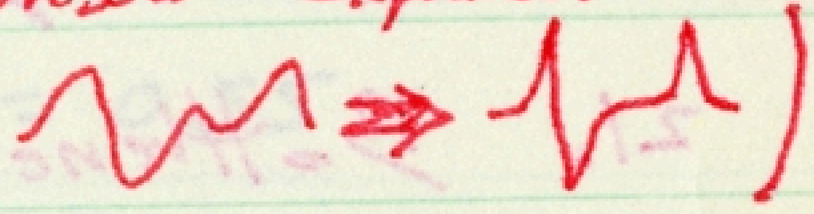
Research Topics :

1. Cascaded queueing systems in manufacturing
2. Coercivity in polycrstalline thin films
3. AWDI and wiggle in metal film heads
   → ~~Corollary~~ corollary : Domain wall motion in metal film heads
4. Partial response signaling in magnetic recording
5. Adaptive signal processing in magnetic recording
6. Quantum theory of ferromagnetic carbon
7. Effects of imperfectly modeled resonance in a variable structure control system
8. Can raw data error rate be improved using nonlinear filtering? (Idea is a compressor-expander to boost peaks and suppress inflexions )
9. Modeling vibration amplification in mechanism shock mounted in a cabinet
10. Calculation of coefficient of mutual inductance coupling in printed circuits
11. Effect of above-Nyquist resonances in a sampled control system
12. Quantum mechanics of 2 interacting particles in a box
13. Grain boundary effect on free electrons in a simple metal
14. Modeling of free electron gas in a ferromagnetic metal
   (~~Coroll~~ corollary : Can free electrons in a metal be
   (modeled as a quantum charge distribution?)

15. Effects of start strategy in mnfc'g system (Kanban, etc)

16. Effect of rework flow on an assembly line

17. Effects of station downtime on an assembly line

18. Batch mngmnt strategies in an assembly process

19. Failure analysis/disposition queues effects on production thruput (include effects of multiple faults and mis-diagnosis)

20. Effects of interpolation and 1st order holds in Digital control systems

21. Bottleneck strategies in assembly processes

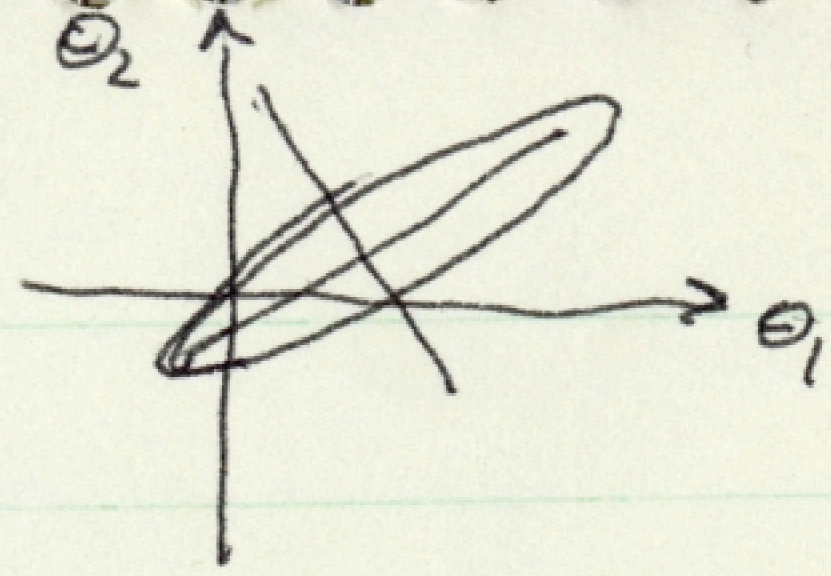
22. Thermal mngmnt of surface mount components

