Everett M. Carpenter

25 May 2024

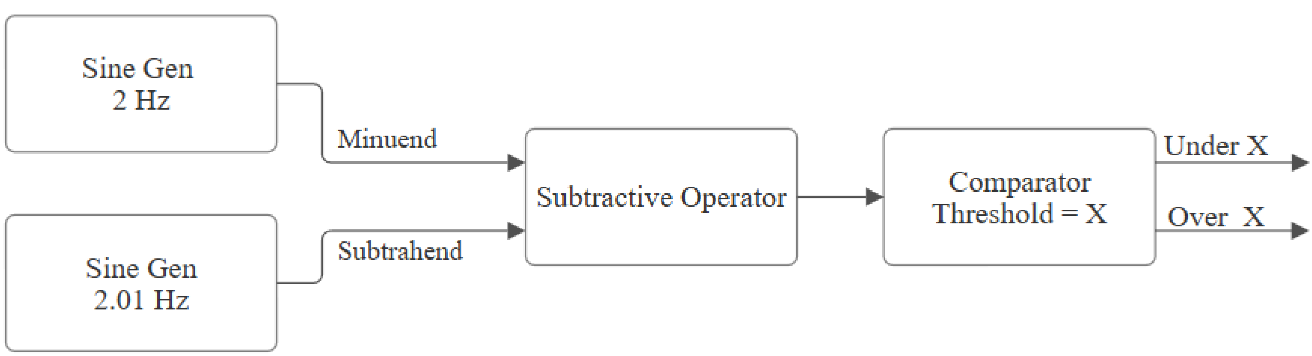
The Phase of Two Sines Modular Concept

The “Phase of Two Sines” patch concept is rather simple, yet it can be used extensively to incorporate decision making into your modular engineering. It requires an understanding of two concepts:

1. Phase in electrical signals (or audio, although its application may be confusing at first).
2. Comparators, and how they work.

Once these concepts are understood, creating this patch becomes straightforward. All that is needed is two oscillators or function generators, a process that can compute the difference or sum of two signals, and a comparator. In my conception of this idea, I used a VCV Rack module that can run BASIC code. The module allowed me to connect two signals and subtract them, and then send the difference to an assignable output.

A block diagram for the signal flow of the “Phase of Two Sines” patch follows:



In this diagram you can see the order of processes. It is important to note that the “Under X” and “Over X” outputs from the comparator are gate outputs. This means the output stands “high” or “low” when the signal is under or over a specified threshold. A simple way of envisioning this is two lamps. One lamp is the “Under X” output, and the second lamp is the “Over X” output. When the input signal is below the threshold, the “Under X” will turn its respective lamp on and the “Over X” lamp will be off. The inverse applies if the input signal is over the threshold. The outputs of “Over X” and “Under X” are absolute, meaning the output is either on or off. You can use these over and under outputs to make decisions, i.e. the starting of a volume envelope to fade in a sound, or a switch that flips between two inputs.

There are three main variables that can be changed in this patch. The variables available to the user are as follows:

1. The *waveform* of the signal generators.
2. The *frequency* of the signal generators.
3. The *threshold* of the comparator.

Each variable can cause unique results, and the combination of all three can create useful outcomes.

Starting with the waveform, two oscillators of the same waveform can create a somewhat simple phase difference between the two, and the increase in difference can be plotted over time. What if the two oscillators are not of the same waveform? What if their waveforms change over time? These questions can be explored using different types of non-linear signal processing, such as rectifiers, logic gates, or certain operands.

Next, the frequency of the independent signal generators is a very useful tool in creating new results. When using two sine functions that are oscillating at speeds ±0.01 of each other, the result of this patch is just a fraction of its potential, as the output of the subtractive operator would be a sine function at the speed of 0.01Hz. When we change the frequency of one or both functions, we can create much more interesting and sometimes unexpected results. Another idea to note, is that the set frequency of one or both oscillators can change over time, allowing a forever changing difference between the two.

The final variable at the user's control is the threshold of the comparator. This allows you to articulate the exact level in which the "Over X" and "Under X" outputs operate. When the threshold is set low, you can have the outputs operating quite frequently; but if it is set high, the "Over X" operation will seem of little to no use. Finding the right balance is key to having a successful comparator in your patch. Some comparators allow the external control of their threshold, meaning the threshold level can change as a result of another operation. Using this feature can be quite useful, especially if you want to create unique and indeterminate patches.

This patch has significant potential when it comes to event processing, signal processing and decision-making. A good starting point could be the live processing of acoustic instruments, although this may require balancing microphones. The patch could be used not as an audible effect, but to make decisions and adjustments to other effects such as phasers, filters and those commonly found on pedal boards. Despite the patch's usefulness, it is important to note the very simple concept behind it: phase relationships and how simple arithmetic functions can be used with complex waveforms to create even further degrees of complexity.