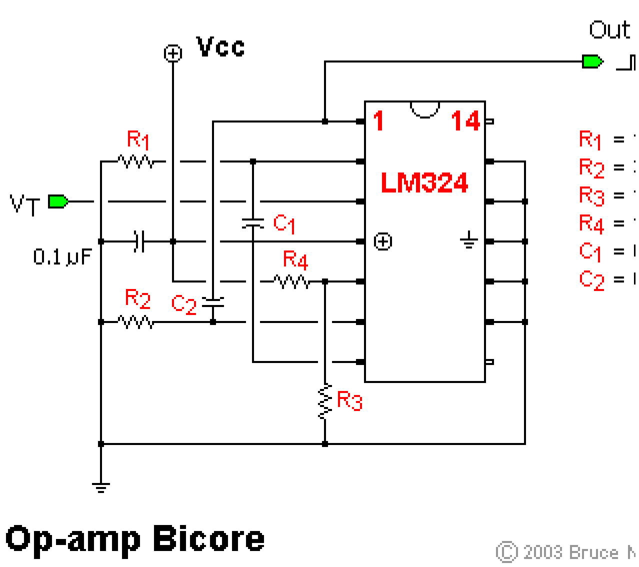
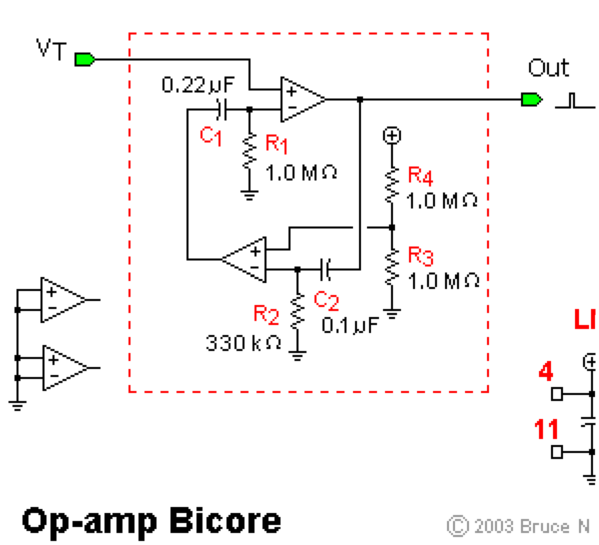
OP-AMP BASED NV NETS

Bruce Robinson published a set of circuits implementing Nv neurons via op-amps. Here's his presentation:

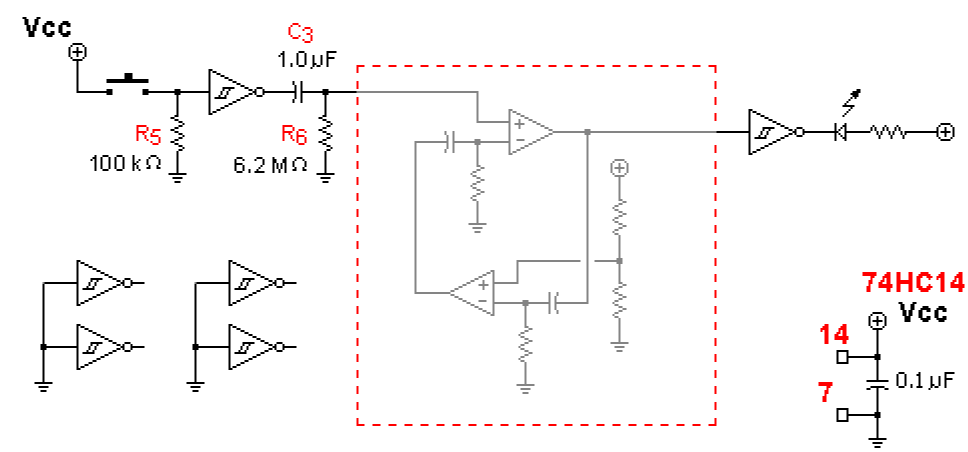
> At first glance, just another bicore variation, but with a higher component count. It seems to reverse the BEAM drive toward simplicity (i.e., more parts, no apparent increase in functionality). But wait...
>
> What I've done is use an LM324 op-amp to build a bicore (two bicores will fit on one chip). Why use an op-amp? Because you can vary the trigger threshold to change the bicore timing. It turns out that this can have some advantages over the usual practice of varying the R-C time constant.





The first image shows the pinout diagram for the basic bicore. The second image is the schematic for the same circuit, and I'll use that for a brief explanation of how the circuit works. You should recognize a basicbicore configuration -- two IC devices acting like inverters, each one with a resistor and capacitor connected to the input (R1 & C1, R2 & C2). What's different is the extra input to each "inverter" -- this sets the trigger threshold. In the upper "neuron", input VT is a variable threshold that controls the bicore frequency. In the lower "neuron", I've set the threshold to a constant -- 1/2 Vcc -- using resistors R3 & R4. The smaller values for R2 and C2 make a short, constant-width pulse. You can replace R3 & R4 with a trimpot (or other circuit) to give the lower neuron a variable delay as well. The values I chose are just about right for driving an LEDso you can play with the circuit on a breadboard. Raising the value of VT means it will take less time for the upper neuron to reach its threshold, so the bicore will speed up. Lowering the value of VT makes the neuron take longer to time out, so the bicore slows down. You can test this effect by connecting a trimpot between Vcc and GND, with the center lead connected to VT.

If your goal is to set the frequency of a bicore using a trimpot, there isn't much point in using this circuit -- just make R1 and/or R2 variable instead, and use inverters instead of op-amps. But if you want to vary thebicore frequency using a circuit, my design has some advantages.



Decreasing Frequency Bicore

The above image shows just one way to use this circuit. Here I've taken the basic op-amp bicore and connected an R-C pair (R6, C3) to the VT input. Pushing the pushbutton will drive the inverter output low; when the pushbutton is released, the inverter output will go high, charging capacitor C3. This will cause the bicore to pulse very quickly. As the charge on C3 drains off through R6, the bicore will slow down.

I've shown an inverter connected to the output, driving an LED. Technically you can drive a low-power LED directly from the op-amp output, but keep in mind that the maximum output voltage from the LM324 is 1.5 volts below Vcc. I added the inverter to the output to keep the LED nice and bright. The effect of this circuit is to cause the LED to flash very quickly when the pushbutton is pushed and released, and then to gradually slow down.

If you attach the same circuit to a motor driver of some kind, the result will be a PWM speed control that causes the motor to spin quickly at first, and then slow down gradually to a crawl. Sounds a bit like Wilf's recent design, doesn't it?

Other applications come to mind. Use this circuit as the slave in a master-slave bicore. Make both thresholds variable and you can change the timing relationship between the master and the slave.

Or create a chain of regular Nv neurons and connect each output to one of these bicores, using C3 and R6. As an impulse travels through the Nv chain, each bicore will be triggered in turn, causing some interesting visual effects. Try it with a 3-neuron chain, or a tricore, and hook each bicore output to a 3-colour LED to get interesting multi-colour visual patterns (Jenny? Tom?).

This is a nice little circuit to play around with on the breadboard to see just what you can do with it.

Source: http://www.solarbotics.net/library/circuits/misc_opampnv.html