
  - Roland UM-ONE (to/from SaffirePro14)  
  - Yamaha UX16 (from Keyboard)

Cables connecting to the **Paca**:  
- FireWire to PC (control from Kyma)  
- FireWire to SaffirePro14 (audio and Midi)

Midi Routing in the ECE402 Lab:
1. **Midi Keyboard** output → Yamaha UX16 → **Continuum Editor** “ExtDevice” input.  
   *The Continuum Editor (a Cycling74 Max program) merges Midi it generates with Kyma and Keyboard Midi.*
2. **Continuum Editor** “Continuum” output → iConnectivity MIO → **Continuum Fingerboard** Midi In.  
   *The Continuum Fingerboard’s SHARC DSP (programmed in C and assembly) channelizes the Midi In (simultaneous notes are put on separate channels), and adds Midi to encode fingers on the playing surface. The DSP also generates audio internally, but the lab assignments use only audio from Kyma.*
3. **Continuum Fingerboard** Midi Out → iConnectivity MIO → **Continuum Editor** “Continuum” input.  
   *The Continuum Editor updates its display based on this Midi input, and also passes this Midi on to Kyma.*
4. **Continuum Editor** “Kyma” output → Roland UM-ONE → SaffirePro14 → **Paca**.  
   *The Paca’s Freescale DSPs run sound algorithms you define in Kyma, as triggered by Midi. The Paca generates a small amount of Midi data (like polyphony updates), which it sends to the Editor.*
5. **Paca** → SaffirePro14 → Roland UM-ONE → **Continuum Editor** “Kyma” input.  
   *The Continuum Editor updates its display based on this Midi input, and also merges it in (1) above.*

Connecting your own Audio Input:
If you would like to use Kyma to process audio from your electric guitar, your acoustic pickup, or a device you built, you may connect it through an unused input on the Mackie mixer. Do not change the cabling on the ECE402 lab bench to connect your device; leave existing cabling as it is, and have your audio signal go through an unused input on the Mackie mixer.

If you connect your equipment to a microphone input on the Mackie, please be sure Phantom Power (switch on back right of Mackie) is off. Phantom power outputs DC power on the microphone inputs, and can destroy your device. Study the Mackie mixer circuit diagram for details.
The Continuum Fingerboard tracks the position and pressure of fingers on its playing surface. Unlike a Midi keyboard, which only starts and stops notes, the Continuum Fingerboard lets the performer intimately interact with the sound throughout every note, breathing life and expression into the musical performance.

The Continuum Fingerboard is neither an easy-to-use gadget nor a device for replacing keyboards and acoustic instruments; instead, it is a new instrument in its own right, designed by Prof. Haken to have immediate appeal as well as lifelong challenges for the serious musician.

The best Kyma sounds for the Continuum Fingerboard are specially designed to make use of its ability to track X,Y,Z of each finger throughout the note. For example, you would never want a vibrato built into a sound you control with the Continuum Fingerboard – your fingers can make a much more lively and variable vibrato than the canned vibrato built into sounds made for Midi keyboards. In Kyma’s Hot Parameter Expressions, these are updated throughout every Continuum Fingerboard note: [for the Quiz in lecture 3, memorize these four variable names and what they mean]

- !KeyDown indicates a finger is touching the surface: -1 for first 5ms, then 1 until the finger is lifted, then 0
- !KeyPitch is finger X (right-to-left) in note number (nn) units: e.g. 59.83 means 17¢ below middle C
- !KeyTimbre is finger Y (front-to-back) with 0 to 1 values: 0 is near side, 1 is far side
- !KeyVelocity is finger Z (pressure), with 0 to 1 values

In the Lab you will have assignments that use Kyma. If you would like experience with a very different kind of synthesizer than Kyma, you can also check out the Continuum Fingerboard’s built-in synthesizer, the EaganMatrix, which is specifically designed for Continuum playing. The EaganMatrix has predefined sounds as well as user-defined sounds. Stereo output from the EaganMatrix can be heard through the Mackie mixer, since the lab bench has the Continuum Fingerboard’s analog headphone outputs cabled to the Mackie. The Continuum Fingerboard also has AES digital audio outputs available.
ECE402 Sound Design Lab - EaganMatrix

This page is part of the HW#0 assigned reading, but will not be included in the in-class quiz.

The ECE402 lab assignments use Symbolic Sound Kyma. If you would like an additional experience, you may want to investigate the EaganMatrix. You are not required to use the EaganMatrix, but you should know a little about this very different approach to digital audio synthesis.

The EaganMatrix is the modular digital synthesizer built into the Continuum Fingerboard, and the user interface (shown above) is part of the Continuum Editor program. The EaganMatrix is the result of a long-term collaboration between Edmund Eagan and Prof. Haken. Edmund Eagan is a Canadian sound designer and a Continuum player; you can find out more about him at www.twelfthroot.com. The EaganMatrix user interface is written in the Cycling74 Max environment, the EaganMatrix DSP code is written in C and hand-optimized floating-point SIMD assembly language (for code examples, google “dsprelated haken”), and the EaganMatrix executes on a DSP board designed by Prof. Haken.

The EaganMatrix allows the user to finely craft musical sound algorithms by connecting audio and control modules via a patching matrix. This matrix is inspired by classical modular matrix patching synthesizers such as the EMS VCS3. However, unlike the analog predecessors, the EaganMatrix doesn't use pins to make patch point connections. Instead, the user defines formulas to place at matrix patch points. Formulas are a function of the position and pressure of each finger on the playing surface, LFOs, and other formulas. When a formula is assigned to a patch point in the matrix, the formula controls the flow of sound from the source module on the matrix row to the destination module on the matrix column. Each three dimensional performance direction of the Continuum playing surface can influence every patch point in a different way.

The EaganMatrix requires the sound designer to think in a particular mathematical way that is different from traditional hardware and software synthesizers. The mathematical language of the EaganMatrix has been distilled to best exploit the performance capabilities of the Continuum Fingerboard. As the sound designer masters this EaganMatrix math, its new capabilities will allow creation of musically satisfying relationships between fingers on the playing surface and the sounds produced, relationships that rival the warmth and complexity of acoustic instruments.


Students that do well in ECE402 may do Independent Study projects (for credit) in a following semester. These projects can be sound design in Kyma or in the EaganMatrix, learning SHARC dsp programming, or related algorithm research.