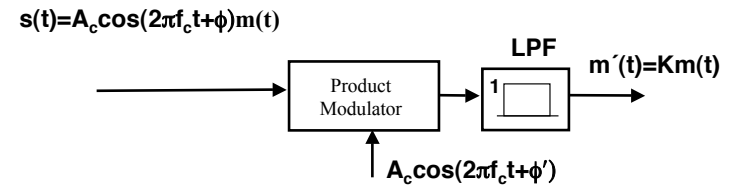


EE179: Lecture 19 Outline

- Review of Last Lecture
- SNR of DSBSC
- Single Sideband Modulation
- AM Radio
- Superheterodyne Receivers

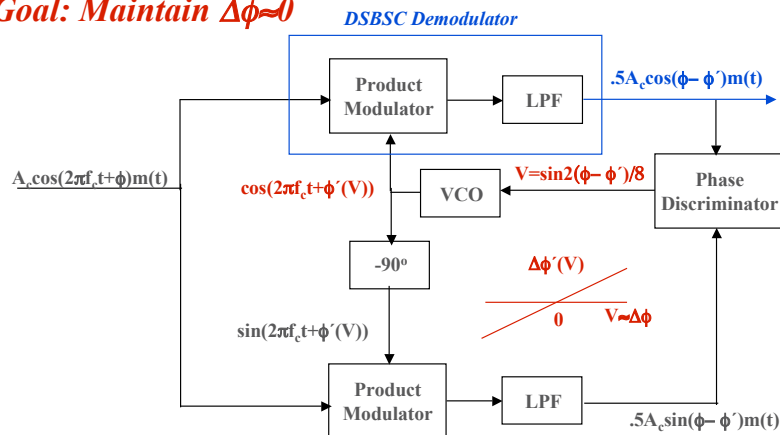
Review of Last Lecture

- Envelope Detectors
- Doublesideband Suppressed Carrier (DSBSC)
- Product Modulators
- Coherent Detection for DSBSC: need $\phi=\phi'$

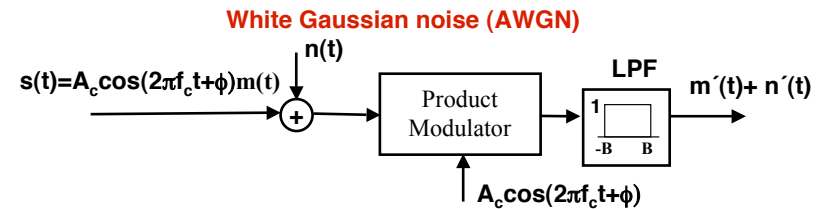


Costas Loop

Goal: Maintain $\Delta\phi=0$



Noise in AM Receivers



- Power in $s(t)$ is $.5A_c^2 P_m$
- Power in $m'(t)$ is $.25A_c^2 P_m$ (half the power in $s(t)$)
- Power in $n'(t)$ is $.5N_0 B$ (PSD $.25N_0$ over BW $2B$)
- $SNR = P_m / P_n = A_c^2 P_m / (2N_0 B) = P_s / (N_0 B)$

Single Sideband

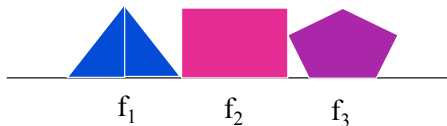
- Only transmits upper or lower sideband of AM



- Reduces bandwidth by factor of 2
- Transmitted signal can be written in terms of Hilbert transform of $m(t)$
- SSB can introduce distortion at DC

AM Radio and Superheterodyne Receivers

- Multiplexes AM radio signals in frequency
 - 10 KHz bandwidth, carrier in 530-1610 KHz



- Receiver needs tight filtering to remove adjacent signals
- LO can radiate out receiver front end
- Fix problems by IF processing (Superheterodyne)

Vestigial Sideband

- Transmits USB or LSB and vestige of other sideband



- Reduces bandwidth by roughly a factor of 2
- Generated using standard AM or DSBSC modulation, then filtering
- Standard AM or DSBSC demodulation
- VSB used for image transmission in TV signals

Main Points

- A Costas loop provides phase synchronization using a VCO and feedback control (coherent detection challenging in all demodulators)
- SNR in AM increases with signal power and decreases with noise PSD and signal bandwidth
- SSB is a spectrally efficient AM technique with half the BW requirements of standard AM and DSBSC.
- VSB similar to SSB, uses slightly more BW for a lower DC distortion.
- AM (and other) receivers downconvert to an IF to avoid filtering/reradiation problems.