23. Optimal ITAE compensation of resonant systems

24. Modeling noise and transducer noise in adaptive control systems

25. Error correcting codes in servo field applications

26. Weighing a moving semi using road-embedded sensors



$\lambda_1 = 0.1 \quad \sqrt{2}\,Q_1 = [1 \;\; 1]^T$

$\lambda_2 = 1.0 \quad \sqrt{2}\,Q_2 = [1 \; -1]^T$

$P_{11} + P_{12} = 0.1 \qquad P_{21} + P_{22} = 0.1$

$P_{11} - P_{12} = +1.0 \qquad P_{21} - P_{22} = -1.0$

$\Rightarrow P_{11} = 0.55 \qquad P_{21} = -0.45$

$P_{12} = -0.45 \qquad P_{22} = +0.55$

$\theta^{(*)} = [1 \;\; 0.05]^T$

$\theta = [1 \;\; 0]^T \Rightarrow$

$$[0 \; -.05] \begin{bmatrix} .55 & -.45 \\ -.45 & .55 \end{bmatrix} \begin{bmatrix} 0 \\ -.05 \end{bmatrix} = [0 \; -.05] \begin{bmatrix} .0225 \\ -.0275 \end{bmatrix} = .001375$$

$\theta = [0 \;\; 0.05] \Rightarrow$

$$[1 \;\; 0] \begin{bmatrix} .55 & -.45 \\ -.45 & .55 \end{bmatrix} \begin{bmatrix} 1 \\ 0 \end{bmatrix} = [1 \;\; 0] \begin{bmatrix} .55 \\ -.45 \end{bmatrix} = 0.55$$

$\theta = [1 \; -.95] \Rightarrow$

$$[0 \;\; 1] \begin{bmatrix} .55 & -.45 \\ -.45 & 0.55 \end{bmatrix} \begin{bmatrix} 0 \\ 1 \end{bmatrix} = [0 \;\; 1] \begin{bmatrix} -.45 \\ .55 \end{bmatrix} = 0.55$$

$$\theta = [1 \;\; 0] \in \begin{cases} \text{inside if } \sigma^2 > 0.001375 \\ \text{outside if } \sigma^2 < 0.001375 \end{cases}$$

$9 \,)\, 13.75 = 1.52\bar{6}$

9
4.7
45
25
18
7

$\sigma = .03\sqrt{1 + .52\bar{6}}$

$\approx .03\,(1 + .26\bar{3})$

$= .0379$

1.263
1.263
3789
8178
2426
1263
1.591169

7 8 6
.0379
.0379
3411
2653
1137
143641

$$[x\ y]\begin{bmatrix} .55x - .45y \\ -.45x + .55y \end{bmatrix} = .55x^2 - .45xy - .45xy + .55y^2$$

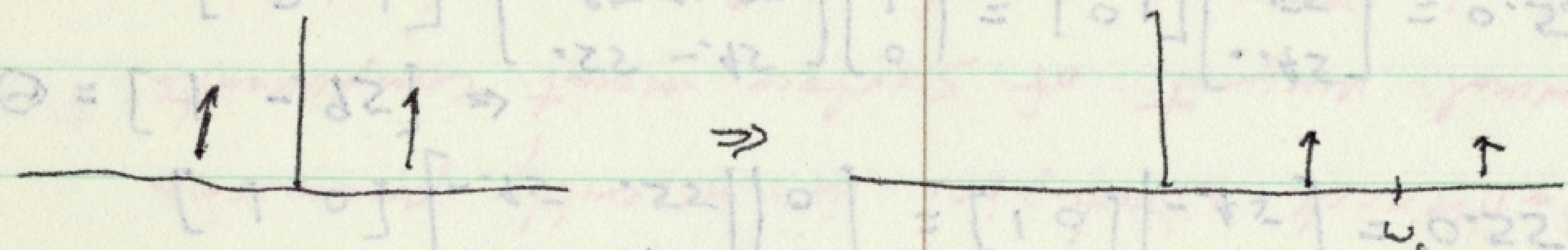
$$= \cancel{0.1x^3}\ .55x^2 + .55y^2 - 0.9xy$$

$$\frac{1}{2}\begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}\begin{bmatrix} .55 & -.45 \\ -.45 & .55 \end{bmatrix}\begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix} = \frac{1}{2}\begin{bmatrix} 1 & 1 \\ 1 & -1 \end{bmatrix}\begin{bmatrix} .1 & 1 \\ .1 & -1 \end{bmatrix}$$

