DreamMaker FX Documentation

DreamMaker

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CHAPTER

ONE

INTRODUCTION

Welcome the DreamMaker FX! This is an audio platform that designed to help musicians and effect designers to explore and create effects and synths that have never been heard before.

It is designed to be accesible for experienced programmers and those who have done no programming.

At its core, this platform consists of a microprocessor connected to a powerful SHARC DSP. SHARC DSPs are specialized audio processors used in lots of high-end audio gear. But we don't need to worry about writing DSP code or dealing with the complexities of DSP system design.

Beyond audio processing, the DreamMaker FX hardware offers lots of options for expanding the hardware. External sensors can be easily wired and connected to various effect parameters.

1.1 Option 1: No programming at all!

When you plug the DreamMakerFX pedal into your Mac or PC, it will show up as a mounted drive (DM_FX). You can download a "UF2" file of the sketch right to that drive and it will start running. This is a great option if you have no interest in programming and just wnat to start playing through some of the creations you find on this site!

1.2 Option 2: Start building your own creations with Arduino

Arduino is a programming platform that is designed to make programming easier and more accessible than it normally is. With just a few lines of code, you can begin creating your own pedal creations.

There are a few ways you can get started:

- Download a "pedal pack" from the Browse Pedals page and start playing with these
- Download a pedal design that someone else has created on this site.
- Start with the Basic echo pedal tutorial and start building from the ground up!

1.3 What is that word, Arduino?

Have you heard about **Arduino**? If not, Arduino is this little circuit board created about 10 years ago which was designed to make programming hardware easy. I won't bore you with the details but that shit got huge. Now lots of people make Arduino-compatible boards (that use their simple programming software) and accessory boards with sensors and other batshit crazy stuff.

So rather than learning some arcane programming language and software tools, you're using one of the easiest programming tools ever created. And there are plenty of resources for learning and getting help out there. Here's a great set of tutorials to get started if you're new to Arduino in general:

https://www.arduino.cc/en/Tutorial/HomePage?from=Main.Tutorials

Okay, so buckle in and get ready to blow some minds.

CHAPTER

TWO

HEAR IT IN ACTION

Here are a few examples of effects created on the DreamMaker FX Platform.

2.1 Perpetuity

Link to effect on DreamMakerFx.com: https://www.dreammakerfx.com/pedal-designs/Perpetuity

This effect allows you to "catch" a note which will ring out indefinitely.

Hold down the left footswtich to "catch" a note which will ring out indefinitely. Press and hold down the left footswitch to layer on more notes to create a sonic canvas to play over. Tap the right footswitch to release the held notes. When the left footswich is held down to capture notes, the clean channel is muted so you only hear the swell of the capture droning notes. This effect works by running the notes through an ADSR envelope so it quickly fades in and then fades out. This audio is then sent to four delay lines that are staggered so the attack / decay of the note becomes a solid wall of sound.

2.2 Pentatonic Theramin

Link to effect on DreamMakerFx.com: https://www.dreammakerfx.com/pedal-designs/Pentatonic-Theramin

This effect doesn't use an instrument at all. Or rather, you are the instrument. This effect requires a SparkFun distance sensor connected to the sensor port on the DreamMaker FX (https://www.sparkfun.com/products/14722).

It uses the synth engine along with some gentle effects to create a theramin that operates over the pentatonic scale. And when there is nothing in front of the sensor, the tones turn off.

Sensors can be wired to really any effect parameter so it creates a lot of interesting opportunities for new kinds of expression.

2.3 Multitudes

Link to effect on DreamMakerFx.com: https://www.dreammakerfx.com/pedal-designs/Multitudes

A cool, multi-layer delay effect created by Joe Dougherty. Consists of a variable length delay pedal where the feedback path of the main delay ("driver") is routed to a secondary delay ("propagator").

2.4 Stereo Reverb

With the immense amount of processing power and on-board RAM, we can create very rich, intricate reverbs using a few of the building blocks (multi-tap delays, all-pass filters, biquad filters, variable delays, and regular delays).

Here's an example of a stereo reverb that consumes about 10% of the available processing resources on the SHARC DSP.

2.5 Polyphonic Guitar Synth

Link to effect on DreamMakerFx.com: https://www.dreammakerfx.com/pedal-designs/Polyphonic-guitar-synth-pedal

The DreamMaker FX platform can track multiple notes being played simultaneouly and create various synth effects from these notes.

This is a polyphonic guitar synth meaning that it tracks multiple strings. It uses an FM synth engine along with ADSR envelope generator and an output filter. The pedal is configured by default to use a triangle (OSC_TRIANGLE) wave that is modulated with a sine wave (OSC_SINE). However, lots of interesting sounds can be created by swapping these out with out types of oscillators (e.g. OSC_SQUARE, OSC_RAMP_POS, OSC_RAMP_NEG, OSC_RANDOM, etc).

CHAPTER

THREE

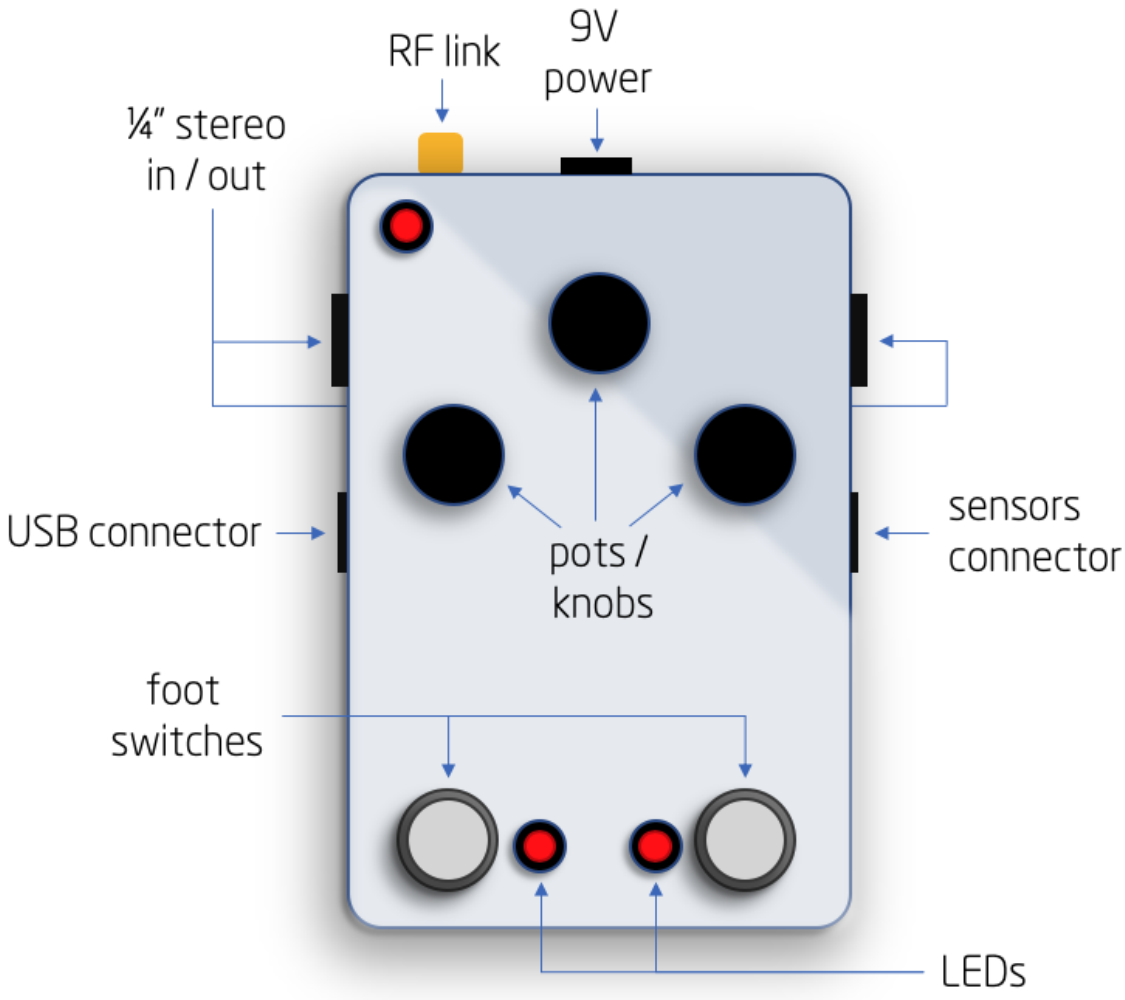
MEET THE HARDWARE

3.1 Gen 1: The Dream Lemur

The first generation hardware was designed in the spring of 2019 and manufactured during the summer.

Features:

- 450MHz SHARC DSP + SAMD51 processor (running Arduino stuff)
- Stereo in / Stereo out @ 48kHz sampling rate
- Short (QWIIC) and long range (CAT-5) sensor interfaces
- Wireless sensor interface (via RF transceiver)
- USB connector (for programming and debug)
- 3 pots
- 2 footswitches
- 2 red LEDs



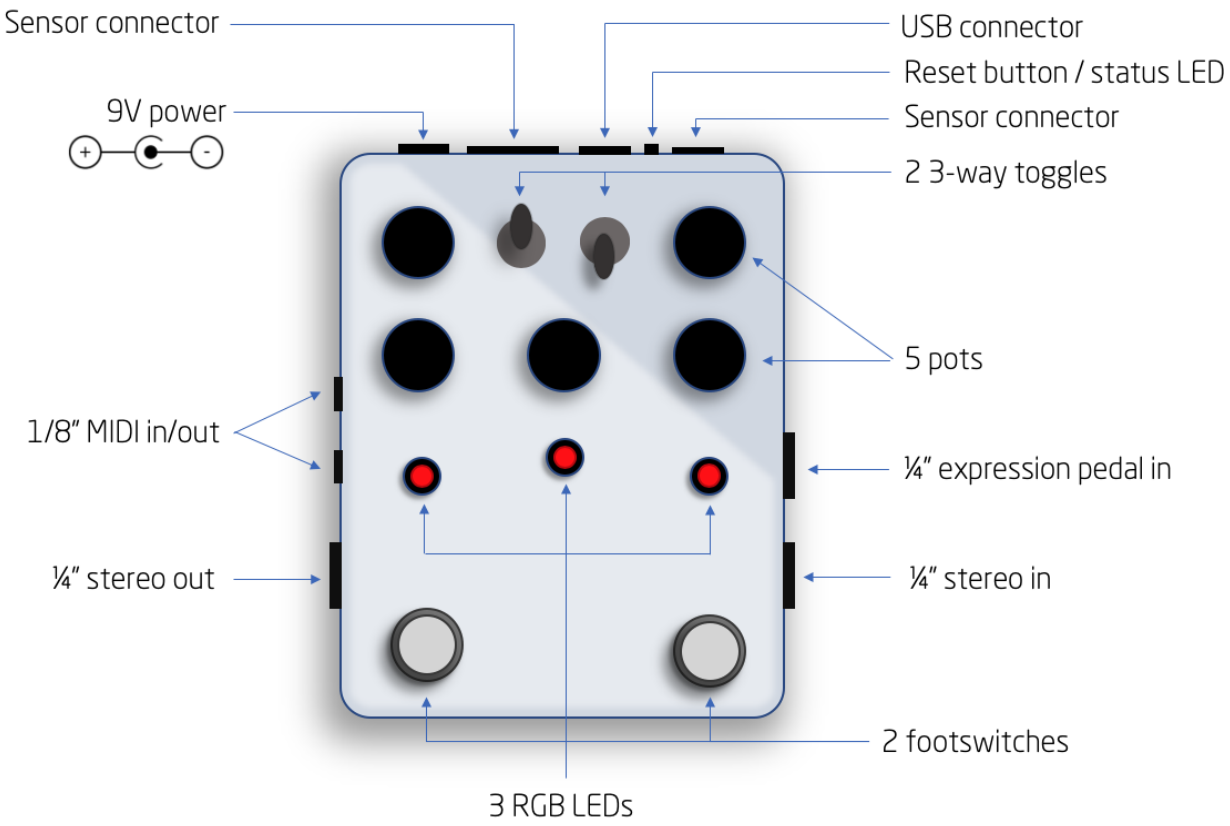
3.2 Gen 2: The Beyonder

The design for the second generation hardware began as soon as we started using the first generation and realized all the things that could be improved. Our first gen-2 hardware is in house and working great so far.

Features

- 450MHz SHARC DSP + SAMD51 processor (running Arduino stuff)
- Stereo in / Stereo out @ 48kHz sampling rate
- Expression pedal
- MIDI in / out
- Short (QWIIC) and long range (CAT-5) sensor interfaces
- USB connector (for programming and debug)
- 5 pots

- 2 footswitches
- 3 RGB LEDs
- 2 3-way toggles



CHAPTER

FOUR

INSTALLATION

This page offers instructions for first time installs and subsequent updates. Half the fun of this platform is that it is always evolving with new modules and capabilities. Once you have the Arduino tools installed, you can check for DreamakerFX updates which bring with them new capabilities and enhancements!

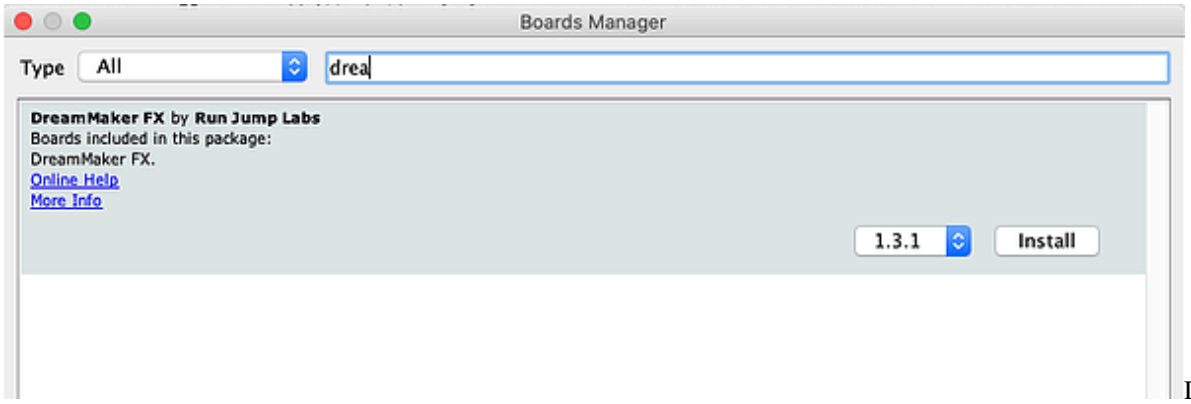
4.1 First time installation

The DreamMaker FX hardware currently supports Windows 10, OS X, and probably Linux. If you're running Windows 7, there are a few additional steps that are required to get the UF2 USB device drivers installed.

First order of business, let's go download some free software and get rolling.

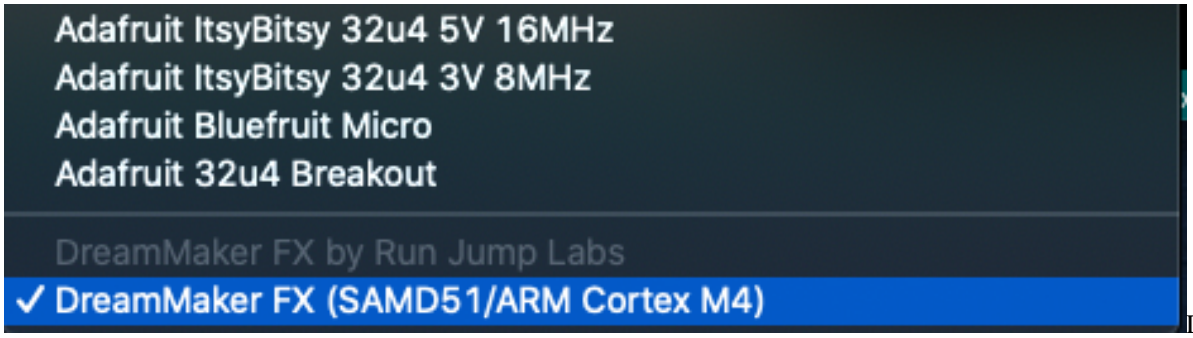
- Download and install the Arduino IDE: https://www.arduino.cc/en/main/software
  - Accept the defaults
  - You may be prompted to install several additional drivers; install them.
  - If you're running OS X Catalina, make sure you're using Arduino v1.8.10 or later.
  - Click `Finish` when the installs are complete.
- Plug the Dream Lemur into an outlet, and connect to a USB port on your computer with a MicroUSB cable. Make sure the USB cable you are using is not a charging cable. There are lots of microUSB charging cables out there that just have wires for power and ground and no data! If you don't see the `DM_FX` drive/volume show up on your computer, you may need to put your pedal into bootloader mode. See the Troubleshooting section for details on how to do this.
- Install the DreamMaker FX Arduino board package In the Arduino IDE:
  - Navigate to either `File` -> `Preferences` on Windows, or `Arduino` -> `Preferences` on Mac. If you're using Linux, we assume you're enough of a bad ass to figure out what to do.
  - In the preferences window, find the text field toward the bottom called `Additional Boards Manager URLs`.
  - Copy and paste the following into that text field: `https://runjumplabs.github.io/arduino-board-index/package_dreammaker_fx_index.json`
  - Click OK to close the preferences window.
  - Navigate to `Tools` -> `Board` -> `Board Manager`.

  - Either type `dream` in the search box, or scroll down until you find `DreamMaker FX by Run Jump Labs`.
  - Click `Install`. This will take a few minutes; then hit `Close`.



DreamMaker FX package

- Select the DreamMaker FX hardeare
  - Navigate to `Tools` -> `Board`. At the very bottom of the list you should see `DreamMaker FX (SAMD51/ARM Cortex M4`. Select it.



DreamMaker FX package

- Make some bitchin' effects and play some rock and/or roll very loudly.

The setup process is very similar to Adafruit boards which use the same Arduino processor (Atmel SAMD51 family). This page may offer some additional help https://learn.adafruit.com/adafruit-metro-m4-express-featuring-atsamd51/setup.

4.2 Updating the DreamMaker FX Arduino package

There are always updates happening with new effects, bug fixes and improvements! When you do a first time install, you'll have the latest and greatest. However, it's always good to check back to see if there are updates.

