BM3000
Foundations of Natural Intelligence

Coupled Oscillator

Syed Saqib Habeeb
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The graphs below show how the freqdiff vs Vs graph changes by tinkering with the amplitude of the external oscillator.

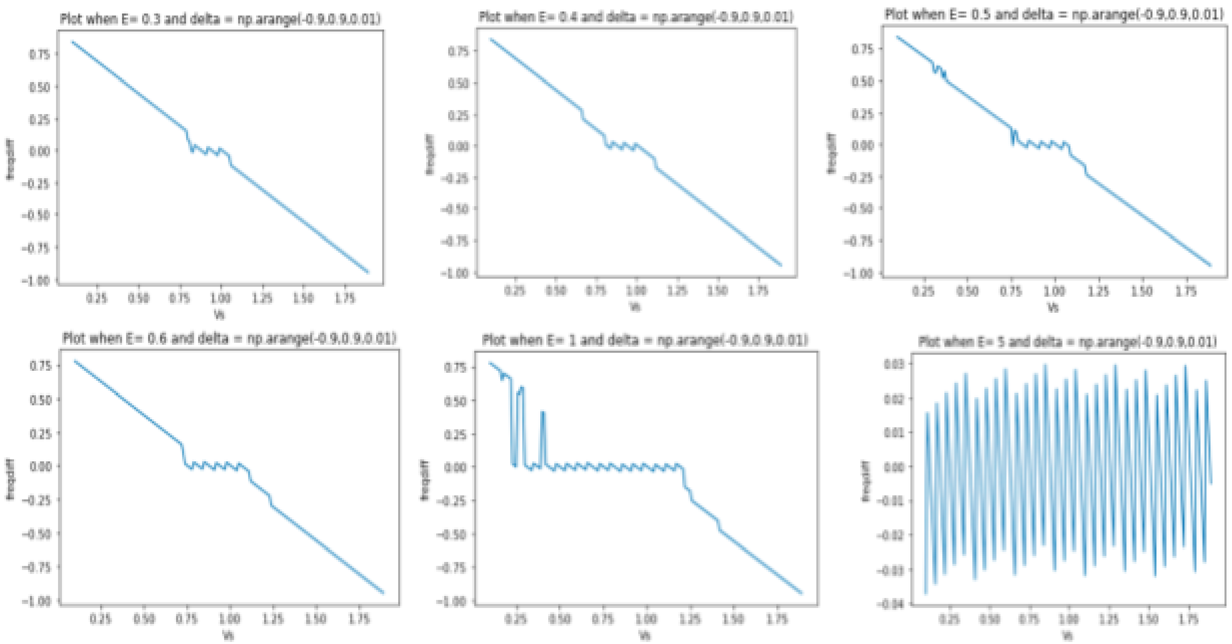


Fig 1: The plots depict the freqdiff VS vs variation when delta is kept constant

As we can see in the graph, the coupled oscillator has a small synchronization region when E= 0.3. But as the value of E increases and after a particular value of E (in this case 1), the synchronization region increases and the oscillator behaves like a sinusoidal oscillator. We can thus say that with the increase in the amplitude of the external oscillator, the region of synchronization increases and in that region, the coupled oscillations are sinusoidal in nature and replicate a motion similar to that of the external oscillator.

When E= 0.6, the region of synchronization is greater than when E=0.3.

In all the graphs we see that the freqdiff decreases after the region of synchronization because a damping effect is observed and there is an increase in freqdiff before the region of synchronization because an amplification effect is observed.

This behavior can be explained by the equation of the coupled oscillator.

y=dx/dt

dy/dt=mu*(1-x**2)*y -((w0**2)*x)+ (E*np.sin(v*t))

The graphs below show the variation of the synchronization region with change in delta.

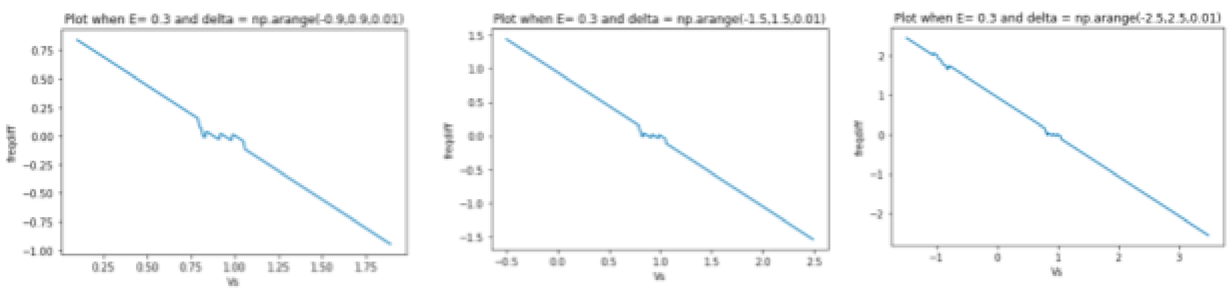


Fig. 2: The plots depict the variation of freqdiff VS vs when amplitude of the external oscillator is kept constant and delta is varied