$$= \cancel{\frac{1}{2}\begin{bmatrix} 0.2 & -0.9 \\ -0.9 & 1.1 \end{bmatrix}} = \frac{1}{2}\begin{bmatrix} .2 & 0 \\ 0 & 2 \end{bmatrix} = \begin{bmatrix} 0.1 & 0 \\ 0 & 1.0 \end{bmatrix}$$

$$a\cos(\omega t)\,e^{j\omega_c t} = \frac{1}{2}a\left(e^{j\omega t} + e^{-j\omega t}\right)e^{j\omega_c t}$$

$$= \frac{a}{2}\left(e^{j(\omega_c+\omega)t} + e^{j(\omega_c-\omega)t}\right)$$



$$a\cos(\omega t)\cos\omega_c t = \frac{a}{4}\left[e^{j(\omega_c+\omega)t} + e^{j(\omega_c-\omega)t} + e^{-j(\omega_c+\omega)t} + e^{-j(\omega_c-\omega)t}\right]$$

$$\frac{a}{4}\left[e^{j(\omega_c+\omega)t} + e^{-j(\omega_c+\omega)t}\right]\cos\omega_c t \Rightarrow$$

$$\frac{a}{2}\cos[(\omega_c+\omega)t]\cos\omega_c t = \frac{a}{4}\left[\cos\omega t + \cos(2\omega_c+\omega)t\right]$$

$$\rightarrow \frac{a}{4}\cos\omega t$$

$$\sin(\omega t) = \cos(\omega t - \pi/2)$$

$$\cos(\omega t + \theta) = \frac{1}{2}\left[e^{j(\omega t+\theta)} + e^{-j(\omega t + \theta)} \right]$$

$$= \frac{1}{2}\left[e^{j\theta} e^{j\omega t} + e^{-j\theta} e^{-j\omega t} \right]$$

$$= \frac{1}{2}\left[(\cos\theta + j\sin\theta) e^{j\omega t} + (\cos\theta - j \sin\theta) e^{-j\omega t} \right]$$

$$= \frac{1}{2}\cos\theta \left[e^{j\omega t} + e^{-j\omega t} \right] + \frac{j}{2} \sin\theta \left[e^{j\omega t} - e^{-j\omega t} \right]$$

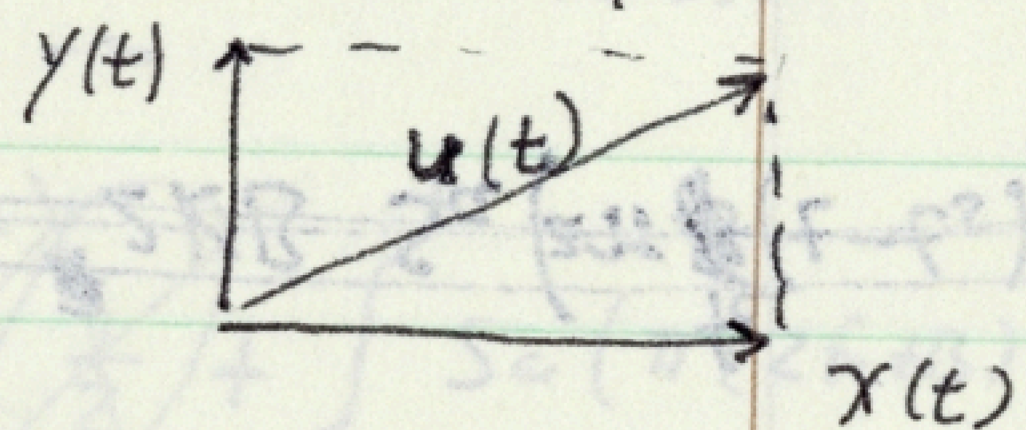
$$= \cos\theta \cos(\omega t) - \sin\theta \sin \omega t$$

$$\therefore\ s(t) = a(t) \cos(\omega t + \theta)$$

$$= (a(t) \cos\theta) \cos\omega t - (a(t) \sin\theta) \sin\omega t$$

$$= x(t) \cos\omega t - y(t) \sin \omega t$$

phasor:

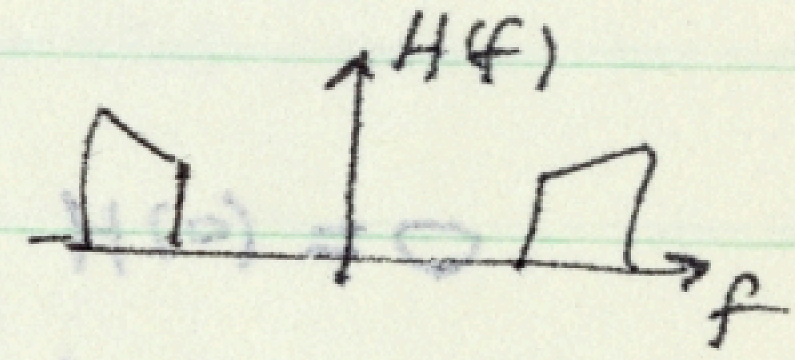


$$u(t) = x(t) + j\, y(t)$$

The definitions

$$C(f - f_c) \triangleq \begin{cases} H(f), & f > 0 \\ 0, & f < 0 \end{cases}$$

$$C^*(-f - f_c) \triangleq \begin{cases} 0, & f > 0 \\ H^*(-f), & f < 0 \end{cases}$$



is motivated by the fact that

$$a(t)\, e^{j\omega_c t}$$ produces only <u>positive</u> frequencies

(for example

$$a(t) = a \cos\omega t \Rightarrow a(t)\, e^{j\omega_c t} = \frac{a}{2}\left(e^{j(\omega_c + \omega)t} + e^{+j(\omega_c - \omega)t} \right)$$)

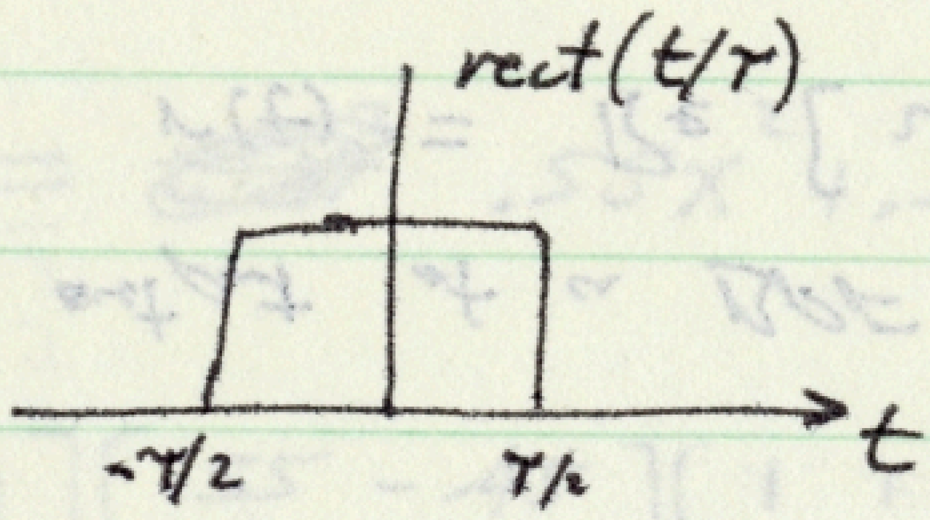
and the output of a BPF has the form

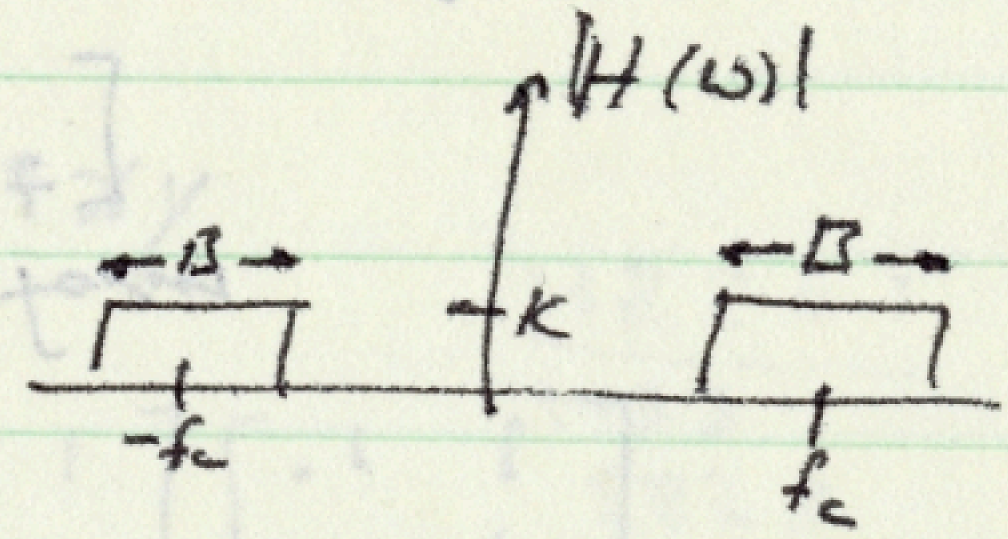
$$r(t) = \mathrm{Re}\left[v(t)\, e^{j\omega_c t} \right]$$