- In the Arduino program:
  - Navigate to `Tools` -> `Board` -> `Board Manager`.
  - Either type `dream` in the search box, or scroll down until you find `DreamMaker FX by Run Jump Labs`.
  - Select the latest version from the pull-down menu; then hit `Update`

A cool feature is that the firmware running on the DSP is automatically updated the first time you download a sketch after an update to the latest version. When you download the effect, you'll see some messages in the serial monitor that the update is happening (just takes a few seconds). The firmware update only happens when the system detects that the firmware on the DSP is a different version than what is running in the Arduino code.

CHAPTER

FIVE

THE ANATOMY OF AN EFFECT

Let's start by learning the anatomy of a basic Arduino "Sketch" (aka "program" in Arduino speak).

With the Arduino app open, go to File->New. You'll see a new text editor window appear with a new "sketch". This sketch will come pre-populated with two *functions*. One is called `setup()` and another is called `loop()`.

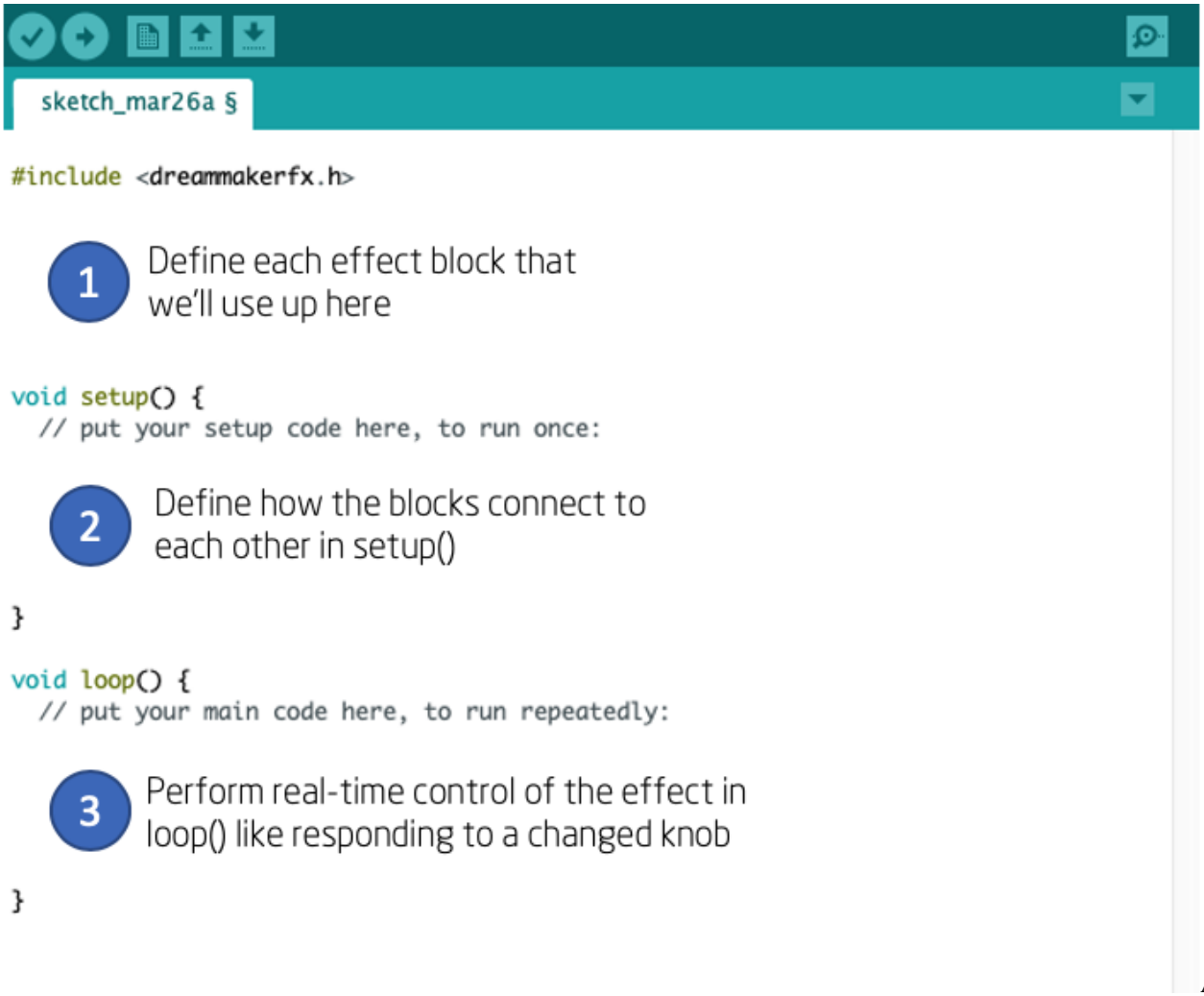
When the sketch is downloaded to our hardware, it will first run any commands in the `setup()` function once. And then it will run the `loop()` function repeatidly. Each time you power up the board, it goes through the same sequence (run `setup()` once and then run `loop()` indefinitely).

When creating effects, there are three places we'll add code.

First (in area #1), we'll define / "declare" which effects building blocks we'll be using at the very top of the file. We can declare up to 100 effect blocks (for example, if you wanted to create 100 delay lines and wire them together, go for it!).

Next (in area #2), we'll define how these building blocks connect to the audio in / out jacks and to each other. We can also route control signals between the effect blocks here too.

Finally (in area #3), we'll add any real-time controls of the effect parameters. This is where we, for example, respond to a pressed footswtich, changed knob or switch.



Anatomy of an effect

While some effects may look complex at first glace, they all really have these three components.

CHAPTER

SIX

TUTORIAL #1: BASIC DELAY PEDAL

As mentioned earlier, one doesn't have to be an experienced programmer to use this platform. The coding patterns for creating various effect and synth components, wiring them together and controlling their parameters is pretty straight forward.

6.1 Basic Arduino anatomy

Let's start by creating a simple echo effect to see how the pieces fit together.

6.2 1. Add the effects library of functions

At the top of the file, we'll add a line that will link in all of the functions, variables and objects that you'll use to create your effects. At the very top of the file, add `#include <dreammakerfx.h>`. You'll add this line to the top of every Arduino sketch you create for this platform.

```
// Include DreamMaker FX library of effects routines
#include <dreammakerfx.h>
```

6.3 2. Add any effects or synthesis *objects*

Above the setup routine, we will add (aka *declare*) any effect and synth *objects* that we'll be using. When we add an object, in many cases we will also provide the initial parameters.

In this case, we are going to create a single echo / delay effect object and name it `my_echo_1`. When we initialize an echo object, it takes two *arguments* or initial parameters. The first is how long the echo is in milliseconds (1000th of a second). And the second is the *feedback* ratio (between 0.0 and 1.0) which determines how much audio is fed back into the echo and thus how long the echo lasts. If feedback is set to 1.0, it will echo forever. And if feedback is set to 0.0, it won't echo at all. Let's set the echo length to be 1 second (or 1000 milliseconds) and the feedback ratio at 0.7.

Add the following code after your `#include <dreammakerfx.h>` line.

```
// Create/declare one echo effect and configure it
fx_delay   my_echo_1(1000.0,  // 1 second echo
                     0.7);    // 0.7 feedback ratio
```

6.4 3. Route the effect into our pedal

Next, in the `setup()` routine, we need to initialize our effects `pedal` and route the audio from the pedal in and out jacks through the various effects and synth objects we're using.

```
void setup() {

  pedal.init();

  // Connect our effect(s) to input and output jacks
  pedal.route_audio(pedal.instr_in, my_echo_1.input);                // Instr in ->␣
↪echo in
  pedal.route_audio(my_echo_1.output, pedal.amp_out);                // Echo out ->␣
↪Amp out

  pedal.run();     // Run the effect

}
```

Let's deconstruct what we just did here.

First, we *called* the `pedal.init();` function to set up our system.

Next, we connected the audio from the input jack of our pedal (aka `instr_in`) to the input of our echo object (aka `my_echo_1.input`) using the `route_audio()` function.

Each effect and synthesis object has a set of input and outputs that can "routed" or virtually "wired" together. There are also some inputs and outputs that are part of the pedal itself. Presently, there is an `instr_in` input (audio in from our instrument) and `amp_out` output (audio out towards our amp).

In this case, we just have one object. We routed / wired the instr_in to the input of our `my_echo_1` object. And then we routed / wired the output of our `my_echo_1` object to the pedal output.

And finally, we call `pedal.run();` which takes our effect configuration, performs the magic, sends it over to the DSP where the effects are run.

6.5 4. Add service function to our loop

The last thing we need to do is add the `pedal.service();` function call in our `loop()` function. This function basically checks in the with the DSP, updates any parameters that need to be updated, and retrieves information from the DSP.

```
void loop() {
  // put your main code here, to run repeatedly:
```

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```
  // sweet nothings to/from DSP
  pedal.service();
}
```

6.6 Bringing it all together

Let's now look at the whole echo effect:

```
// Include our library of effects routines
#include <dreammakerfx.h>

// Create/declare one echo effect and configure it
fx_delay   my_echo_1(1000.0,  // 1 second echo
                     0.7);    // 0.7 feedback ratio

void setup() {

  pedal.init();   // Initialize the system

  // Connect our effect(s) to input and output jacks
  pedal.route_audio(pedal.instr_in, my_echo_1.input);                // Instr in ->␣
↪echo in
  pedal.route_audio(my_echo_1.output, pedal.amp_out);                // Echo out ->␣
↪Amp out

  pedal.run();    // Run the effect

}

void loop() {
  // put your main code here, to run repeatedly:

  // sweet nothings to/from DSP
  pedal.service();
}
```

So you've just created a basic echo stomp box - congratulations!

6.7 Running the effect on hardware

Navigate to Tools -> Serial Monitor. This will bring up the console log. When your effect configuration is processed on the Arduino processor, some information will be sent to the console letting you know how things were routed and everything is okay. You'll also see the telemtry data from the DSP too so you can see if any effect failed to initialize or something went wrong.

Click the **Upload** button in the upper-left hand side of the Arduino IDE (it's the arrow pointing to the right). Your code will compile and then download to the board. After a second or two, you'll hear the echo effect applied to any audio you send through the pedal!

Once you have downloaded an effect, it is stored in memory on the pedal. If you disconnect the pedal and plug it in later, it will start up running the same effect. To overwrite the effect currently stored in the pedal, just press the reset button twice in quick success to upload a new effect.

CHAPTER

SEVEN

THE BASICS OF CREATING / ADDING EFFECTS

As you hopefully remember from 12 seconds ago, we create/declare the effects we want to use at the top of program.

```
// Create/declare one echo effect and configure it
fx_delay    my_echo_1(1000.0, 0.7);
```

The first word (which in this case is `fx_delay`) is the *type* of effect we want to create. The API docs (and the next section) contain the complete list of the effects that are available.

We then provide a name for our effect object (which in the example above is `my_echo_1`). This needs to be a unique word with no spaces (just characters and underscores really).

And finally, we provide the initial parameters for that effect (i.e. where the knobs are set initially).

Again, the Effect Blocks section on the left contains documentation for each of the various effect blocks that are available.

What's neat is that this *object* then becomes its own stand-alone effect. We can create multiple objects of the same type in our program (i.e. multiple delays in this case) that each have their own parameters and which are each wired-in in their own ways.

```
// Create/declare one echo effect and configure it
fx_delay    my_echo_1(1000.0, 0.7);
fx_delay    my_echo_2(2000.0, 0.8);     // Totally legit!
```

Just make sure each object you create/declare in your system has a unique name even if they are different effect types. For example, don't do this:

```
// Create/declare one echo effect and configure it
fx_delay        ricky_bobby(1000.0, 0.7);
fx_pitch_shift  ricky_bobby(0.8);     // BAD! DON'T DO THIS, ricky_bobby already␣
↪exists!
```

Oh yeah, this is important: in some cases an effect will have a few different ways you can initialize it. Most effects have a *simple* initializer that you just need to pass one or two values to. And, they may have a more *advanced* initializer that allows you to do ever more things with that effect. Usually the advanced initializer is a super-set of the simple initializer.

Here's an example of us initializing two `fx_amplitude_mod` objects with both the simple and advanced initializer functions:

```
fx_amplitude_mod    tremelo_1(1.0,      // Rate is 1Hz
                              0.5);     // Depth is 0.5 (0->1)
fx_amplitude_mod    tremelo_2(1.0,       // Rate is 1Hz
```

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```
                                0.5,        // Depth is 0.5 (0->1)
                                OSC_TRI,    // Modulation waveform is triangle instead of␣
↪sine
                                false);     // Not using an external signal as our␣
↪modulator
```

The beauty of this is that we have a DSP platform with tons of memory and lots of DSP processing power so you can create effects that incorporate several different individual effect objects / instances.

CHAPTER

EIGHT

THE BASICS OF ROUTING AUDIO

Get ready because we're going to start using the word *node* a lot. I hope that's okay. A node is what it sounds like: it's a *node*. Or a point of connection.

8.1 Effect audio nodes

Each effect has one or more *nodes* that can pipe audio into it or out of it. All effects that process audio have both an `input` node and an `output` node. Things like an envelope tracker that are just measuring an audio signal may just have an audio `input` node but no audio `output` node. Also, some effects have additional nodes beyond `input` and `output` and this is where shit gets real. Did you see the movie Inception? That question will make sense eventually.

Details on the nodes that each effect has can be found in Appendix A.

8.2 System audio nodes

And the system has *nodes* for input from instrument and output to amp.

- `pedal.instr_in` is the input jack of the pedal. This might blow your mind, but this is actually an output jack in the sense that it is outputting audio that we can send to the inputs of other effects.
- `pedal.amp_out` is the output hack of the pedal. This might blow your mind again, but this is actually an input jack in the sense that it is receiving audio from other effects (and then sending to the amp).

8.3 Connecting nodes

As we just saw in the echo example, there is a function called `route_audio` that we use to connect our effects to the input and output jacks of the pedal and also to each other. The first *argument* of this function is an output node and the second *argument* is an input node.

Let's use it in a (programming) sentence. In this example, we're going to have a tremelo that then feeds into a delay. It'll be like having your guitar plugged into a tremelo pedal that then plugs into a delay pedal that then plugs into your amp.

(*note: if it's not yet obvious, you can call each effect you create just about whatever you want*).

```
// Create objects for these effects
fx_amplitude_mod  happy_tremelo(1.0, 0.5);       // 1Hz rate, 0.5 depth
fx_delay          sweet_baby_echo(1000.0, 0.7); // 1000ms, 0.7 feedback


void setup() {
  pedal.init();   // Initialize the system

  // Route tremelo through echo/delay effect
  pedal.route_audio(pedal.instr_in, happy_tremelo.input);
  pedal.route_audio(happy_tremelo.output, sweet_baby_echo.input);
  pedal.route_audio(sweet_baby_echo.output, pedal.amp_out);

  pedal.run();    // Run the effect
}
```

Or let's get more crazy. Let's say we have a delay pedal and each time through the delay, we're going to pitch shift up. So it would sound like this: ECHO Echo echo echo (where each time you say 'echo' you say it in a lower pitch voice).

The fx_delay has two additional nodes called `fx_send` and `fx_receive`. We're going to run these through our handy-dandy pitch shifter. For this, we're going to use the more advanced delay setup function that allows us to pass a few additional parameters (more info in Appendix A on this):

```
// Create objects for these effects
fx_delay          echoey_snail(1000.0,     // Delay length: 1000ms
                               1000.0,     // Max delay length: 1000ms
                               0.7,        // Feedback: 0.7
                               1.0,        // Feedthrough: 1.0
                               true);      // Enable delay fx loop
fx_pitch_shift    shift_down(0.85);        // Pitch shift down 0.85 x current pitch


void setup() {
  pedal.init();   // Initialize the system

  // input -> delay -> output
  pedal.route_audio(pedal.instr_in, echoey_snail.input);
  pedal.route_audio(echoey_snail.output, pedal.amp_out);

  // Now patch in pitch shifter into delay fx loop
  pedal.route_audio(echoey_snail.fx_send, shift_down.input);
  pedal.route_audio(shift_down.output, echoey_snail.fx_receive);

  pedal.run();    // Run the effect
}
```

Pretty cool, right?

8.4 A few routing rules

Obey these rules to avoid humiliation and sadness:

An output node can be routed to multiple input nodes

```
pedal.route_audio(pedal.instr_in, delay_1.input);
pedal.route_audio(pedal.instr_in, delay_2.input);
```

An input node can only have one input. However, you can use the `fx_mixer` nodes if you want to send multiple outputs to an input.

```
pedal.route_audio(delay_1.output, my_mixer_2.input_1);
pedal.route_audio(delay_2.output, my_mixer_2.input_2);
pedal.route_audio(my_mixer_2, pedal.amp_out);
```

And you can't route input nodes to other input nodes, or output nodes to other output nodes. It's always output->input.

CHAPTER

NINE

THE BASICS OF CONTROLLING EFFECTS

We've been talking a lot about getting effects set up and running. Now let's talk about how to change the proverbial knobs on the effects once they're running.

Now, take a deep breath and get comfortable because this next sentence is important. There are two ways we can control effects:

1. we can use other effects that generate control signals (like the envelope tracker) to control the parameters of other effects or...
2. we can control the parameters directly from our Arduino program.

9.1 Option 1: Using effect control nodes

Similar to our audio nodes, all effects have several *control nodes* that are inputs for controlling their individual parameters (like delay length and feedback). Some effects have *control node* outputs like the envelop filter which are control signals based on the audio going through these effects.

Remember when you read "an envelope tracker is just measuring an audio signal and may just have an audio `input` node but no audio `output` node"? Well, the envelop tracker has an *audio* `input` node and a *control* `output` node. Similarly, a synth have a *control* `input` node (like a musical node to play) but have an *audio* `output` node where the synthesized audio is sent.

We can route these control signals just like we do audio signals using the `route_control` function.

For example, let's say we wanted to create a sweet envelope filter. Essentially what an envelope filter is a bandpass filter that changes frequency based on how loud you are playing. So what we want to do is take the output of the envelop tracker (which tracks how loud the notes we play are) and send this to the center frequency control parameter of a bandbass filter.