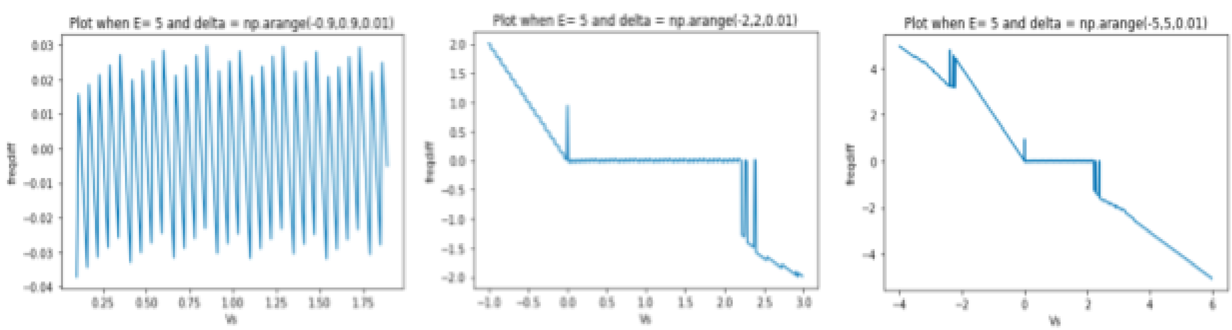


Fig 3: Change in region of synchronization with change in delta

We can clearly see that there is no change in the region of synchronization with change in delta, but by tinkering with delta we can calculate the exact length of the region of synchronization.

From the graphs below we can see that we need a greater amplitude of the external oscillator if with an increase in delta.

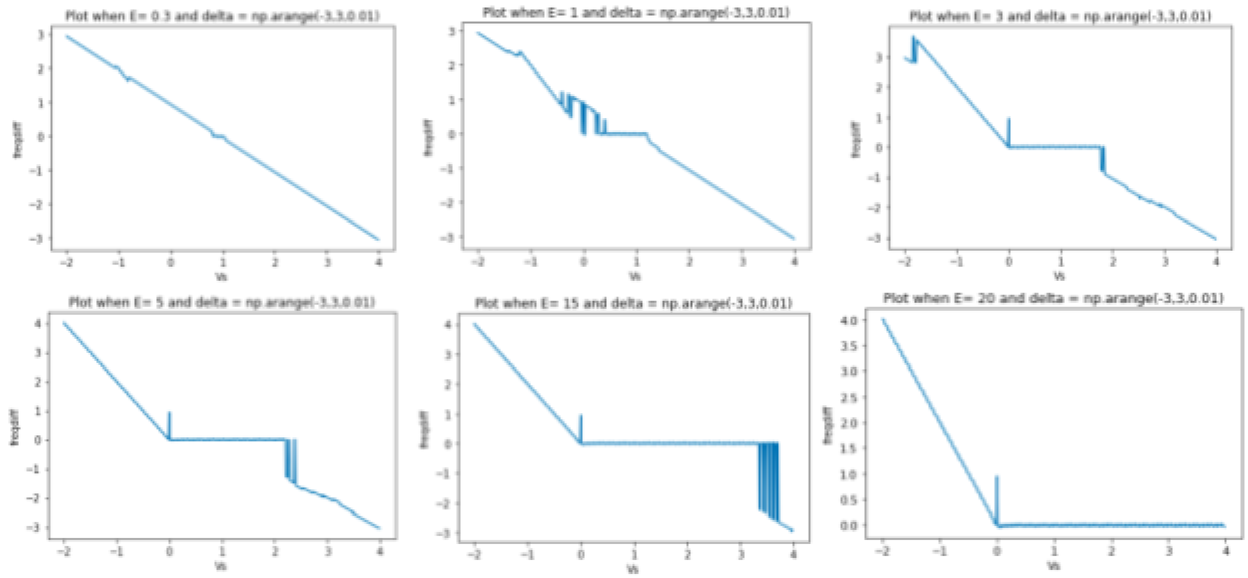
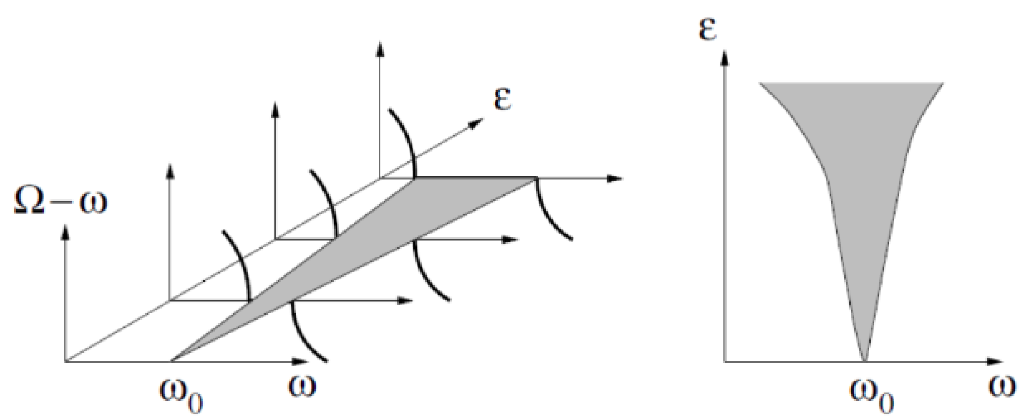


Fig.4 : Figure shows the requirement of a higher amplitude oscillator if detuning increases

Arnold Tongue:

A typical arnold tongue is of the form



Here w_0 = 1.