when represented in complex envelope form. Then

$$v(t) = u(t) * c(t) \quad \text{w/} \quad c(t) = \mathcal{F}^{-1}\{ C(f) \}$$

$$H(\omega) = K\left[\mathrm{rect}\left((f-f_c)/B\right) + \mathrm{rect}\left((f+f_c)/B\right)\right] e^{-j\omega t_o}$$





$$X(\omega) = \pi\,\delta(\omega) + \frac{1}{j\omega}$$

$$G(\omega) = \pi\,\delta(\omega)H(\omega) + \frac{H(\omega)}{j\omega} = \frac{H(\omega)}{j\omega}$$

since $H(0) = 0$

math problem: $\delta(\omega)\cdot 0 \neq$ defined

check this in my notes!

For $h_{BPF}(t)$ w/ $t_o \neq 0$

$$\cancel{h(t) = 2KB\ Sa\left(2\pi f_c(t-t_o)\right)\cos(}$$

$$h(t) = 2KB\ Sa\left[\pi B(t-t_o)\right]\cos\left(2\pi f_c(t-t_o)\right)$$

$$g(t) = \int_{-\infty}^{t} h(\tau)\,d\tau \qquad \text{w/} \quad t_o = 0$$

$$= 2KB\int_{-\infty}^{t} Sa\left[\pi B\tau\right]\cos(2\pi f_c\tau)\,d\tau$$

$$g(t) = 2KB \int_{-\infty}^{t} \frac{\sin(\pi B\tau)}{\pi B\tau} \cos(2\pi f_c \tau)\, d\tau$$

$$= KB \int_{-\infty}^{t} \frac{\sin(\pi(2f_c+B)\tau) + \sin(\pi(B-2f_c)\tau)}{\pi B\tau}\, d\tau$$

$$= \cancel{KB}\ \cancel{K(2f_c+B)}$$

$$= K(2f_c+B) \int_{-\infty}^{t} \frac{\sin(\pi(2f_c+B)\tau)}{\pi(2f_c+B)\tau}\, d\tau - K(2f_c-B) \int_{-\infty}^{t} \frac{\sin(\pi(2f_c-B)\tau)}{\pi(2f_c-B)\tau}\, d\tau$$

see 2 pages later

$$= K(2f_c+B)\left[\cancel{\tfrac{1}{2}} + \int_0^t Sa(\pi(2f_c+B)\tau)\, d\tau\right] \qquad \begin{array}{l} u = a\tau \\ du = a\, d\tau \\ d\tau = \frac{du}{a} \end{array}$$

$$- K(2f_c-B)\left[\cancel{\tfrac{1}{2}} + \int_0^t Sa(\pi(2f_c-B)\tau)\, d\tau\right]$$

$$\cancel{= KB + K(2f_c+B) \int_0^{\pi(2f_c+B)t} \sin(u)}$$

Now $$\int_0^t \frac{\sin(a\tau)}{a\tau}\, d\tau = \frac{1}{a}\int_0^{at} \frac{\sin(u)}{u}\, du = \frac{1}{a} Si(at)$$

$u = a\tau$
$du = a\, d\tau$

$\therefore$

$$g(t) = KB + \frac{K}{\pi} Si\left(\pi(2f_c+B)t\right) - \frac{K}{\pi} Si\left(\pi(2f_c-B)t\right)$$