Before we get into building this effect, here's one important detail about how we use the `route_control` function: The `route_control()` function takes two additional values beyond the input and output node: an offset and a scale factor. Here's what that means. The envelop tracker will generate a control signal between 0 and 1.0 indicating the current volume of the notes we're playing. However, we want to sweep our filter from say 600Hz to 1400Hz (typical range of a wah pedal). So we want to scale our signal that goes from 0 to 1 to one that goes from 600 to 1400. So we'll use an offset of 600.0 and then the signal by 800.0. Here's the equation to keep in the back of your brain:

```
output = (input x scale_factor) + offset_factor
```

So let's create our envelop filter:

```
fx_biquad_filter    auto_wah_filter(800.0,               // Initial frequency is
                                    FILTER_WIDTH_NARROW, // Filter is narrow
                                    BIQUAD_TYPE_BPF);    // Filter type is bandpass

fx_envelope_tracker vol_tracker(10,       // 10ms attack
                                1000);    // 1000ms / 1s release

void setup() {
  edal.init();   // Initialize the system

  // input -> filter -> output
  pedal.route_audio(pedal.instr_in, auto_wah_filter.input);
  pedal.route_audio(auto_wah_filter.output, pedal.amp_out);

  // Also send audio in to our envelope tracker to measure the signal
  pedal.route_audio(pedal.instr_in, vol_tracker.input);

  // Finally, route the control signals so the envelope tracker can control
  // the filter with scale and offset values
  pedal.route_control(vol_tracker.envelope, auto_wah_filter.freq, 800.0, 600.0);

  pedal.run();    // Run the effect
}
```

9.2 Option 2: Directly controlling parameters

All effects also include dedicated routines for controlling their parameters. When these routines are called, the effects running on the DSP are immediately updated so these happen in real time.

The `loop()` function is where we can make these modifications.

Now the question is what value would we use to modify these effects. We happen to have three knobs or "pots" as they're known (short for potentiometer which is a variable resistor). In our loop function, we can check if these knobs have changed and updated parameters accordingly.

Let's return to our delay effect. We want our first knob (aka pot0) to control the length of the delay and the second knob to control the feedback. The pot values vary from 0.0 (all the way left) to 1.0 (all the way right).

```
// Include our library of effects routines
#include "dm_fx.h"

// Create/declare one echo effect and configure it
fx_delay   my_echo_1(1000.0,  // 1 second echo
                     0.7);    // 0.7 feedback ratio

void setup() {

  pedal.init();   // Initialize the system

  // Connect our effect(s) to input and output jacks
  pedal.route_audio(pedal.instr_in, my_echo_1.input);
  pedal.route_audio(my_echo_1.output, pedal.amp_out);

  pedal.run();    // Run the effect
```

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```
}

void loop() {
  // put your main code here, to run repeatedly:

  // Control delay length with pot0
  if (pedal.pot_left.has_changed()) {
    my_echo_1.set_length_ms(pedal.pot_left.val * 1000.0);
  }

  // Control delay feedback with pot1
  if (pedal.pot_right.has_changed()) {
    my_echo_1.set_length_ms(pedal.pot_right.val);
  }

  // sweet nothings to/from DSP
  pedal.service();

}
```

The next section has more details on how to use the knobs and pots.

9.3 Option 3: Controlling effects with external sensors

Where things get really cool is when we begin using sensors and other sources outside the pedal to set parameters. We could use a motion sensor to control a parameter like so

```
void loop() {
  my_echo_1.set_length_ms(motion_sensor_position);

  // sweet nothings to/from DSP
  pedal.service();
}
```

CHAPTER

TEN

BUTTONS, KNOBS AND LIGHTS

The DreamMakerFX platform has a few buttons and knobs on it. Each of these is completely programmable.

10.1 Configuring the Buttons (aka Footswitches)

The buttons can be set up to do the following:

1. Bypass the entire effect like a typical bypass switch on a pedal
2. Tap in a tempo or delay lenght
3. Behave as a momentary effect (i.e. while button is held down, do one thing and when it is release, do something else)
4. Behave as a toggle for an effect (i.e. tap it once to turn something on, tap it again to turn it off).

10.2 1. Configuring the button as a pedal bypass switch

To configure either the left or right footswtich to become the bypass button for the effect, we use the `pedal.add_bypass_button()` function while defining our pedal routes in `setup()`. When we *call* the `pedal.add_bypass_button()` function, we tell it which footswtich to use as the bypass button by using either `FOOTSWITCH_LEFT` or `FOOTSWITCH_RIGHT` as the *argument*.

Let's revisit our delay function and set it up to use the left footswitch as the bypass button. If you don't add a bypass switch, the effect will just start running out of the gate.

```
void setup() {

  pedal.init();   // Initialize the system

  // Connect our effect(s) to input and output jacks
  pedal.route_audio(pedal.instr_in, my_echo_1.input);                    // Instr in ->␣
↪echo in
  pedal.route_audio(my_echo_1.output, pedal.amp_out);                    // Echo out ->␣
↪Amp out

  // Left foot switch is bypass
  pedal.add_bypass_button(FOOTSWITCH_LEFT);
```

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```
  pedal.run();    // Run the effect

}
```

10.3 2. Configuring the button to be a tap delay/tempo button

A tap function allows you to tap the switch at a certain tempo/rate. The Arduino will lock onto this tap rate and it can be used to update things like the rate of a tremelo and the length/time of an echo effect.

To configure either of the footswitches to be a tap delay/tempo button, we use the `pedal.add_tap_interval_button()` function. Just like the pedal bypass function, we can use either footswitch as our tap delay/tempo input. We just can't use the same footswitch that we're using for bypass. The `pedal.add_tap_interval_button()` takes two arguments. The first is the foot switch we want to use (either `FOOTSWITCH_LEFT` or `FOOTSWITCH_RIGHT`). The second argument determines if we want the LED next to the footswitch to flash at the same rate. Setting the second argument to `true` will enable the LED strobe and setting it `false` will disable the LED strobe.

Let's again revisit the delay function and add the ability to "tap in" a new delay length using the right footswitch.

```
void setup() {

  pedal.init();   // Initialize the system

  // Connect our effect(s) to input and output jacks
  pedal.route_audio(pedal.instr_in, my_echo_1.input);                // Instr in ->␣
↪echo in
  pedal.route_audio(my_echo_1.output, pedal.amp_out);                // Echo out ->␣
↪Amp out

  // Left foot switch is bypass
  pedal.add_bypass_button(FOOTSWITCH_LEFT);

  // Right foot switch is our tap delay lenght input and turn on LED strobe
  pedal.add_tap_interval_button(FOOTSWITCH_RIGHT, true);

  pedal.run();    // Run the effect

}
```

In our `loop()` function, we call `pedal.new_tap_interval()` to determine if the user has tapped in a new tempo and if so, what we want to do about it. If the user has just tapped in a new tempo/delay lenght, this function will **return** `true` and if this user has not, it will return `false`.

We then have two options in terms of how we read the tap interval. Some effects take a period of time (tyically in milliseconds) as an argument like fx_delay. Other effects that use an oscillator take a rate (typically cycles per second).

If we are reading the newly tapped interval for a function that uses time in milliseconds, we use `pedal.get_tap_interval_ms()`. And if we are reading the newly tapped interval for a function that uses rate in Hertz, we use `pedal.get_tap_freq_hz()`.

In this case, we are using a delay function so when we detect that we have a new tap interval from the user, we're going to update the length of the delay effect using the tap interval in milliseconds (e.g. using `pedal.get_tap_interval_ms()`).

```
loop() {
  // If new delay time has been tapped in, use that
  if (pedal.new_tap_interval()) {

          // Update delay length with new tap interval
    my_delay.set_length_ms(pedal.get_tap_interval_ms());
  }

  // Service pedal
  pedal.service();

}
```

If we also have the option to change the tempo / time of an effect with other means (like a pot), we may want to update the rate the light is flashing. In this case, we can use `pedal.set_tap_blink_rate_ms()` and `set_tap_blink_rate_ms()` to set a new blink rate. First argument is which LED and the second is whether or not to flash the LED.

So with just a few lines of code, we've added the ability to tap in a tempo into the pedal to control the rate of LFOs (flangers, phasers, tremelos, vibratos, etc.) or the length of our delays.

10.4 3. Configuring the button to be a momentary switch

Sometimes it's nice to be able to hold a footswitch down to momentarily change the sound of the effect.

Here, we can use the `pedal.button_pressed()` and `pedal.button_released()` functions. The first argument is the footswitch to watch (either `FOOTSWITCH_LEFT` or `FOOTSWITCH_RIGHT`). And the second argument is whether to set the LED next to that footswitch while it is being held down. Similar to the others, this should be either `true` or `false`.

```
loop() {

          if (pedal.button_pressed(FOOTSWITCH_RIGHT, true)) {
            // Adjust one or more effect parameters when button is held down
          }
          if (pedal.button_released(FOOTSWITCH_RIGHT, true)) {
            // Adjust back one or more effect parameters when button is released
          }

  // Service pedal
  pedal.service();

}
```

10.5 4. Configuring the button to be a toggle switch

This will be implemented soon!

In the mean time, you can use the `pedal.button_pressed()` function like so to behave like a toggle:

```
loop() {

        static bool toggle = false;
```

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```
        static bool first_press = false;

        if (pedal.button_pressed(FOOTSWITCH_RIGHT, false)) {
          // Is this the first time though where button is pressed?
          if (first_press) {
             toggle = !toggle;
          }
          first_press = false;
        } else {
          // Reset so next time button goes low, we can respond on first press
          first_press = true;
        }

        // Do effect based on toggle state
        if (toggle) {
          digitalWrite(PIN_FOOTSW_LED_RIGHT, HIGH);
          // change effect parameter here when enabled
        } else {
          digitalWrite(PIN_FOOTSW_LED_RIGHT, LOW);
          // change effect parameter here when not enabled
        }

  // Service pedal
  pedal.service();

}
```

10.6 Configuring the Knobs (aka Pots)

Just like we have functions to detect when a user has pressed a button, we also have a similar function to detect when a user has adjusted one of the knobs (also known as potentiometerss or just "pots").

The fucnctions `pedal.pot_left.has_changed()`, `pedal.pot_center.has_changed()` and `pedal.pot_right.has_changed()` will return true if the corresponding knob / pot has been adjusted.

We then have two options for reading the value of the pot: `pedal.pot_0.val` and `pedal.pot_0.val_log`. In both cases, the range of values will be from 0.0 (full left / counter-clock-wise) to 1.0 (full right / clock-wise). However, the `pedal.pot_0.val_log` function applies a logarithmic curve to the value. This can be useful when you want a lot of precision at the low-end of the pot and less at the high end (such as setting frequencies).

The value of the pots will always be between 0.0 and 1.0 so in many cases, we'll need to scale these based on what aspect of the effect we are changing. For example, if want to use a pot to change the frequency range of a filter from 200.0Hz to 800.0Hz, we'll need to add an offset of 200.0 and then multiply by 600.0 (to map 0.0->1.0 to 200.0->800.0).

Let's add some pots to our delay effect to control time / length, feedback, and the wet/dry mix. Let's also add the ability to tap a delay and update the tap flash rate when the center pot has changed.

```
void loop() {

  // If new delay time has been tapped in, use that
  if (pedal.new_tap_interval()) {
    my_delay.set_length_ms(pedal.get_tap_interval_ms());
  }
```

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```
  // Left pot changes the volume of the first loop
  if (pedal.pot_left.has_changed()) {
    my_delay.set_feedback(pedal.pot_left.val);
  }

  // Right pot changes the wet / dry mix
  if (pedal.pot_right.has_changed()) {
    my_delay.set_dry_mix(1.0 - pedal.pot_right.val);
    my_delay.set_wet_mix(pedal.pot_right.val);
  }

  // Center pot can also be used to change the delay length
  // from 100ms to 3000ms
  if (pedal.pot_center.has_changed()) {
    float new_length_ms = 100.0 + pedal.pot_center.val*2900.0;
    my_delay.set_length_ms(new_length_ms);
    pedal.set_tap_blink_rate_ms(new_length_ms);
  }

  // Service pedal
  pedal.service();
}
```

10.7 Turning on and off the Lights (aka LEDs)

The two lights (aka LEDs) next to each footswtich can be controlled using the Arduino `digitalWrite()` function. The first argument is the footswitch LED `PIN_FOOTSW_LED_LEFT` or `PIN_FOOTSW_LED_RIGHT` and the next argument is whether is should be on / `HIGH` or off `LOW`.

To turn on the left LED, we'd do this: `digitalWrite(PIN_FOOTSW_LED_LEFT, HIGH)`. And to turn off that LED, we'd do this: `digitalWrite(PIN_FOOTSW_LED_LEFT, LOW)`.

CHAPTER

ELEVEN

USING THE API

There is an ever-growing list of effects and synth objects that can be routed and controlled in very interesting and novel ways. These building blocks can be routed together and novel ways. And, some building blocks and control the parameters of other building blocks.

- `fx_amplitude_mod` - Amplitude modulation continuously changes the volume of the audio running through it and can be used to create tremelo effects and more advanced gating effects.
- `fx_biquad_filter` - A basic audio filter that filters out certain frequency ranges of audio. This can be configured as a low-pass, high-pass, band-pass filter, etc. This block can be used for general EQ, wah pedals, auto-wahs and envelope filters.
- `fx_clipper` - Provides soft and hard clipping functions that can be used to create a wide variety of distortions. When combined with the `fx_biquad_filter`, a wide range of tones can be realized to recreate the sounds of tube-amps and distortion pedals.
- `fx_compressor` - A compressor/limiter block that provides dynamic volume control. This can be used to create a longer *sustain* effect on guitars and basses. It can also be used to keep our audio signals within range so we don't end up with output distortion.
- `fx_delay` - Used to create delay-based effects like echoes and reverbs.
- `fx_envelope_tracker` - Tracks the volume of the input signal and can be used to control other effects like `fx_biquad_filter` for creating an auto-wah / envelope filter.
- `gain` - Increases or decreases the volume of the audio signal.
- `fx_instr_synth` - Basically a guitar/bass synth. Generates synth tones based on the note that is being played. Follows string bends too. This will be vastly enhanced in next version of API to support polyphonic note tracking.
- `fx_looper` - A looper effect can capture a sample of audio and loop it indefinitely.
- `fx_mixer` - Provides a variety of mixers to mix multiple effect outputs into a single signal.
- `fx_oscillator` - Various oscillators that can be used to generate audio or control effects.
- `phase shift` - A phase shifter connected to an LFO.
- `fx_pitch_shift` - Adjusts the pitch of the incoming signal.
- `fx_ring_mod` - This one is bananas. It basically modulates the incoming signal with a sine wave to create wild harmonics.
- `fx_shaper` - Basically a synth that generates a wave at the same frequency, one octave below, and two octaves below. Each of the three synthesized signals has their own output channel so they can either be mixed or sent through different effects.
- `fx_slicer` - Chops up audio in time domain and sends to differnt channels. Great for making rhymthmic effects.

- `fx_variable_delay` - This is a short delay line that is varied in real time. This is core building block for flanger, chorus, and vibrato effects.

There are several other modules in development including reverbs, all-pass filter, automatic loop detector, etc.

11.1 Special parameters and constants

Some objects take inputs that aren't numbers but rather a constant that is chosen from a list. Below is a list of the constants that may be used when initializing an effect.

`BIQUAD_FILTER_TYPE`: Types of filters that can be implemented with `fx_biquad_fiter`

- `BIQUAD_TYPE_LPF` - low-pass filter (cuts out high frequencies)
- `BIQUAD_TYPE_HPF` - high-pass filter (cuts out low frequencies)
- `BIQUAD_TYPE_BPF` - band-pass filter (only lets a limited range of frequencies through)
- `BIQUAD_TYPE_NOTCH` - opposite of band-pass
- `BIQUAD_TYPE_PEAKING` - don't worry about it
- `BIQUAD_TYPE_L_SHELF` - similar to low pass
- `BIQUAD_TYPE_H_SHELF` - similar to high pass

`BIQUAD_FILTER_WIDTH`: How "wide" a filter is for use with `fx_biquad_fiter`

- `FILTER_WIDTH_VERY_NARROW` - very narrow indeed
- `FILTER_WIDTH_NARROW` - like a wah filter
- `FILTER_WIDTH_MEDIUM` - a bit narrow
- `FILTER_WIDTH_WIDE` - wide with flat response (q=0.7071)
- `FILTER_WIDTH_VERY_WIDE` - very wide

`ENV_TRACKER_TYPE`: Type of envelop tracking

- `ENV_TRACK_PEAKS` - haha, there is only one option - rides the peaks like riding the lion

`EFFECT_TRANSITION_SPEED`: How quickly to transition parameters when a parameter is modified (used in several effects)

- `TRANS_VERY_FAST` - rabbit
- `TRANS_FAST`
- `TRANS_MED`
- `TRANS_SLOW`
- `TRANS_VERY_SLOW` - turtle

`OSC_TYPES`: Types of oscillators (used in several effects)

- `OSC_SINE` - sine wave
- `OSC_TRI` - triangle wave
- `OSC_SQUARE` - square wave
- `OSC_PULSE` - pulse wave
- `OSC_RAMP` - ramp wave

POLY_CLIP_FUNC: Various clipping functions for use with fx_clipper

- POLY_SMOOTHSTEP - try it and see if you like it
- POLY_SMOOTHERSTEP - try it and see if you like it
- POLY_SIMPLE_1 - try it and see if you like it
- POLY_SIMPLE_2 - try it and see if you like it

CHAPTER

TWELVE

DEBUGGING SKETCHES

There are a few different resources that are available for debugging a sketch that isn't working as intended.

