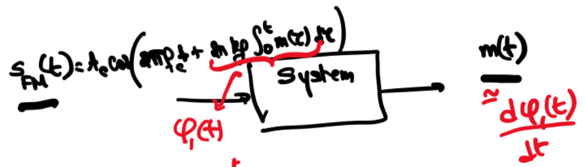
Online Tutorial #01 - FM Demodulation - PLL - Part I

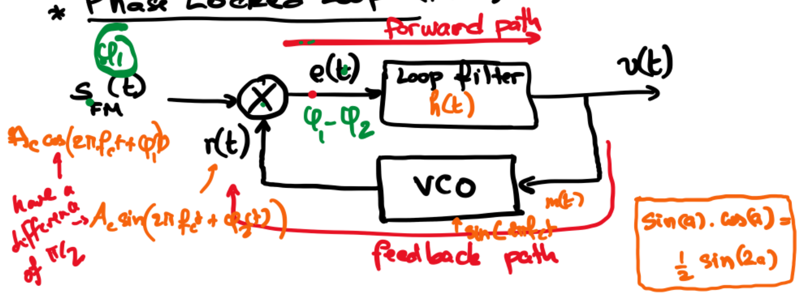
Friday, March 20, 2020
12:01 PM

Objective: to use a system that takes $s_{FM}(t)$ as input and returns $m(t)$ as output.



$\varphi_1(t) = 2\pi k_f \int_0^t m(\tau)\,d\tau$

* Phase Locked Loop (PLL):



if $\boxed{v(t) = m(t)}$ then $r(t)$ is a FM signal similar to $s_{FM}(t)$ but with $\pi/2$ phase difference.

In that case, $e(t)$ will not have low frequency components and the loop converges to the desired output.

if $v(t) \neq m(t)$ then $r(t)$ is a FM signal that is different than $s_{FM}(t)$.

In that case, $e(t)$ will have a low freq. component $\rightarrow$ $v(t)$ will change to get closer to $m(t)$

$$\sin(a)\cos(b) = \frac{1}{2}\Big[\underbrace{\sin(a+b)}_{\text{high freq.}} + \underbrace{\sin(a-b)}_{\text{low freq}}\Big]$$

PLL can be seen as a negative feedback system on the phases.

To analyze this system, we make two assumptions:

1- the VCO frequency is exactly the same as the center frequency of the FM signal.

2- there is a $\pi/2$ phase shift between the unmodulated carrier of the VCO and the unmodulated carrier of the FM signal