When initializing a sketch, you can enable debug by calling `pedal.init(true)` instead of `pedal.init()`. This will put the pedal in "debug mode" which means it will send information to the Serial Monitor (Tools->Serial Monitor). Open the Serial Monitor before downloading your sketch. Once the sketch is running, you'll see status info and any errors that were encountered while processing the routing information.

```
// Include our library of effects routines
#include <dreammakerfx.h>

// Create/declare one echo effect and configure it
fx_delay my_echo_1(1000.0,    // 1 second echo
                   0.7);      // 0.7 feedback ratio

void setup() {

   pedal.init(MSG_INFO); // Initialize the system and display additional information

   // Connect our effect(s) to input and output jacks
   pedal.route_audio(pedal.instr_in, my_echo_1.input);
   pedal.route_audio(my_echo_1.output, pedal.amp_out);

   pedal.run(); // Run the effect

}
```

You can also generate a report of the final routing and parameters by adding a few additional commands before calling `pedal.run()`. `print_instance_stack()` will show you all of the instances in the sketch. `print_routing_table()` will show you how the audio and control are wired up. And `print_param_tables()` will show you the parameters for each instance.

```
// Include our library of effects routines
#include <dreammakerfx.h>

// Create/declare one echo effect and configure it
fx_delay my_echo_1(1000.0,    // 1 second echo
                   0.7);      // 0.7 feedback ratio


void setup() {

   pedal.init(MSG_INFO); // Initialize the system
```

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```
    // Connect our effect(s) to input and output jacks
    pedal.route_audio(pedal.instr_in, my_echo_1.input);
    pedal.route_audio(my_echo_1.output, pedal.amp_out)

    // Print debug info to Serial Monitor
    pedal.print_instance_stack();
    pedal.print_routing_table();
    pedal.print_param_tables();

    pedal.run(); // Run the effect

}
```

CHAPTER

THIRTEEN

GENERAL TROUBLESHOOTING

13.1 Issue: DM_FX volume not showing up when plugging pedal into USB port

There are a few common reasons why a pedal doesn't show up when plugging it into USB

- The pedal also needs to be plugged into the wall as it is not USB powered. Go plug it in.
- The cable is a USB charging cable and doesn't have any data wires. Find a different cable.
- The pedal needs to be placed in bootloader mode. Place the pedal in bootloader mode per the description below.
- If you're running Linux or Windows 7, this may be an Arduino driver issue. Make sure you're running the latest version of the Arduino IDE.

13.2 Issue: SAM-BA operation failed error while downloading an Arduino sketch

When clicking the download button, sometimes the download process will stop.

When this happens, wait for the Arduino IDE to display the message `"SAM-BA operation failed"` which usually happens a few seconds after the download process stops. Then, put the pedal into bootloader mode as shown below. You should see the DM_FX drive/volume appear on your computer after you do this. You should now be able to download without issue.

13.3 Issue: After downloading my sketch, one footswitch LED is on and the other is periodically strobing

If the pedal encounters an error while downloading your sketch, it will turn on the left LED and periodically strobe the right LED. The number of times the right LED strobes in quick succession indicates the issue the pedal encountered.

- 2 flashes - the pedal encountered an illegal routing combination (e.g. two output nodes connected to an input node). Try using debug mode as described in the Debugging Sketches article.

- 3 flashes - the firmware running on the DSP does not match the Arduino package version. Make sure your firmware is up to date.
- 5 flashes - the DSP is not running or responding. Run for the hills.

13.4 Issue: I am getting a "bad CPU type in executable" error when compiling my sketch

Upgrade your Arduino tools to version 1.8.10 or later. This is a known issue running Arduino on OS X Catalina.

13.5 Issue: When building my sketch, error "dreammakerfx.h: No such file or directory"

If you encounter the following error while compiling your sketch, it likely means you don't have the right board selected in the Arduino tools.

```
exit status 1
Dreammakerfx.h: No such file or directory
```

First, make sure you have the DreamMakerFX package installed as described in the Installing section. Then, make sure you have the DreamMakerFX hardware selected. Go to Tools->Boards and you'll see a number of different Arduino boards listed in the menu. At the end of the list in the menu, you should see DreamMaker FX (SAMD51/ARM Cortex M4 Core). Select this and try compiling again.

13.6 Placing the pedal in bootloader mode

To place the pedal into bootloader mode, follow this process:

Placing DreamMaker FX into bootloader mode

In rare circumstances, the pedal may not respond to the bootloader sequence. In this case, remove the back cover of the pedal and press the reset button on the circuit board twice in quick succession while the pedal is powered up. A small LED near the USB connector should flash a few times and then slowly strobe in and out (like it is breathing). This will also put the pedal into bootloader mode. You should see the DM_FX drive/volume appear on your computer after you do this. You should now be able to download without issue.

CHAPTER

FOURTEEN

CLASS FX_PEDAL

- Defined in file_src_dreammakerfx.h

14.1 Class Documentation

class fx_pedal

The pedal.

The `pedal` object is the root of all functionality on DreamMakerFx. We reference this object when wiring effects together and controlling the various knobs, buttons, lights, etc.

An effect will always have a few common elements:

```
#include <dreammakerfx.h>

void setup() {

  // Initialize the pedal hardware
  pedal.init();

  // Route audio through the pedal to any effects modules
  pedal.route_audio(pedal.instr_in, pedal.amp_out);


  // Run the effect on the DSP
  pedal.run();

}

void loop() {

  // Exchange information wiht the DSP
  pedal.service();

}
```

There are several other functions that control the buttons, lights/LEDs, knobs/pots and toggle switches.

Public Functions

fx_pedal()

void **init**(void)
Initializes the pedal object with default debug level (just warnings and errors)

void **init**(DEBUG_MSG_LEVEL *debug_level*)
Initializes the pedal object with user defined debug level.

Parameters

- `[in] debug_level`: The debug level to display (MSG_DEBUG, MSG_INFO, MSG_WARN, MSG_ERROR)

void **init**(DEBUG_MSG_LEVEL *debug_level*, bool *dsp_no_reset*)
Initializes the pedal object with used defined debug level, bypasses DSP reset.

Parameters

- `[in] debug_level`: The debug level to display (MSG_DEBUG, MSG_INFO, MSG_WARN, MSG_ERROR)
- `[in] dsp_no_reset`: The dsp no reset (set to true to bypass reset)

void **init**(bool *debug_enable*)

void **init**(bool *debug_enable*, bool *dsp_telem*)

bool **run**(void)
Runs the current canvas (i.e. compiles and downloads to the DSP)

Return True if successful, false if not

void **service**(void)
Pedal service function that should be called in the Arduino loop() function.

bool **route_audio**(fx_audio_node **out*, fx_audio_node **in*)
Routes a source node (output) to a destination mode (input)

Return True is successful, false if not

Parameters

- `src`: The source / output
- `dest`: The destination / input

bool **route_control**(fx_control_node **src*, fx_control_node **dest*)
Route a control source node (output) to a destination mode (input)

Return True is successful, false if not

Parameters

- `src`: The source node (should be an output)
- `dest`: The destination node (should be an input)

bool **route_control** (fx_control_node *_src_, fx_control_node *_dest_, float _scale_, float _offset_)
Route a control source node (output) to a destination mode (input)

Return True is successful, false if not

Parameters

- `src`: The source node (should be an output)
- `dest`: The destination node (should be an input)
- `[in] scale`: The scale to apply to the control value
- `[in] offset`: The offset to apply to the control value

void **add_bypass_button** (FOOTSWITCH _footswitch_)
Set one of the footswitches to be a bypass button.

This function will also set the corresponding LED to turn on and off when bypass is disabled / enabled.

Parameters

- `[in] footswitch`: The footswitch (FOOTSWITCH_RIGHT, FOOTSWITCH_LEFT)

void **add_tap_interval_button** (FOOTSWITCH _footswitch_, bool _enable_led_flash_)
Set one of the footswitches to be a tap tempo / length button.

Parameters

- `[in] footswitch`: The footswitch (FOOTSWITCH_RIGHT, FOOTSWITCH_LEFT, FOOTSWITCH_BOTH)
- `[in] enable_led_flash`: Set the corresponding LED to flash at tempo rate

void **bypass_fx** (void)

void **enable_fx** (void)

bool **new_tap_interval** (void)
Returns true when a new tap interval has been tapped in by the user.

Return { description_of_the_return_value }

float **get_tap_interval_ms** (void)
Returns the current tap interval in milliseconds.

Return The tap interval in milliseconds.

float **get_tap_freq_hz** (void)
Returns the current tap interval in Hertz (cycles / second)

Return The tap frequency in Hertz

void **set_tap_blink_rate_hz** (float _rate_hz_)
Sets the LED blink rate for tap interval.

Use this if there is a pot that can also change the tempo / rate / duration to override what has been previously "tapped" in.

Parameters

- `[in] rate_hz`: The new blink rate in Hertz

void **set_tap_blink_rate_hz** (float *rate_hz*, FOOTSWITCH *led*)
Sets the LED blink rate for tap interval with LED control.

Use this if there is a pot that can also change the tempo / rate / duration to override what has been previously "tapped" in.

Parameters

- `[in] rate_hz`: The new blink rate in Hertz
- `[in] led`: Which LED to flash (FOOTSWITCH_LEFT, FOOTSWITCH_RIGHT)

void **set_tap_blink_rate_ms** (float *ms*)
Sets the LED blink rate in milliseconds.

Use this if there is a pot that can also change the tempo / rate / duration to override what has been previously "tapped" in.

Parameters

- `[in] ms`: The blink rate in milliseconds

void **set_tap_blink_rate_ms** (float *ms*, FOOTSWITCH *led*)
Sets the LED blink rate for tap interval with LED control.

Use this if there is a pot that can also change the tempo / rate / duration to override what has been previously "tapped" in.

Parameters

- `[in] ms`: The new blink period in milliseconds
- `[in] led`: Which LED to flash (FOOTSWITCH_LEFT, FOOTSWITCH_RIGHT)

bool **button_pressed** (FOOTSWITCH *footswitch*, bool *enable_led*)
Checks if a button was just pressed and optionally turns on an LED when it is.

This function is used to create events when a button is held down and released to momentarily enable / disable functionality.

Return true if button is pressed, false if not

Parameters

- `[in] footswitch`: The footswitch (FOOTSWITCH_LEFT, FOOTSWITCH_RIGHT, (FOOTSWITCH_LEFT, FOOTSWITCH_BOTH)
- `[in] enable_led`: If true, lights LED while button pressed

bool **button_released** (FOOTSWITCH *footswitch*, bool *enable_led*)
Checks if a button was just released and optionally turns off an LED when it was.

This function is used to create events when a button is held down and released to momentarily enable / disable functionality.

Return { description_of_the_return_value }

Parameters

- `[in] footswitch`: The footswitch (FOOTSWITCH_LEFT, FOOTSWITCH_RIGHT, (FOOTSWITCH_LEFT, FOOTSWITCH_BOTH)
- `[in] enable_led`: If true, turns off the LED when button is released

void **register_tap**(void)

void **button_press_check**(void)

void **service_button_events**(void)

void **print_instance_stack**(void)
Utility function to print the instance stack to the console.

void **print_routing_table**(void)
Utility function to print the routing table to the console.

void **print_param_tables**(void)
Utility function to print the parameter tables.

void **print_processor_load**(int *seconds*)
Prints the current processor loading (percentage) to Serial console.

Parameters

- `[in] seconds`: How many seconds to wait before displaying the loading again

void **spi_transmit_param**(EFFECT_TYPE *instance_type*, uint32_t *instance_id*, PARAM_TYPES *param_type*, uint8_t *param_id*, void **value*)

void **parameter_service**(void)

Public Members

bool **bypass_control_enabled**

bool **bypassed**

FOOTSWITCH **bypass_footswitch**

bool **tap_control_enabled**

bool **tap_blink_only_enabled**

FOOTSWITCH **tap_footswitch**

fx_pot **pot_right**

fx_pot **pot_center**

fx_pot **pot_left**

fx_led **led_left**

fx_led **led_right**

fx_pot **pot_top_left**

fx_pot **pot_top_right**

fx_pot **pot_bot_left**

fx_pot **pot_bot_center**

fx_pot **pot_bot_right**

fx_pot **exp_pedal**

fx_switch **toggle_left**

fx_switch **toggle_right**

fx_led **led_center**

fx_audio_node ***instr_in**
: Alias for left instrument in (mono)

fx_audio_node ***instr_in_l**
: Left instrument in node

fx_audio_node ***instr_in_r**
: Right instrument in node

fx_audio_node ***amp_out**
: Alias for left instrument out (mono)

fx_audio_node ***amp_out_l**
: Left amp out node

fx_audio_node ***amp_out_r**
: Right amp out node

fx_audio_node ***mic_in_l**

fx_audio_node ***mic_in_r**

fx_control_node ***note_frequency**
: Pedal variable of current note frequency

fx_control_node ***note_duration**
: Pedal variable of current note duration in milliseconds

fx_control_node ***new_note**
: Pedal variable of when a new note is played

Protected Attributes

fx_audio_node ***audio_node_stack**[4]

fx_control_node ***control_node_stack**[4]

Friends

friend fx_pedal::fx_effect

CHAPTER

FIFTEEN

CLASS FX_LED

- Defined in file_src_dreammakerfx.h

15.1 Class Documentation

class fx_led

These functions are used to control the LEDs on the pedal.

The LEDs are part of the `pedal` object. The LEDs available on the first version of hardware are `pedal.led_left` and `pedal.led_right`. On the second generation of hardware, there is also a `pedal.led_center`. Add the routines described below to these like so:

To turn on the left LED:

```
pedal.led_left.turn_on();     // Turn on left LED
```

To turn off the right LED;

```
pedal.led_right.turn_off();  // Turn off right LED
```

To set the center LED to a purplish color:

```
pedal.led_center.turn_on(40, 0, 50); // Red = 40, Blue = 50
```

Fade the right LED from red to blue over 1 second

```
pedal.led_right.set_rgb(RED);
pedal.led_right.fade_to_rgb(BLUE, 1000.0);
```

Public Functions

void **turn_on**()

Turns on this LED. When using an RGB LED, this turns it on to red.

```
pedal.led_right.turn_on();  // turns on the right LED
```

void **turn_on**(uint8_t *red*, uint8_t *green*, uint8_t *blue*)

Turns on this LED to a specific RGB color.

```
pedal.led_left.turn_on(100, 0, 75); // turn left LED purple
```

Parameters

- `[in] red`: The red component (0-255)
- `[in] green`: The green component (0-255)
- `[in] blue`: The blue component (0-255)

void **turn_on**(LED_COLOR *rgb*)

Turns on this LED to a specific RGB color. If the LED is not an RGB LED, it will just turn on the LED anyway.

```
pedal.led_left.turn_on(GREEN);
```

Parameters

- `[in] rgb`: The color from LED_COLOR type

void **turn_off**()

Turns off this LED.

```
pedal.led_center.turn_off(); // turn off center LED
```

void **set_rgb**(uint8_t *red*, uint8_t *green*, uint8_t *blue*)

Sets the RGB color value for this LED.

```
pedal.led_center.set_rgb(40, 0, 50); // Set center LED to purplish color
```

Parameters

- `[in] red`: The new red component (0-255)
- `[in] green`: The new green component (0-255)
- `[in] blue`: The new blue component (0-255)

void **set_rgb**(LED_COLOR *rgb*)

Sets the RGB color value for this LED.

```
pedal.led_right.set_rgb(RED);  // set right LED to red color
```

Parameters

- `[in] rgb`: The color from LED_COLOR type

void **fade_to_rgb**(uint8_t *red*, uint8_t *green*, uint8_t *blue*, uint32_t *milliseconds*)

Fade this LED to a new RGB value. The fade happens in the background.

Fade the right LED from red to blue over 1 second.

```
pedal.led_right.set_rgb(RED);
pedal.led_right.fade_to_rgb(0, 0, 100, 1000.0);
```

The fade happens in the background so the code execution will not wait until the fade completes.

Parameters

- `[in] red`: The red component (0-255)

- `[in] green`: The green component (0-255)
- `[in] blue`: The blue component (0-255)
- `[in] milliseconds`: The milliseconds component (0-255)

void **`fade_to_rgb`**(LED_COLOR *rgb*, uint32_t *milliseconds*)

Fade this LED to a new RGB value.

Fade the right LED from red to blue over 1 second

```
pedal.led_right.set_rgb(RED);
pedal.led_right.fade_to_rgb(BLUE, 1000.0);
```

The fade happens in the background so the code execution will not wait until the fade completes.

Parameters

- `[in] rgb`: The color from LED_COLOR type
- `[in] milliseconds`: The milliseconds to perform fade over

void **`service`**()

CHAPTER

SIXTEEN

CLASS FX_POT

- Defined in file_src_dreammakerfx.h

16.1 Class Documentation

class fx_pot

These functions are used to read the pots (aka the knobs) of the pedal.

Each knob has a value ranging from 0.0 (full counter-clockwise) to 1.0 (full clock-wise).

The first generation hardware has three pots (`pedal.pot_left`, `pedal.pot_center`, and `pedal.pot_right`).

The second generation hardware has five pots (`pedal.pot_top_left`, 'pedal.pot_top_right', 'pedal.pot_bot_left<tt>,pedal.pot_bot_center<tt>andpedal.pot_bot_right`). To preserve backwards compatibility with sketches developed on the first generation hardware, the `pedal.pot_left` will map to 'pedal.pot_bot_left` (and same for center and right pots).

Use the *`.has_changed()`* function to determine when a pot has been adjusted by the user.

```
void loop() {

  if (pedal.pot_left.has_changed()) {
    delay_effect.set_feedback(pedal.pot_left.val);    // Set feedback of delay␣
↪using left pot
  }

  // Other code in loop()...
```

Public Functions

bool **has_changed**(void)

Returns true if this pot has been changed by the user

```
if (pedal.pot_left.has_changed()) {
  delay_effect.set_feedback(pedal.pot_left.val);    // Set feedback of delay␣
↪using left pot
}
```

.

Return True if changed, False otherwise.

void **read_pot**()

fx_pot(int *pin*)

Public Members

float **val**
Current value of pot (0.0 to 1.0)

float **val_inv**
Current value of pot (1.0 to 0.0)

float **val_log**
Current value of pot with log curve applied (still 0.0 to 1.0)

float **val_log_inv**
Current value of pot with inverse log curve applied (still 0.0 to 1.0)

CHAPTER

SEVENTEEN

CLASS FX_SWITCH

- Defined in file_src_dreammakerfx.h

17.1 Class Documentation

class fx_switch

These functions are used to control the toggle switches on the pedal.

The switches, which are available on the second generation hardware, are part of the `pedal` object. The available switches are `pedal.toggle_left` and `pedal.toggle_right`.

```
void loop() {

  // When the user changes the left toggle switch, change the color of the LED
  if (pedal.toggle_left.has_changed()) {
    if (pedal.toggle_left.position == SWITCH_POS_UP) {
      pedal.led_left.turn_on(RED);
    }

    else if (pedal.toggle_left.position == SWITCH_POS_MIDDLE) {
      pedal.led_left.turn_on(GREEN);
    }

    else if (pedal.toggle_left.position == SWITCH_POS_DOWN) {
      pedal.led_left.turn_on(BLUE);
    }
  }

  // Other code in loop()...

}
```

Public Members

SWITCH_POS **position**
Current switch position (SWITCH_POS_UP, SWITCH_POS_MIDDLE, SWITCH_POS_DOWN)

CHAPTER

EIGHTEEN

CLASS FX_ADSR_ENVELOPE

- Defined in file_src_effects_dm_fx_adsr_envelope.h

18.1 Inheritance Relationships

18.1.1 Base Type

- `public fx_effect` (exhale_class_classfx__effect)

18.2 Class Documentation

class fx_adsr_envelope : **public** fx_effect

Effect: Envelope generator.

An envelope generator creates a volume envelope that can applied to either the audio from the instrument or an oscillator. The volume envelope has four components: (A)ttack, (D)ecay, (S)ustain, (R)elease. These parameters can be adjusted to make short tight notes or long swells.

Here's more information about how these work: https://en.wikipedia.org/wiki/Envelope_(music)

The ADSR envelope is triggered / kicked-off with an event. This is typically a new note event from the pedal.

```
#include <dreammakerfx.h>

// Add your fx module declarations here
fx_adsr_envelope  env(250.0,  // Attack is 250ms
                      10.0,   // Decay is 10ms
                      10.0,   // Sustain is 10ms
                      500.0,  // Release is 500ms
                      1.0,    // Sustain ratio
                      1.0,    // Full volume
                      true);  // Enable look-ahead buffer to suppress initial␣
↪plucks

void setup() {
  // put your setup code here, to run once:

  // Initialize the pedal!
  pedal.init(MSG_INFO, true);

  // Route audio through effects from pedal.instr_in to pedal.amp_out
```

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```
  pedal.route_audio(pedal.instr_in, env.input);
  pedal.route_audio(env.output, pedal.amp_out);

  // IMPORTANT!  route the new note event from the pedal to the start node of the␣
↪ADSR
  pedal.route_control(pedal.new_note, env.start);

  // left footswitch is bypass
  pedal.add_bypass_button(FOOTSWITCH_LEFT);

  // Run this effect
  pedal.run();

}
```

Public Functions

fx_adsr_envelope (float *attack_ms*, float *decay_ms*, float *sustain_ms*, float *release_ms*, float *sustain_ratio*, float *gain_out*, bool *look_ahead*)
constructor/initializer for the ADSR envelope

```
// Add your fx module declarations here
 fx_adsr_envelope  env(250.0,  // Attack is 250ms
                       10.0,   // Decay is 10ms
                       10.0,   // Sustain is 10ms
                       500.0,  // Release is 500ms
                       1.0,    // Sustain ratio
                       1.0,    // Full volume
                       true);  // Enable look-ahead buffer
```

Parameters

- `[in] attack_ms`: The attack in milliseconds
- `[in] decay_ms`: The decay in milliseconds
- `[in] sustain_ms`: The sustain in milliseconds
- `[in] release_ms`: The release in milliseconds
- `[in] sustain_ratio`: Ratio of sustain volume to peak volume between attack / decay
- `[in] gain_out`: The gain out (linear: 0.0 to 1.0)
- `[in] look_ahead`: When set to true, a small look-ahead buffer is used such that the initial impulse of a plucked note is suppressed

void **enable** ()
Enable the **this_effect** (it is enabled by default)

void **bypass** ()
Bypass the **this_effect** (will just pass clean audio through)

void **set_attack_ms** (float *attack*)
Sets the attack time in milliseconds.

Parameters

- `[in] attack`: The attack time in milliseconds

void **set_decay_ms** (float *decay*)
Sets the decay time in milliseconds.

Parameters

- `[in] decay`: The decay time in milliseconds

void **set_sustain_ms** (float *sustain*)
Sets the release time in milliseconds.

Parameters

- `[in] sustain`: The sustain time in milliseconds

void **set_release_ms** (float *release*)

void **set_output_gain** (float *gain*)
Sets the output gain (linear)

Parameters

- `[in] gain`: The gain value (linear)

Public Members

fx_audio_node ***input**
Audio routing node: primary audio input

fx_audio_node ***output**
Audio routing node: primary audio output

fx_control_node ***attack_ms**
Control routing node [input]: envelope attack in milliseconds

fx_control_node ***decay_ms**
Control routing node [input]: envelope decay in milliseconds

fx_control_node ***sustain_ms**
Control routing node [input]: envelope sustain in milliseconds

fx_control_node ***release_ms**
Control routing node [input]: envelope release in milliseconds

fx_control_node ***peak_ratio**
Control routing node [input]: relative volume after attack (0.0 to 1.0) - will be scaled by output volume

fx_control_node ***sustain_ratio**
Control routing node [input]: relative volume during sustain (0.0 to 1.0) - will be scaled by output volume

fx_control_node ***gain_out**
Control routing node [input]: output pain

fx_control_node ***start**
Control routing node [input]: start - start a new ADSR envelope run

fx_control_node ***value**
Control routing node [output]: value of the envelope

CHAPTER

NINETEEN

CLASS FX_AMPLITUDE_MOD

- Defined in file_src_effects_dm_fx_amplitude_modulator.h

19.1 Inheritance Relationships

19.1.1 Base Type

- `public fx_effect` (exhale_class_classfx__effect)

19.2 Class Documentation

class fx_amplitude_mod : **public** fx_effect

Effect: Amplitude modulator for creating tremelo-like effects.

Amplitude modulators are the basic building blocks of tremelos and rhythmic effects. They essentially use an oscillator / waveform or an external control signal to vary the amplitude / volume of a signal.

```
#include <dreammakerfx.h>

fx_amplitude_mod    mod1(1.0,     // Rate (Hz) is once per second
                         0.8,     // Depth (0.0->1.0)
                         0,       // Initial phase (degrees)
                         OSC_SINE,// Oscillator type is a sine wave
                         false);  // Don't use external LFO

void setup() {

  pedal.init();   // Initialize pedal

  // Route audio through effects
  pedal.route_audio(pedal.instr_in, mod1.input);
  pedal.route_audio(mod1.output, pedal.amp_out);

  pedal.add_bypass_button(FOOTSWITCH_LEFT); // Use left footswitch/LED to bypass␣
↪effect

  pedal.run();    // Run effects
}

void loop() {
```

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```
  // Pot 0 changes the rate of the tremelo from 0 to 4Hz
  if (pedal.pot_0.has_changed()) {
    mod1.set_rate_hz(pedal.pot_0.val*4.0);
  }

  // Pot 1 changes the depth from 0.0 to 1.0
  if (pedal.pot_1.has_changed()) {
    mod1.set_depth(pedal.pot_1);
  }

   pedal.service(); // Run pedal service to take care of stuff
}
```

There are lots of cool things you can try with amplitude modulators: use tap function to set rate, use a instrument input through a pitch shifter as the external modulator, use high modulation frequency like 440.0Hz, try a few in parallel running through filters with different initial phase values (to create harmonic tremelos).

Public Functions

fx_amplitude_mod(float *rate_hz*, float *depth*)

Basic constructor/initializer for amplitude modulator.

```
fx_amplitude_mod    mod1(1.0,      // Rate (Hz) is once per second
                         0.8);     // Depth (0.0->1.0)
```

Parameters

- `[in] modulation_rate`: When using an internal oscillator, the "modulation" rate is oscillation (cycles per second). When in doubt, start with 1.0 (one cycle per second)
- `[in] modulation_depth`: How much the volume is "modulated". A value of 0.0 is none at all and a value of 1.0 means full volume to zero volume.

fx_amplitude_mod(float *rate_hz*, float *depth*, float *initial_phase_deg*, OSC_TYPES *modulation_type*, bool *use_ext_modulator*)

Advanced constructor for the amplitude modulator.

```
fx_amplitude_mod    mod1(1.0,      // Rate (Hz) is once per second
                         0.8,      // Depth (0.0->1.0)
                         0,        // Initial phase (degrees)
                         OSC_SINE,// Oscillator type is a sine wave
                         false);  // Don't use external LFO
```

Parameters

- `[in] rate_hz`: When using an internal oscillator, the "modulation" rate is oscillation (cycles per second). When in doubt, start with 1.0 (one cycle per second)
- `[in] depth`: How much the volume is "modulated". A value of 0.0 is none at all and a value of 1.0 means full volume to zero volume.
- `[in] initial_phase_deg`: The initial phase of the oscillator in degrees. When in doubt, use 0.0. This is useful when you want to have multiple oscillators running at different phases such as in harmonic tremelo where one may be at 0.0 and the other at 180.0.

- `[in] modulation_type`: See `OSC_TYPES` for available waveforms (sine, square, triangle, random, pulse, etc.) as the modulation source.
- `[in] use_ext_modulator`: Rather than using an internal modulator, you can also use an external audio source. Route audio to the .ext_mod_in audio to use it as the external modulator.

void **`enable`**()
Enable the amplitude modululator (it is enabled by default)

void **`bypass`**()
Bypass the amplitude modululator (will just pass clean audio through)

void **`set_depth`**(float *depth*)
Sets the depth of the amplitude modululator.

```
mod1.set_depth(0.5);  // Sets the depth of the modulator to a fixed value
```

Parameters

- `[in] depth`: The depth fom 0.0 -> 1.0. 0.0 is no modulation at all, 1.0 is full modulation.

void **`set_rate_hz`**(float *rate_hz*)
Sets the rate of the modulator in Hertz (cycles per second)

Parameters

- `[in] rate_hz`: The rate hz

void **`set_lfo_type`**(OSC_TYPES *new_type*)
Sets the the type of oscillator used as the LFO.

Parameters

- `[in] new_type`: The new type of LFO (OSC_TYPES)

void **`print_params`**(void)
Print the parameters for this effect.

Public Members

fx_audio_node ***`input`**
Audio routing node: primary audio input

fx_audio_node ***`output`**
Audio routing node: primary audio output

fx_audio_node ***`ext_mod_in`**
Audio routing node: external modulator audio input

fx_control_node ***`depth`**
Control routing node: amplifude modulator depth (should be between 0.0 and 1.0)

fx_control_node ***`rate_hz`**
Control routing node: amplitide modulator rate (Hz) (i.e. 1.0 = once per second)

CHAPTER

TWENTY

CLASS FX_ARPEGGIATOR

- Defined in file_src_effects_dm_fx_arpeggiator.h

20.1 Inheritance Relationships

20.1.1 Base Type

- `public fx_effect` (exhale_class_classfx__effect)

20.2 Class Documentation

class fx_arpeggiator : **public** fx_effect

Effect: Arpeggiator which can sequence rhythmic patterns of pitch, gain and parameters.

An arpeggiator is a control source that can play sequences of notes and other control signals.

The arpeggiator relies on a structure that you define at the top of your Arduino sketch that contains the sequence that the arpeggiator will run through. This sequence can have up to 16 steps. In this example, our sequence is called `steps2` but you can name it whatever you'd like.

You can also add `.param_1` and `.param_2` to this struct for any additional control values. These control values can be wired into any type of control note (filters, distortions, etc.)

```
ARP_STEP steps2[] = {
{ .freq = SEMI_TONE_2, .vol = 0.3, .dur = 125.0 },
{ .freq = SEMI_TONE_0, .vol = 0.0, .dur = 375.0 },
{ .freq = SEMI_TONE_5, .vol = 0.3, .dur = 375.0 },
{ .freq = SEMI_TONE_7, .vol = 0.9, .dur = 125.0 },
};
```

Public Functions

fx_arpeggiator (int *total_steps*, ARP_STEP **steps*)
Simple constructor for arpeggiator.

See above for a description of how to define an arpeggiator sequence.

```
// Define arp sequence with 4 steps with a total duration of 1 second
ARP_STEP steps2[] = {
  { .freq = SEMI_TONE_2, .vol = 0.3, .dur = 125.0 },
  { .freq = SEMI_TONE_0, .vol = 0.0, .dur = 375.0 },
  { .freq = SEMI_TONE_5, .vol = 0.3, .dur = 375.0 },
  { .freq = SEMI_TONE_7, .vol = 0.9, .dur = 125.0 },
};

// Define our arpeggiator
fx_arpeggiator  arp2(4,            // Total number of steps
                     &steps2[0]);  // Reference to our sequence
```

Parameters

- `[in] total_steps`: The total arpeggiator steps
- `steps`: A pointer to an array of ARP_STEP containing the steps

void **set_time_scale** (float *new_time_scale*)
Sets the time scale ratio of the arpeggiator.

Parameters

- `[in] new_time_scale`: The new time scale ratio (1.0 is current time scale, > 1.0 is faster, < 1.0 is slower)

void **set_duration_ms** (float *new_duration*)
Sets the duration of the arpeggiator in milliseconds.

Parameters

- `[in] new_duration`: The new duration in milliseconds

void **print_params** (void)

Public Members

fx_control_node ***time_scale**
Control routing node: Time scale of arpeggiator (aka playback rate). A value of 1.0 runs arpeggiator at default speed. Lower is slower, higher is faster.

fx_control_node ***period_ms**
Control routing node: Target duration of the arpeggiator. Arpeggiator will be scaled so the whole sequence fits within this time.

fx_control_node ***freq**
Control routing node: Frequency value for each stage of the arpeggiator

fx_control_node ***vol**
Control routing node: Volume value for each stage of the arpeggiator

fx_control_node ***param_1**
: Control routing node: Auxiliary parameter #1 for each stage of the arpeggiator

fx_control_node ***param_2**
: Control routing node: Auxiliary parameter #2 for each stage of the arpeggiator

fx_control_node ***start**
: Control routing node: Restarts the arpeggiator - wire to new note event to start arp sequence with each note

CHAPTER

TWENTYONE

CLASS FX_BIQUAD_FILTER

- Defined in file_src_effects_dm_fx_biquad_filter.h

21.1 Inheritance Relationships

21.1.1 Base Type

- `public fx_effect` (exhale_class_classfx__effect)

21.2 Class Documentation

class fx_biquad_filter : **public** fx_effect

Effect: Biquad filter for implementing various types of filters (low pass, high pass, band pass, etc.)

The biquad filter can be used to create static filters such as equalizers and dynamic filters such as auto-wahs and other interesting swept filtering effects.

Filters are a basic building block of so many audio effects. Filters allow certain frequencies to pass through and decrease the volume at other frequencies.

A wah pedal is a band pass filter that is "swept" across a range of frequencies based on foot position.

In this example, we'll create an auto-wah filter where we have an envelope tracker which tracks the volume we're playing at and uses this to move the filter frequency. This example uses both route_audio AND route_control. This is where the magic lies.

```
#include <dreammakerfx.h>
fx_envelope_tracker   envy_tracky(10,     // 10 ms attack
                                  100,    // 100 ms release
                                  false); // not triggered

fx_biquad_filter   wah_filter(300.0,                 // 300 Hz starting frequency
                              FILTER_WIDTH_NARROW,   // Width of the filter is␣
↪narrow
                              BIQUAD_TYPE_BPF);      // Type is bandpass

void setup() {
  pedal.init();   // Initialize pedal

  // Route audio through effects
  pedal.route_audio(pedal.instr_in, wah_filter.input);
```

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```
  pedal.route_audio(wah_filter.output, pedal.amp_out);

  // Route audio to envelope tracker
  pedal.route_audio(pedal.instr_in, envy_tracky.input);

  // Route control from envelop tracker to filter frequency
  pedal.route_control(envy_tracky.envelope, wah_filter.freq, 1000.0, 300.0); //␣
↪range 0->1 to 300->300+1000

  pedal.add_bypass_button(FOOTSWITCH_LEFT); // Use left footswitch/LED to bypass␣
↪effect

  pedal.run();     // Run effects
}

void loop() {
  pedal.service(); // Run pedal service to take care of stuff
}
```

There are lots of cool things you can try with filters: hook up a filter to the envelope tracker to create an auto-wah, run a clipper through a filter to get various tube sounds, hook up an oscillator to the filter frequency to create a rhythmic filter sweep, run filters through amplitude modulators to create harmonic modulators.

Public Functions

fx_biquad_filter(float *filt_freq*, float *filt_resonance*, BIQUAD_FILTER_TYPE *filt_type*)

Basic constructor for biquad filter.

```
// 200Hz 2nd-order (default) low-pass filter to just let bass frequencies␣
↪through
fx_biquad_filter   simple_filt(200.0,
                               1.0,
                               BIQUAD_TYPE_LPF );
```

Parameters

- `[in] filt_freq`: This is the cutoff frequency or center frequency of the filter in Hertz.
- `[in] filt_resonance`: This is how quickly the filter "rolls off" – is it a gentle, wide filter or a tight narrow filter? A value of 1.0 is no resonance; > 1.0 is more resonant, < 1.0 is less resonant.
- `[in] filt_type`: Filters come in lots of colors. Low-pass filters (LPF) cut higher frequencies. High-pass filters (HPF) cut lower frequencies. Band-pass filters (BPF) cut frequencies on both sides of the filter frequency. And notch filters cut the frequencies at the filter frequency and allow others to pass.

fx_biquad_filter(float *filt_freq*, float *filt_resonance*, BIQUAD_FILTER_TYPE *filt_type*, BIQUAD_FILTER_ORDER *order*)

Basic constructor for biquad filter.

```
// A stronger 6th order 200Hz low-pass filter to just let bass frequencies␣
↪through
fx_biquad_filter   simple_filt(200.0,
                               1.0,
```

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```
                                    BIQUAD_TYPE_LPF,
                                    BIQUAD_ORDER_6 );
```

Parameters

- `[in] filt_freq`: This is the cutoff frequency or center frequency of the filter in Hertz.
- `[in] filt_resonance`: This is how quickly the filter "rolls off" – is it a gentle, wide filter or a tight narrow filter? A value of 1.0 is no resonance; > 1.0 is more resonant, < 1.0 is less resonant.
- `[in] filt_type`: Filters come in lots of colors. Low-pass filters (LPF) cut higher frequencies. High-pass filters (HPF) cut lower frequencies. Band-pass filters (BPF) cut frequencies on both sides of the filter frequency. And notch filters cut the frequencies at the filter frequency and allow others to pass.
- `[in] order`: The number of filtering stages – higher is more extreme filtering effect

fx_biquad_filter(float *filt_freq*, float *filt_resonance*, float *filter_gain*, BIQUAD_FILTER_TYPE *filt_type*, EFFECT_TRANSITION_SPEED *trans_speed*)

Advanced constructor for biquad filter.

Parameters

- `[in] filt_freq`: This is the cutoff frequency or center frequency of the filter in Hertz.
- `[in] filt_resonance`: This is how quickly the filter "rolls off" – is it a gentle, wide filter or a tight narrow filter? A value of 1.0 is no resonance; > 1.0 is more resonant, < 1.0 is less resonant.
- `[in] filter_gain`: The filter gain in dB (used in peaking and shelf filters)
- `[in] filt_type`: Filters come in lots of colors. Low-pass filters (LPF) cut higher frequencies. High-pass filters (HPF) cut lower frequencies. Band-pass filters (BPF) cut frequencies on both sides of the filter frequency. And notch filters cut the frequencies at the filter frequency and allow others to pass.
- `[in] trans_speed`: When a new filter frequency or filter width is provided, the transition speed determines how quickly the filter will transition.

fx_biquad_filter(float *filt_freq*, float *filt_resonance*, float *filter_gain_db*, BIQUAD_FILTER_TYPE *filt_type*, EFFECT_TRANSITION_SPEED *trans_speed*, BIQUAD_FILTER_ORDER *order*)

Advanced constructor for biquad filter.

Parameters

- `[in] filt_freq`: This is the cutoff frequency or center frequency of the filter in Hertz.
- `[in] filt_resonance`: This is how quickly the filter "rolls off" – is it a gentle, wide filter or a tight narrow filter? A value of 1.0 is no resonance; > 1.0 is more resonant, < 1.0 is less resonant.
- `[in] filter_gain_db`: The filter gain in dB (used in peaking and shelf filters)
- `[in] filt_type`: Filters come in lots of colors. Low-pass filters (LPF) cut higher frequencies. High-pass filters (HPF) cut lower frequencies. Band-pass filters (BPF) cut frequencies on both sides of the filter frequency. And notch filters cut the frequencies at the filter frequency and allow others to pass.
- `[in] trans_speed`: When a new filter frequency or filter width is provided, the transition speed determines how quickly the filter will transition.

- `[in] order`: The number of filtering stages – higher is more extreme filtering effect

void **enable**()
Enable the biquad filter (it is enabled by default)

void **bypass**()
Bypass the biquad filter (will just pass clean audio through)

void **set_freq**(float *freq*)
Sets a new cutoff/critical frequency (Hz).

Parameters

- `[in] freq`: The new center frequency for the filter in Hz (must be lower than 24000.0)

void **set_q**(float *q*)
Sets a new Q factor for the filter. For more information on Q factor, read this: https://en.wikipedia.org/wiki/Q_factor.

Parameters

- `[in] q`: The Q factor (must be between 0.01 and 100.0)

void **set_resonance**(float *filt_resonance*)
Sets the resonance; 1.0 is none (0.7071)

Parameters

- `[in] filt_resonance`: The resonance (must be between 0.01 and 100.0)

void **set_gain**(float *gain*)
Sets the filter gain. This is only used in shelving filters.

Parameters

- `[in] gain`: The gain in dB

void **print_params**(void)
Print the parameters for this effect.

Public Members

fx_audio_node ***input**
Audio routing node: primary audio input

fx_audio_node ***output**
Audio routing node: primary audio output

fx_control_node ***freq**
Control routing node: center/critical frequency of the filter in Hz (i.e. 800.0 for 800Hz)

fx_control_node ***q**
Control routing node: width of the filter

fx_control_node ***gain**
Control routing node: gain of the filter (used in shelving filters)

CHAPTER

TWENTYTWO

CLASS FX_COMPRESSOR

- Defined in file_src_effects_dm_fx_compressor.h

22.1 Inheritance Relationships

22.1.1 Base Type

- `public fx_effect` (exhale_class_classfx__effect)

22.2 Class Documentation

class fx_compressor : **public** fx_effect

Effect: Compressor/Limiter.

Think of a compressor as a small robot that controls a volume knob based on how loud you're playing. When you strike a loud chord, the robot immediately turns the volume down and as the chord rings out, the robot turns the volume up progressively, so it sounds like you're just sustaining the chord. Instead of dying off, it sounds steady for a few seconds as the robot is turning up the volume. Compressors are used a lot with acoustic instruments and vocals but also with electric guitars too. A common in country music is running a Telecaster through a compressor.

```
#include <dreammakerfx.h>

fx_compressor compressor_1(-30.0,    // Initial threshold in dB
                           8,        // Initial ratio (1:8)
                           10.0,     // Attack (10ms)
                           100.0,    // Release (100ms)
                           2.0);     // Initial output gain (2x);

void setup() {
  pedal.init(); // Initialize pedal

  // Route audio through effects
  pedal.route_audio(pedal.instr_in, compressor_1.input);
  pedal.route_audio(compressor_1.output, pedal.amp_out);

  pedal.add_bypass_button(FOOTSWITCH_LEFT); // Use left footswitch/LED to bypass␣
↪effect

  pedal.run();  // Run effects
```

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```
}

void loop() {
  // Run pedal service to take care of stuff
  pedal.service();

  if (pedal.pot_left.has_changed()) {.   // Left pot sets threshold from -20dB to␣
↪-70dB
    compressor_1.set_threshold(-20 - (50.0 * pedal.pot_left.val);
  }
  if (pedal.pot_center.has_changed()) {    // Center pot sets compression ration␣
↪from 1:1 to 40:1
    compressor_1.set_ratio(1.0+ (40.0 * pedal.pot_center.val));
  }
 if (pedal.pot_right.has_changed()) {    // Right pot sets output gain from 1.0␣
↪to 6.0
    compressor_1.set_output_gain(1.0 + pedal.pot_right.val*5.0);
  }
}
```

There are several cool things to do with compressors: Add a compressor on either side of a clipper to create more dynamics, run two compressors through a LPF and HPF to create a multi-band compressor (where low end and high end are compressed independently), vary compressor parameters with an LFO to get some wild sounds.

Public Functions

fx_compressor (float *thresh*, float *ratio*, float *attack*, float *release*, float *gain_out*)
Constructs a new instance.

Parameters

- `[in] thresh`: Where the robot starts turning down the volume. This value is in decibels so a good place to start is between -60.0 and -30.0
- `[in] ratio`: How aggressively the robot will turn down the volume when the input exceeds the threshold. Values from 2-16 create a softer effect. A very high value of 100.0 creates a hard ceiling.
- `[in] attack`: Time in milliseconds for robot to respond when a note exceeds the threshold. Setting this to 20-30 will allow a bit of a peak to sneak through.
- `[in] release`: how long before the robot stops controlling volume after volume goes below threshold
- `[in] gain_out`: output volume (from 1.0 and up)

void **enable** ()
Enable the **this_effect** (it is enabled by default)

void **bypass** ()
Bypass the **this_effect** (will just pass clean audio through)

void **set_threshold** (float *threshold*)
Sets the compressor threshold.

Parameters

- `[in] threshold`: The threshold is where the robot starts turning down the volume. This value is in decibels so a good place to start is between -60.0 and -30.0

void **set_ratio**(float *ratio*)
Sets the compression ratio.

Parameters

- `[in] ratio`: The ratio is how aggressively the robot will turn down the volume when the input exceeds the threshold. Values from 2-16 create a softer effect. A very high value of 100.0 creates a hard ceiling.

void **set_attack**(float *attack*)
Sets the time it takes for the compressor to be fully engaged after volume exceeds threshold.

Parameters

- `[in] attack`: The attack is the time in milliseconds for robot to respond when a note exceeds the threshold. Setting this to 20-30 will allow a bit of a peak to sneak through.

void **set_release**(float *release*)
Sets the time it takes for the compressor to release the volume control when the volume goes back below the threshold.

Parameters

- `[in] release`: The release is the time in milliseconds for robot to respond when a note falls below the threshold.

void **set_output_gain**(float *gain_out*)
Sets the output gain of the compressor.

Parameters

- `[in] gain_out`: The gain out (typically 1.0 for no gain adjustment and higher to increase gain)

void **print_params**(void)

Public Members

fx_audio_node ***input**
Audio routing node: primary audio input

fx_audio_node ***output**
Audio routing node: primary audio output

fx_control_node ***threshold**
Control routing node [input]: Compressor/limiter threshold in dB (i.e. -30.0)

fx_control_node ***ratio**
Control routing node [input]: Compressor/limiter compression ratio (a value of 100.0 would be a ratio of 1:100)

fx_control_node ***attack**
: Control routing node [input]: Compressor/limiter attack rate in milliseconds

fx_control_node ***release**
: Control routing node [input]: Compressor/limiter release rate in milliseconds

fx_control_node ***out_gain**
: Control routing node [input]: Compressor/limiter output gain (linear value so a value of 2.0 would double the signal amplitude)

CHAPTER

TWENTYTHREE

CLASS FX_DELAY

- Defined in file_src_effects_dm_fx_delay.h

23.1 Inheritance Relationships

23.1.1 Base Type

- `public fx_effect` (exhale_class_classfx__effect)

23.2 Class Documentation

class fx_delay : **public** fx_effect

Effect: Delay/echo.

A delay effect is basically an echo machine. Unlike other delay pedals, we have a massive amount of delay memory so you can create delays that are several seconds long. Also, this delay block allows you to add your own effects to the "feedback" path of the echo so each echo can run though an effects chain. Put a pitch shifter in here and each echo changes pitch. Add a phase shifter and each echo gets progressively "phasey". Put another echo effect in there and create effects like the movie Inception.

This example creates a delay and places a low-pass dampening filter in the feedback loop so each echo gets darker and darker.

```
#include <dreammakerfx.h>

fx_delay    delay_1(1000.0, // Initial delay length of 1 second / 1000ms
                        5000.0, // Max delay of 5 seconds
                        0.7,    // Initial feedback value of 0.7
                        1.0,    // Clean mix
                        0.7,    // Delay / echo mix
                        true);  // Enable fx send/receive loop

fx_biquad_filter  fb_filt(1200.0,               // 1200 Hz starting frequency
                          FILTER_WIDTH_NORMAL,  // Width of the filter is narrow
                          BIQUAD_TYPE_LPF);     // Type is low-pass

void setup() {
  pedal.init(); // Initialize pedal

  // Route audio through effects
```

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```
  pedal.route_audio(pedal.instr_in, delay_1.input);
  pedal.route_audio(delay_1.output, pedal.amp_out);

  // Route filter through delay fx send/receive loop
  pedal.route_audio(delay_1.fx_send, fb_filt.input);
  pedal.route_audio(fb_filt.output, delay_1.fx_receive);

  pedal.add_bypass_button(FOOTSWITCH_LEFT); // Use left footswitch/LED to bypass␣
↪effect

  pedal.run();     // Run effects
}

void loop() {
  pedal.service(); // Run pedal service to take care of stuff
}
```

There are lots of cool things you can do with delays: Create a set of delays in parallel with lengths (1000ms, 750ms, 333ms) to create cool rhythmic echoes, create elaborate effects chains in the delay's feedback loop, add delays into the feedback fx send/receive loop of the delay, control a filter from a delayed version of a signal

Public Functions

fx_delay (float *delay_len_ms*, float *feedback*)

Basic constructor for delay effect.

```
// Set up a basic 1 second echo
fx_delay    delay_1(1000.0, // Initial delay length of 1 second / 1000ms
                    0.7);    // Initial feedback value of 0.7
```

Parameters

- `[in] delay_len_ms`: The length of the echo in milliseconds (1000.0 milliseconds = 1 second). For the advanced constructor, the delay_len_max_ms determines the total memory allocated for this delay and will be the max length. In the basic constructor, the initial length is also the maximum delay length.
- `[in] feedback`: How much of the output is feedback to the input. A value of 0.0 will product a single delay. A value of 1.0 will produce endless echoes. 0.5-0.7 is a nice decaying echo.

fx_delay (float *delay_len_ms*, float *delay_len_max_ms*, float *feedback*, float *mix_dry*, float *mix_wet*, bool *enable_ext_fx*)

Advanced constructor for delay effect.

```
// Set up a delay with max delay of 5 seconds and an fx send/receive loop
fx_delay    delay_1(1000.0, // Initial delay length of 1 second / 1000ms
                    5000.0, // Max delay of 5 seconds
                    0.7,    // Initial feedback value of 0.7
                    1.0,    // Clean mix
                    0.7,    // Delay / echo mix
                    true);  // Enable fx send/receive loop
```

Parameters

- `[in] delay_len_ms`: The length of the echo in milliseconds (1000.0 milliseconds = 1 second). For the advanced constructor, the delay_len_max_ms determines the total memory allocated for this delay and will be the max length. In the basic constructor, the initial length is also the maximum delay length.
- `[in] delay_len_max_ms`: The maximum length of the delay (if the delay length is modified)
- `[in] feedback`: How much of the output is feedback to the input. A value of 0.0 will product a single delay. A value of 1.0 will produce endless echoes. 0.5-0.7 is a nice decaying echo.
- `[in] mix_dry`: The mix of the clean signal (0.0 to 1.0)
- `[in] mix_wet`: The mix of the delayed/echo signal (0.0 to 1.0)
- `[in] enable_ext_fx`: Whether or not to enable the fx send / receive loop (true or false)

void **`enable`**()
Enables the delay effect.

void **`bypass`**()
Bypass the delay effect (will just pass clean audio through)

void **`set_length_ms`**(float *len_ms*)
Update the length of the delay. Note, if you used the simple constructor, the length of the delay needs to be less than or equal to the initial delay value. If you want the ability to set a longer delay than the initial value, use the advanced constructor as this will allow you to also specify the total amount of delay space to allocate which is then the maximum length of a delay.

void **`set_feedback`**(float *feedback*)
Updates the feedback parameter of the delay.

Parameters

- `[in] feedback`: How much of the output is feedback to the input. A value of 0.0 will product a single delay. A value of 1.0 will produce endless echoes. 0.5-0.7 is a nice decaying echo.

void **`set_dry_mix`**(float *dry_mix*)
Sets the dry mix.

Parameters

- `[in] dry_mix`: The mix of the clean signal (0.0 to 1.0)

void **`set_wet_mix`**(float *wet_mix*)
Updates the wet / delay mix of the delay (0.0 to 1.0)

Parameters

- `[in] wet_mix`: The mix of the delayed/echo signal (0.0 to 1.0)

Public Members

fx_audio_node ***input**
: Audio routing node [input]: primary audio input

fx_audio_node ***output**
: Audio routing node [output]: primary audio output

fx_audio_node ***fx_send**
: Audio routing node [output]: effect loop send before entering delay line of this effect

```
// Route audio through effects
pedal.route_audio(pedal.instr_in, delay_1.input);
pedal.route_audio(delay_1.output, pedal.amp_out);

// Route filter through delay fx send/receive loop
pedal.route_audio(delay_1.fx_send, fb_filt.input);
pedal.route_audio(fb_filt.output, delay_1.fx_receive);
```

fx_audio_node ***fx_receive**
: Audio routing node [output]: effect loop return before entering delay line of this effect

```
// Route audio through effects
pedal.route_audio(pedal.instr_in, delay_1.input);
pedal.route_audio(delay_1.output, pedal.amp_out);

// Route filter through delay fx send/receive loop
pedal.route_audio(delay_1.fx_send, fb_filt.input);
pedal.route_audio(fb_filt.output, delay_1.fx_receive);
```

fx_control_node ***length_ms**
: Control routing node [input]: Length of delay line in milliseconds (1/1000s of a second)

fx_control_node ***feedback**
: Control routing node [input]: Feedback ratio (between 0.0 and 1.0)

fx_control_node ***dry_mix**
: Control routing node [input]: Dry mix (between 0.0 and 1.0)

fx_control_node ***wet_mix**
: Control routing node [input]: Wet mix (between 0.0 and 1.0)

CHAPTER

TWENTYFOUR

CLASS FX_DESTRUCTOR

- Defined in file_src_effects_dm_fx_destructor.h

24.1 Inheritance Relationships

24.1.1 Base Type

- `public fx_effect` (exhale_class_classfx__effect)

24.2 Class Documentation

class fx_destructor : **public** fx_effect

Effect: Destructor - provides various types of hard and soft destructors for creating different types of distortions.

Here's a nice summary of clipping using polynomials to create various types of distortions topic: http://sites.music.columbia.edu/cmc/music-dsp/FAQs/guitar_distortion_FAQ.html

Public Functions

fx_destructor(float *param_1*, DESTRUCTOR_TYPE *clip_type*)

Basic constructor for the destructor (for models with one parameter)

Parameters

- `[in] param_1`: The first parameter of the destructor (varies by destructor type)
- `[in] clip_type`: Destructor function; See `DESTRUCTOR_TYPE` in Special parameters and constants

fx_destructor(float *param_1*, float *param_2*, DESTRUCTOR_TYPE *clip_type*)

Basic constructor for the destructor (for models with one parameter)

Parameters

- `[in] param_1`: The first parameter of the destructor (varies by destructor type)
- `[in] param_2`: The second parameter of the destructor (varies by destructor type)
- `[in] clip_type`: Destructor function; See `DESTRUCTOR_TYPE` in Special parameters and constants

fx_destructor (float *param_1*, float *param_2*, float *output_gain*, DESTRUCTOR_TYPE *clip_type*)
Advanced constructor for the destructor.

Parameters

- `[in] param_1`: The first parameter of the destructor (varies by destructor type)
- `[in] param_2`: The second parameter of the destructor (varies by destructor type)
- `[in] output_gain`: The output stage gain (linear)
- `[in] clip_type`: Destructor function; See `DESTRUCTOR_TYPE` in Special parameters and constants

void **enable** ()
Enable the destructor (it is enabled by default)

void **bypass** ()
Bypass the destructor (will just pass clean audio through)

void **set_param_1** (float *new_param_1*)
Sets the clipping threshold.

Parameters

- `[in] threshold`: The threshold for clipping should be between 0.1 and 1.0. A value of 0.1 will provide aggressive clipping where as a value of 0.8 will provide more gentle clipping.

void **set_clipping_threshold** (float *new_clip*)
Sets the clipping threshold when using SMOOTH_CLIP, SMOOTHER_CLIP or SMOOTH_FUZZ.

Parameters

- `[in] new_clip`: The new clipping threshold (typically around 0.1)

void **set_param_2** (float *new_param_2*)
Sets the input drive before the destructor.

Parameters

- `[in] drive`: The drive a value that the incoming signal will get multiplied by before entering the destructor.

void **set_input_drive** (float *new_drive*)
Sets the input drive when using SMOOTH_CLIP, SMOOTHER_CLIP or SMOOTH_FUZZ.

Parameters

- `[in] new_drive`: The new input drive (1.0 is no input gain, >1 will drive input signal into saturation)

void **set_output_gain** (float *new_gain*)
Sets the output gain of the destructors.

Parameters

- `[in] gain`: The gain is the value that will be multiplied at the output stage of the destructor.

void **print_params**(void)
Print the parameters for this effect.

Public Members

fx_audio_node ***input**
Audio routing node [input]: primary audio input

fx_audio_node ***output**
Audio routing node [output]: primary audio output

fx_control_node ***param_1**
Control routing node [input]: clipping threshold (0.0 -> 1.0)

fx_control_node ***param_2**
Control routing node [input]: input drive multiplier before destructor (up to 64.0)

fx_control_node ***output_gain**
Control routing node [input]: output gain (linear)

CHAPTER

TWENTYFIVE

CLASS FX_ENVELOPE_TRACKER

- Defined in file_src_effects_dm_fx_envelope_tracker.h

25.1 Inheritance Relationships

25.1.1 Base Type

- `public fx_effect` (exhale_class_classfx__effect)

25.2 Class Documentation

class fx_envelope_tracker : **public** fx_effect

Effect: Envelope tracker.

An envelope tracker creates a control signal that follows the volume of the audio running into it.

There is also a control signal built into the pedal itself that can be used for current volume. However, the envelope tracker also provides discrete control for attack and release.

For more advanced envelope control, see the ADSR Envelope function.

Public Functions

fx_envelope_tracker(float *attack_speed_ms*, float *decay_speed_ms*, bool *triggered*)

Constructs a new envelope tracker instance.

Parameters

- `[in] attack_speed_ms`: The attack speed milliseconds
- `[in] decay_speed_ms`: The decay speed milliseconds
- `[in] triggered`: Indicates if triggered (should envelope value drop down to zero when new note event is detected)

fx_envelope_tracker(float *attack_speed_ms*, float *decay_speed_ms*, bool *triggered*, float *ctrl_scale*, float *ctrl_offset*)

void **set_attack_speed_ms**(float *attack_speed_ms*)

void **set_decay_speed_ms**(float *decay_speed_ms*)

void **set_env_scale** (float *scale*)
Sets the envelope scale.

Parameters

- `[in] scale`: The scale value / multiplier

void **set_env_offset** (float *offset*)

void **print_params** (void)

Public Members

fx_audio_node ***input**

fx_control_node ***decay_speed_ms**
Control routing node: decay speed of envelope (milliseconds)

fx_control_node ***attack_speed_ms**
Control routing node: attack speeed of envelope (milliseconds)

fx_control_node ***envelope**
Control routing node: envelope signal

fx_control_node ***scale**
Control routing node: scale of envelope signal

fx_control_node ***offset**
Control routing node: offset of envelope signal

CHAPTER

TWENTYSIX

CLASS FX_GAIN

- Defined in file_src_effects_dm_fx_gain.h

26.1 Inheritance Relationships

26.1.1 Base Type

- `public fx_effect` (exhale_class_classfx__effect)

26.2 Class Documentation

class fx_gain : **public** fx_effect

Effect: Gain - used to increase or decrease the volume of an audio signal.

Public Functions

fx_gain (float *gain_val*)

Basic constructor/initializer for gain.

Parameters

- `[in] gain_val`: The gain value

fx_gain (float *gain_val*, EFFECT_TRANSITION_SPEED *gain_trans_speed*)

Advanced constructor for the gain.

Parameters

- `[in] gain_val`: The gain value (typically between 0.0->1.0 to make a signal quiter and > 1.0 to make a signal louder)
- `[in] gain_trans_speed`: The gain transaction speed based on `EFFECT_TRANSITION_SPEED` defined above (i.e. slow -> fast)

void **enable** ()

Enable the **this_effect** (it is enabled by default)

void **bypass** ()

Bypass the **this_effect** (will just pass clean audio through)

void **set_gain** (float *new_gain*)
Sets the gain multiplier. For example, a value of 2 will double the volume/amplitude and a value of 0.5 will halve the volume/amplitude.

Parameters

- `[in] new_gain`: The new gain value (0.0 -> 4.0)

void **set_gain_db** (float *new_gain_db*)
Sets the gain multiplier using decibles. For example, a value of 0 will keep volume the same, a value of 6 will double the amplitude/volume, a value of -6 will halve the amplitude/volume.

Parameters

- `[in] new_gain_db`: The new gain value (dB)

void **print_params** (void)
Prints the parameters for the delay effect.

Public Members

fx_audio_node ***input**
Audio routing node: primary audio input

fx_audio_node ***output**
Audio routing node: primary audio output

fx_control_node ***gain**
Control routing node: gain value input - you can then link the envelope filter to this to create slow swell effects

CHAPTER

TWENTYSEVEN

CLASS FX_INSTRUMENT_SYNTH

- Defined in file_src_effects_dm_fx_instrument_synth.h

27.1 Inheritance Relationships

27.1.1 Base Type

- `public fx_effect` (exhale_class_classfx__effect)

27.2 Class Documentation

class fx_instrument_synth : **public** fx_effect

Effect: Polyphonic instrument synth.

The instrument synth is capable of reading polyphonic notes from a stringed instrument and playing synth notes in their place.

The instrument synth does not have an input. It is hard-wired into the instrument in jack of the pedal.

Public Functions

fx_instrument_synth(OSC_TYPES *osc_type*, float *attack_ms*, float *filter_resonance*, float *filter_response*)

Constructs a new instance of the instrument synth (basic constructor)

Parameters

- `[in] osc_type`: The type of oscillator
- `[in] attack_ms`: The attack milliseconds
- `[in] filter_resonance`: The filter resonance (1.0 is normal, > 1 increases resonance)
- `[in] filter_response`: How much the filter sweeps (0.0 to 1.0)

fx_instrument_synth(OSC_TYPES *osc_type*, OSC_TYPES *fm_mod_osc_type*, float *fm_mod_depth*, float *freq_ratio*, float *freq_ratio_fm_mod*, float *attack_ms*, float *filter_resonance*, float *filter_response*)

Constructs a new instance of the instrument synth (advanced constructor)

Parameters

- [in] osc_type: The type of oscillator
- [in] fm_mod: The type of oscillator used for fm synthesis
- [in] fm_mod_depth: The depth of the fm synthesis (0.0 to 1.0)
- [in] freq_ratio: The frequency ratio of played note to synth note (e.g. 1.0 is same, 0.5 is octave down, 2.0 is octave up)
- [in] freq_ratio_fm_mod: The frequency ratio of the fm modulation to synthesized note
- [in] attack_ms: The attack milliseconds
- [in] filter_resonance: The filter resonance (1.0 is normal, > 1 increases resonance)
- [in] filter_response: How much the filter sweeps

void **enable**()
Enable the instrument synth (it is enabled by default)

void **bypass**()
Bypass the instrument synth (will just pass zero audio through)

void **set_freq_ratio**(float *ratio*)
Sets the frequency ratio of the synth.

Parameters

- [in] ratio: Ratio of synthesized frequency to note playing. For example, a value of 1.0 would play the same note. A value of 0.5 would play a note an octave below. A value of 2.0 would play a note an octave above.

void **set_fm_mod_ratio**(float *fm_mod_ratio*)
Sets the fm modifier ratio.

Parameters

- [in] fm_mod_ratio: The fm modifier ratio relative to the frequency of the tone being played

void **set_fm_mod_depth**(float *depth*)
Sets the fm modifier depth.

Parameters

- [in] depth: The FM mod depth (0.0 -> 1.0)

void **set_attack_ms**(float *attack_ms*)
Sets the attack milliseconds.

Parameters

- [in] attack_ms: The attack milliseconds

void **set_filter_resonance**(float *resonance*)
Sets the filter resonance.

Parameters

- [in] resonance: The resonance of the filter

void **set_filter_response**(float *response*)
Sets the filter responsiveness.

Parameters

- `[in] response`: The response (0.0 is not responsive / static filter, 1.0 is very dynamic filter)

void **set_oscillator_type**(OSC_TYPES *new_type*)
Sets the the type of oscillator used as the primary synth.

Parameters

- `[in] new_type`: The new type of LFO (OSC_TYPES)

void **set_oscillator_type_fm_mod**(OSC_TYPES *new_type*)
Sets the the type of oscillator used as the primary synth.

Parameters

- `[in] new_type`: The new type of LFO (OSC_TYPES)

void **print_params**(void)
Prints the parameters for the instrument synth.

Public Members

fx_audio_node ***output**
Audio routing node: primary audio output

fx_control_node ***attack_ms**
Control routing node: Attack (ms) - attack rate of the synth in milliseconds

fx_control_node ***freq_ratio**
Control routing node: Frequency ratio - Ratio of synthesized frequency to note playing. For example, a value of 1.0 would play the same note. A value of 0.5 would play a note an octave below. A value of 2.0 would play a note an octave above.

fx_control_node ***fm_mod_freq_ratio**
Control routing node: Frequency ratio of fm modulator - Ratio of fm modulator frequency to synth frequency. A value of 1.0 would do fm mod at same frequency as note being synthesized.

fx_control_node ***fm_mod_depth**
Control routing node: Frequency mod depth

fx_control_node ***resonance**
Control routing node: Filter resonance - The resonance of the filter applied each synth voice. A value of 1.0 is no resonance, value higher than 1.0 increases resonance. Values below 1.0 (but higher than 0.0) further smooth out the filter.

fx_control_node ***response**
Control routing node: Filter response - How far the filter sweeps with each played note

CHAPTER

TWENTYEIGHT

CLASS FX_LOOPER

- Defined in file_src_effects_dm_fx_looper.h

28.1 Inheritance Relationships

28.1.1 Base Type

- `public fx_effect` (exhale_class_classfx__effect)

28.2 Class Documentation

class fx_looper : **public** fx_effect

Effect: Looper - capture and playback loops.

Here's a nice tutorial on how looper pedals work in general https://en.wikipedia.org/wiki/Live_looping

Public Functions

fx_looper(float *looper_dry_mix*, float *looper_loop_mix*, float *looper_max_length_seconds*, bool *looper_enable_loop_preprocessing*)

Constructor/initializer for amplitude modulator.

```
fx_looper looper1(1.0,         // Dry mix set to full
                  1.0,         // Wet mix set to full
                  10,          // Max loop length set to 10 seconds (can be␣
↪way more)
                  false);      // Do not use fx send/receive when recording␣
↪loop
```

Parameters

- `[in] looper_dry_mix`: The looper dry mix
- `[in] looper_loop_mix`: The looper loop mix
- `[in] looper_max_length_seconds`: The looper maximum length seconds
- `[in] looper_enable_loop_preprocessing`: The looper enable loop preprocessing

void **enable**()
Enable the **this_effect** (it is enabled by default)

void **bypass**()
Bypass the **this_effect** (will just pass clean audio through)

void **start_loop_recording**()

void **stop_loop_recording**()

void **stop_loop_playback**()

void **set_playback_rate**(float *playback_rate*)

void **set_loop_mix**(float *new_loop_mix*)
Sets the loop mix.

Parameters

- `[in] new_loop_mix`: The new loop mix value (0.0 -> 1.0)

void **set_dry_mix**(float *new_dry_mix*)
Sets the dry mix.

Parameters

- `[in] new_dry_mix`: The new dry mix value (0.0 -> 1.0)

void **print_params**(void)
Prints the parameters for the delay effect.

Public Members

fx_audio_node ***input**
Audio routing node: primary audio input

fx_audio_node ***output**
Audio routing node: primary audio output

fx_audio_node ***preproc_send**
Audio routing node: pre-loop effects send (process audio before it ends up in the loop)

fx_audio_node ***preproc_receive**
Audio routing node: pre-loop effects receive (process audio before it ends up in the loop)

fx_control_node ***start**
Control routing node: Trigger to start loop recording

fx_control_node ***stop**
Control routing node: Trigger to stop loop recording

fx_control_node ***playback_rate**
Control routing node: Loop playback rate (1.0 is recorded rate, > 1.0 is faster / higher pitch, < 1.0 is slower, <0 is reverse)

fx_control_node ***dry_mix**
Control routing node: clean/dry mix

fx_control_node ***loop_mix***
: Control routing node: clean/dry mix

fx_control_node ***loop_length_seconds***
: Control routing node: [output] loop length - can be tied to things like delay length to create delay lines that are synced to the loop length

fx_control_node ***loop_length_seconds_set***
: Control routing node: [input] loop length - used to set loop length before a loop is recorded (to sync with other loops)

CHAPTER

TWENTYNINE

CLASS FX_MULTITAP_DELAY

- Defined in file_src_effects_dm_fx_delay_multitap.h

29.1 Inheritance Relationships

29.1.1 Base Type

- `public fx_effect` (exhale_class_classfx__effect)

29.2 Class Documentation

class fx_multitap_delay : **public** fx_effect

Effect: Multi-tap delay.

A multi-tap delay is a delay line that has multiple read "taps" set a different delay lenghts. Multi-tap delays can be used to create interesting rhythmic effects and are also a foundational building block of reverbs.

Here an example of using a multi-tap delay to generate early reflections in a reverb algorithm

```
fx_multitap_delay     early_reflections(10.5, 0.2,     // Tap 1 (length and gain)
                                        13.5, 0.2,     // Tap 2 (length and gain)
                                        16.0, 0.2,     // Tap 3 (length and gain)
                                        19.5, 0.2,     // Tap 4 (length and gain)
                                        0.5,          // Dry mix
                                        0.5);         // Effect mix
```

Public Functions

fx_multitap_delay(float *tap_len_1_ms*, float *gain_1*, float *tap_len_2_ms*, float *gain_2*, float *tap_len_3_ms*, float *gain_3*, float *tap_len_4_ms*, float *gain_4*, float *dry_mix*, float *wet_mix*)

Basic constructor for the multi-tap delay effect.

If a tap isn't being used, set its delay length to zero

Parameters

- `[in] tap_len_1_ms`: The tap 1 length 1 milliseconds
- `[in] gain_1`: The gain of tap

- `[in] tap_len_2_ms`: The tap 2 length 2 milliseconds
- `[in] gain_2`: The gain of tap
- `[in] tap_len_3_ms`: The tap 3 length 3 milliseconds
- `[in] gain_3`: The gain of tap
- `[in] tap_len_4_ms`: The tap 4 length 4 milliseconds
- `[in] gain_4`: The gain of tap
- `[in] dry_mix`: The dry mix
- `[in] wet_mix`: The wet mix

void **`enable`**()
Enable the multitap delay (it is enabled by default)

void **`bypass`**()
Bypass the multitap delay (will just pass clean audio through)

void **`set_dry_mix`**(float *dry_mix*)
Updates the dry / clean mix of the multitap delay (0.0 to 1.0)

Parameters

- `[in] dry_mix`: The new dry mix

void **`set_wet_mix`**(float *wet_mix*)
Updates the wet / delay mix of the multitap delay (0.0 to 1.0)

Parameters

- `[in] wet_mix`: The new wet mix

Public Members

fx_audio_node ***`input`**
Audio routing node [input]: primary audio input

fx_audio_node ***`output`**
Audio routing node [output]: primary audio output

CHAPTER

THIRTY

CLASS FX_OSCILLATOR

- Defined in file_src_effects_dm_fx_oscillators.h

30.1 Inheritance Relationships

30.1.1 Base Type

- `public fx_effect` (exhale_class_classfx__effect)

30.2 Class Documentation

class fx_oscillator : **public** fx_effect
Utility: Oscillator that can has both audio and control outputs.

Public Functions

fx_oscillator(OSC_TYPES *osc_type*, float *freq*, float *amplitude*)
Basic constructor for an oscillator when used as an audio source.

Parameters

- `[in] osc_type`: The osc type (see OSC_TYPES)
- `[in] freq`: The frequency in Hz
- `[in] amplitude`: The amplitude (linear scale e.g. 0.0 -> 1.0 typically)

fx_oscillator(OSC_TYPES *osc_type*, float *freq*, float *amplitude*, float *initial_phase*)
Basic constructor for an oscillator used as a control source.

Parameters

- `[in] osc_type`: The osc type (see OSC_TYPES)
- `[in] freq`: The frequency in Hz
- `[in] amplitude`: The amplitude (linear scale e.g. 0.0 -> 1.0 typically)
- `[in] initial`: phase The initial phase of the oscillator in degrees (0-360)

void **enable**()
Enable the oscillator (it is enabled by default)

void **bypass**()
Bypass the oscillator (it will provide just a constant value)

void **set_frequency**(float *freq*)
Upates the frequency in Hz of the current oscillator.

Parameters

- `[in] freq`: The frequency in Hz

void **set_amplitude**(float *amplitude*)
Updates the amplitude for the current oscillator.

Parameters

- `[in] amplitude`: The amplitude (linear)

void **set_oscillator_type**(OSC_TYPES *new_type*)
Sets the oscillator type.

Parameters

- `[in] new_type`: The new type of oscillator (OSC_TYPES)

void **print_params**(void)
Print the parameters for this effect.

Public Members

fx_audio_node ***output**
Audio routing node: primary audio oscillator output

fx_control_node ***freq**
Control routing node: frequency of the oscillator in Hz

fx_control_node ***amplitude**
Control routing node: amplitude of the oscillator (linear, typically between 0.0 and 1.0)

fx_control_node ***offset**
Control routing node: The DC offset of the amplifier. Useful if you're using this to control parameters in ranges not centered around 0.0.

fx_control_node ***value**
Control routing node: The current value of the oscillator. Connect this node to external oscillator nodes for effects.

CHAPTER

THIRTYONE

CLASS FX_PHASE_SHIFTER

- Defined in file_src_effects_dm_fx_phase_shifter.h

31.1 Inheritance Relationships

31.1.1 Base Type

- `public fx_effect` (exhale_class_classfx__effect)

31.2 Class Documentation

class fx_phase_shifter : **public** fx_effect

Effect: Phase shifter for creating rich phase shifts.

Example: **phase_shifter_1.c**

Public Functions

fx_phase_shifter(float *rate_hz*, float *depth*, float *feedback*)

Basic constructor/initializer for the phase shifter.

Parameters

- `[in] rate_hz`: The rate hz of the LFO modulating the phase shifter
- `[in] depth`: The depth of the phase shifter
- `[in] feedback`: The feedback of the phase shifter

fx_phase_shifter(float *rate_hz*, float *depth*, float *feedback*, float *inital_phase*, OSC_TYPES *mod_type*)

Constructs a new instance.

Parameters

- `[in] rate_hz`: The rate hz of the LFO modulating the phase shifter
- `[in] depth`: The depth of the phase shifter (0.0 -> 1.0)
- `[in] feedback`: The feedback of the phase shifter (-1.0 -> 1.0)

- `[in] inital_phase`: The inital phase in degrees of the LFO
- `[in] mod_type`: The modifier type (OSC_TYPES)

void **enable**()
Enable the phase shifter (it is enabled by default)

void **bypass**()
Bypass the phase shifter (will just pass clean audio through)

void **set_depth**(float *depth*)
Sets the depth of the phase shifter.

Parameters

- `[in] depth`: The depth fom 0.0 -> 1.0. 0.0 is no modulation at all, 1.0 is full modulation.

void **set_rate_hz**(float *rate_hz*)
Sets the rate of the phase shifter in Hertz (cycles per second)

Parameters

- `[in] rate_hz`: The rate hz

void **set_feedback**(float *feedback*)
Sets the feedback of the phase shifter.

Parameters

- `[in] feedback`: Feedback value (between -1.0 and 1.0)

void **set_lfo_type**(OSC_TYPES *new_type*)
Sets the the type of oscillator used as the LFO.

Parameters

- `[in] new_type`: The new type of LFO (OSC_TYPES)

void **print_params**(void)
Print the parameters for this effect.

Public Members

fx_audio_node ***input**
Audio routing node: primary audio input

fx_audio_node ***output**
Audio routing node: primary audio output

fx_control_node ***depth**
Control routing node: phase shifter depth (should be between 0.0 and 1.0)

fx_control_node ***rate_hz**
Control routing node: phase shifter rate (Hz) (i.e. 1.0 = once per second)

fx_control_node ***feedback**
Control routing node: phase shifter feedback (should be between -1.0 and 1.0)

CHAPTER

THIRTYTWO

CLASS FX_PITCH_SHIFT

- Defined in file_src_effects_dm_fx_pitch_shift.h

32.1 Inheritance Relationships

32.1.1 Base Type

- `public fx_effect` (exhale_class_classfx__effect)

32.2 Class Documentation

class fx_pitch_shift : **public** fx_effect

Effect: Pitch shifter - shifts audio up or down in pitch.

This is a de-glitching, time-domain based implmentation. Also see the *fx_pitch_shift_fd* pitch shifter which provides a frequency-domain based approach (phase vocoder).

Public Functions

fx_pitch_shift(float *pitch_shift_freq*)

void **enable**()

Enable the pitch shifter (it is enabled by default)

void **bypass**()

Bypass the pitch shifter (will just pass clean audio through)

void **set_freq_shift**(float *freq_shift*)

Update the pitch shifter value. A freq_shift of 0.5 will drop down one octave. A value of 2.0 will go up one octave. A value of 1.0 will play at current pitch (no shift).

Parameters

- `[in] freq_shift`: The frequency shift

void **print_params**(void)

Print the parameters for this effect.

Public Members

fx_audio_node ***input**
: Audio routing node: primary audio input

fx_audio_node ***output**
: Audio routing node: primary audio output

fx_control_node ***freq_shift**

CHAPTER

THIRTYTHREE

CLASS FX_PITCH_SHIFT_FD

- Defined in file_src_effects_dm_fx_spectralizer.h

33.1 Inheritance Relationships

33.1.1 Base Type

- `public fx_effect` (exhale_class_classfx__effect)

33.2 Class Documentation

class fx_pitch_shift_fd : **public** fx_effect

Effect: Pitch shifter - shifts audio up or down in pitch.

This effect uses a phase vocoder to perform the pitch shift so it can perform multiple pitch shifts at the same time.

Public Functions

fx_pitch_shift_fd(float *freq*, float *volume*, float *volume_clean*)

Basic constructor/initializer for the frequency-domain based pitch shifter.

When setting the frequency, you can utilize a set of constants that define various semitone relationships. The constant `SEMI_TONE_10`, for example, is 10 semitones above the current note. Adding an `N` for negative moves the tones below the note. For example, the constant `SEMI_TONE_N17` is 17 semitones below the current note.

```
fx_pitch_shift_fd    pitch_shift(SEMI_TONE_7,  // Set pitch shift to fifth␣
↪above (7 semitones) or approx 1.5
                                 0.7,  // Pitch shift mix
                                 1.0); // Clean mix
```

Parameters

- `[in] freq`: The relative frequency shift (2.0 would be an octave up, 0.5 would be an octave down)
- `[in] vol`: The volume/mix of frequency shifted audio
- `[in] vol_clean`: The volume/mix of the clean audio

fx_pitch_shift_fd (float *freq_1*, float *volume_1*, float *freq_2*, float *volume_2*, float *volume_clean*)
Advanced constructor/initializer for the frequency-domain based pitch shifter.

When setting the frequency, you can utilize a set of constants that define various semitone relationships. The constant `SEMI_TONE_10`, for example, is 10 semitones above the current note. Adding an `N` for negative moves the tones below the note. For example, the constant `SEMI_TONE_N17` is 17 semitones below the current note.

```
fx_pitch_shift_fd    pitch_shift(SEMI_TONE_7,  // First shift is a fifth above
                                 0.7,  // First tone volume is 0.7
                                 SEMI_TONE_12,  // Second shift is an octave␣
↪above
                                 0.5,  // Second tone volume is 0.5
                                 1.0); // Clean mix set to 1.0
```

Parameters

- `[in] freq_1`: The first relative frequency shift (2.0 would be an octave up, 0.5 would be an octave down)
- `[in] volume_1`: The volume of the first frequency shifted tone
- `[in] freq_2`: The second relative frequency shift (2.0 would be an octave up, 0.5 would be an octave down)
- `[in] volume_2`: The volume of the second frequency shifted tone
- `[in] volume_clean`: The clean volume

void **enable**()
Enable the pitch shifter (it is enabled by default)

void **bypass**()
Bypass the pitch shifter (will just pass clean audio through)

void **set_freq_shift_1** (float *new_freq_shift*)
Sets the pitch shifter value. A freq_shift of 0.5 will drop down one octave. A value of 2.0 will go up one octave. A value of 1.0 will play at current pitch (no shift).

When setting the frequency, you can also utilize a set of constants that define various semitone relationships. The constant `SEMI_TONE_10`, for example, is 10 semitones above the current note. Adding an `N` for negative moves the tones below the note. For example, the constant `SEMI_TONE_N17` is 17 semitones below the current note.

Parameters

- `[in] new_freq_shift`: The frequency shift

void **set_freq_shift_2** (float *new_freq_shift*)
Sets the second pitch shifter value. A freq_shift of 0.5 will drop down one octave. A value of 2.0 will go up one octave. A value of 1.0 will play at current pitch (no shift).

When setting the frequency, you can also utilize a set of constants that define various semitone relationships. The constant `SEMI_TONE_10`, for example, is 10 semitones above the current note. Adding an `N` for negative moves the tones below the note. For example, the constant `SEMI_TONE_N17` is 17 semitones below the current note.

Parameters

- `[in] new_freq_shift`: The frequency shift

void **set_vol_1** (float *new_vol_1*)
Sets the volume/gain of the first pitch shift channel.

Parameters

- `[in] vol_1`: The volume level (0.0 to 1.0)

void **set_vol_2** (float *new_vol_2*)
Sets the volume/gain of the second pitch shift channel (if used)

Parameters

- `[in] vol_2`: The volume level (0.0 to 1.0)

void **set_vol_clean** (float *new_vol_clean*)
Sets the clean mix.

Parameters

- `[in] vol_2`: The volume level (0.0 to 1.0)

void **print_params** (void)
Print the parameters for this effect.

Public Members

fx_audio_node ***input**
Audio routing node: primary audio input

fx_audio_node ***output**
Audio routing node: primary audio output

fx_control_node ***freq_shift_1**
Control routing node: first pitch shift amount

fx_control_node ***freq_shift_2**
Control routing node: second pitch shift amount

fx_control_node ***vol_1**
Control routing node: volume of first pitch shift channel

fx_control_node ***vol_2**
Control routing node: volume of second pitch shift channel

fx_control_node ***vol_clean**
Control routing node: clean mix

CHAPTER

THIRTYFOUR

CLASS FX_RING_MOD

- Defined in file_src_effects_dm_fx_ring_modulator.h

34.1 Inheritance Relationships

34.1.1 Base Type

- `public fx_effect` (exhale_class_classfx__effect)

34.2 Class Documentation

class fx_ring_mod : **public** fx_effect

Effect: Ring modulator - frequency modulates the audio - crazy sounding.

The following example is a full ring modulator pedal with tone control, wet/dry mix and of course ring modulator.

___ring_mod_1.c___

Public Functions

fx_ring_mod(float *ring_mod_freq*, float *ring_mod_depth*)

Basic constructor/initializer for the ring modulator.

Parameters

- `[in] ring_mod_freq`: The ring modifier frequency
- `[in] ring_mod_depth`: The ring modifier depth

fx_ring_mod(float *ring_mod_freq*, float *ring_mod_depth*, bool *enable_filter*)

Advanced constructor/initializer for the ring modulator.

Parameters

- `[in] ring_mod_freq`: The ring modifier frequency
- `[in] ring_mod_depth`: The ring modifier depth
- `[in] enable_filter`: Removes lower harmonics and creates more of a pitch shifting effect (less crazy)

void **enable**()
Enable the ring modulator (it is enabled by default)

void **bypass**()
Bypass the ring modulator (will just pass clean audio through)

void **set_freq**(float *new_freq*)
Sets the carrier frequency of the ring moduator (Hz)

Parameters

- `[in] new_freq`: The new frequency

void **set_depth**(float *new_depth*)
Sets the depth of the ring modulator (0.0 -> 1.0)

Parameters

- `[in] new_depth`: The new depth

void **print_params**(void)
Prints the parameters for the delay effect.

Public Members

fx_audio_node ***input**
Audio routing node [input]: primary audio input

fx_audio_node ***output**
Audio routing node [output]: primary audio output

fx_control_node ***freq**
Control routing node [input]: the carrier frequency of the ring moduator (Hz)

fx_control_node ***depth**
Control routing node [input]: modulation depth

CHAPTER

THIRTYFIVE

CLASS FX_SLICER

- Defined in file_src_effects_dm_fx_slicer.h

35.1 Inheritance Relationships

35.1.1 Base Type

- `public fx_effect` (exhale_class_classfx__effect)

35.2 Class Documentation

class fx_slicer : **public** fx_effect

Effect: Slicer - chops up audio in the time domain and pipes to different effects.

Example: ___slicer_1.c___

Public Functions

fx_slicer(float *period_ms*, int32_t *channels*)

Basic constructor/initializer for the slicer.

Parameters

- `[in] period_ms`: The period in milliseconds
- `[in] channels`: The number of channels to slice between during the period

void **enable**()

Enable the slicer (it is enabled by default)

void **bypass**()

Bypass the slicer (will just pass clean audio through)

void **set_period_ms**(float *period*)

Upates the period in milliseconds for the slicer.

Parameters

- `[in] period`: The period in milliseconds (thousands of a second)

void **print_params**(void)
Print the parameters for this effect.

Public Members

fx_audio_node ***input**
Audio routing node: primary audio input

fx_audio_node ***output_1**
Audio routing node: audio output for slicer channel 0

fx_audio_node ***output_2**
Audio routing node: audio output for slicer channel 1

fx_audio_node ***output_3**
Audio routing node: audio output for slicer channel 2

fx_audio_node ***output_4**
Audio routing node: audio output for slicer channel 3

fx_audio_node ***output_5**
Audio routing node: audio output for slicer channel 4

fx_audio_node ***output_6**
Audio routing node: audio output for slicer channel 5

fx_audio_node ***output_7**
Audio routing node: audio output for slicer channel 6

fx_audio_node ***output_8**
Audio routing node: audio output for slicer channel 7

fx_control_node ***period**
Control routing node: period in in milliseconds

fx_control_node ***start**
Control routing node: restarts the sequence at position 0 for triggering with a new note

CHAPTER

THIRTYSIX

CLASS FX_VARIABLE_DELAY

- Defined in file_src_effects_dm_fx_variable_delay.h

36.1 Inheritance Relationships

36.1.1 Base Type

- `public fx_effect` (exhale_class_classfx__effect)

36.2 Class Documentation

class fx_variable_delay : **public** fx_effect

Effect: Variable delay - foundational block of flangers and choruses.

The variable delay effect is the basis for a number of time-varying delay effects like chorus, flanger, phaser, vibrato, Leslie simulator, etc.

Here's a nice tutorial on how variable delays work in these various building blocks: https://www.dsprelated.com/freebooks/pasp/Time_Varying_Delay_Effects.html

Example: ___var_del_1.c___

Public Functions

fx_variable_delay(float *rate_hz*, float *depth*, float *feedback*, OSC_TYPES *mod_type*)

Basic constructor/initializer for variable delay.

Parameters

- `[in] rate_hz`: The modulation rate in Hz
- `[in] depth`: The modulation depth (0.0 -> 1.0)
- `[in] feedback`: The feedback from output to input (-1.0 -> 1.0)
- `[in] mod_type`: The shape of the waveform used to modulate (e.g. OSC_SINE, OSC_TRI, etc.)

fx_variable_delay(float *rate_hz*, float *depth*, float *feedback*, float *buf_size_ms*, float *mix_clean*, float *mix_delayed*, OSC_TYPES *mod_type*, bool *ext_mod*)

Basic constructor/initializer for variable delay.

Parameters

- `[in] rate_hz`: The modulation rate in Hz
- `[in] depth`: The modulation depth (0.0 -> 1.0)
- `[in] feedback`: The feedback from output to input (-1.0 ->1.0)
- `[in] buf_size_ms`: The size of the audio in milliseconds (start wtih a value around 30)
- `[in] mix_clean`: The clean mix. If this is set to 0.0, then you'll just get the pitch changing aspect of the wave that can used for tape delay simulators, etc.
- `[in] mix_delayed`: The delayed signal mix.
- `[in] mod_type`: The shape of the waveform used to modulate (e.g. OSC_SINE, OSC_TRI, etc.)
- `[in] ext_mod`: whether to use an external modulation source (set to true or false)

fx_variable_delay(float *rate_hz*, float *depth*, float *feedback*, float *buf_size_ms*, float *mix_clean*, float *mix_delayed*, OSC_TYPES *mod_type*, bool *ext_mod*, float *initial_phase*)
Basic constructor/initializer for variable delay.

Parameters

- `[in] rate_hz`: The modulation rate in Hz
- `[in] depth`: The modulation depth (0.0 -> 1.0)
- `[in] feedback`: The feedback from output to input (-1.0 ->1.0)
- `[in] buf_size_ms`: The size of the audio in milliseconds (start wtih a value around 30)
- `[in] mix_clean`: The clean mix. If this is set to 0.0, then you'll just get the pitch changing aspect of the wave that can used for tape delay simulators, etc.
- `[in] mix_delayed`: The delayed signal mix.
- `[in] mod_type`: The shape of the waveform used to modulate (e.g. OSC_SINE, OSC_TRI, etc.)
- `[in] ext_mod`: whether to use an external modulation source (set to true or false)
- `[in] initial_phase`: Initial phase in degrees

void **enable**()
Enable the **this_effect** (it is enabled by default)

void **bypass**()
Bypass the **this_effect** (will just pass clean audio through)

void **set_depth**(float *depth*)
Updates the depth of the variable delay.

Parameters

- `[in] depth`: The new depth value

void **set_rate_hz**(float *rate_hz*)
Updates the rate (Hz) of the variable delay.

Parameters

- `[in] rate_hz`: The new rate hz

void **set_feedback**(float *feedback*)
Updates the feedback parameter of the variable delay.

Parameters

- `[in] feedback`: The new feedback value (-1.0->1.0)

void **set_mix_clean**(float *mix_clean*)
Updates the clean mix of the variable delay.

Parameters

- `[in] mix_clean`: The new clean mix value

void **set_mix_delayed**(float *mix_delayed*)
Updates the delayed signal mix of the variable delay.

Parameters

- `[in] mix_delayed`: The new delayed mix value

void **set_lfo_type**(OSC_TYPES *new_type*)
Sets the the type of oscillator used as the LFO.

Parameters

- `[in] new_type`: The new type of LFO (OSC_TYPES)

void **print_params**(void)
Prints the parameters for this effect.

Public Members

fx_audio_node ***input**
Audio routing node [input]: primary audio input

fx_audio_node ***output**
Audio routing node [output]: primary audio output

fx_audio_node ***ext_mod_in**
Audio routine node [input]: use another signal as the modulator source such as an *fx_oscillator*. The oscillator can be run though the clipper for example to create new types of waveforms.

fx_audio_node ***modulated_out**
Audio routing node [output]: just the pitch modulated signal without mixing in the original signal

fx_control_node ***depth**
Control routing node [input]: modulation depth

fx_control_node ***rate_hz**
Control routing node [input]: modulation rate in Hz

fx_control_node ***feedback**
Control routing node [input]: feedback

fx_control_node ***mix_clean**
: Control routing node [input]: clean signal mix

fx_control_node ***mix_delayed**
: Control routing node [input]: delayed signal mix

DreamMaker FX is an audio effects platform that is designed to help musicians easily invent and perform through novel effects that have never been heard before.

DreamMaker FX is build around the Arduino platform making it easy to create and control complex effects. However, unlike other Arduino-based effects platforms, audio processing on DreamMaker FX is done on a powerful SHARC DSP. SHARC DSPs are specialized audio processors used in lots of high-end audio gear.

If you want to hear it in action, check out the *Hear it in action*.

Visit http://www.dreammakerfx.com to see the platform in action.

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