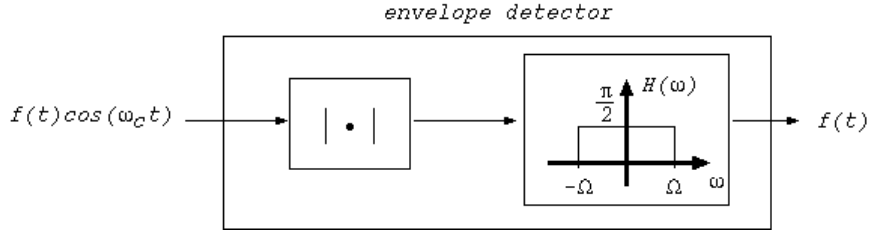
Lecture 37, Friday, April 1, 2022

- Envelope detection



  - Output of full-wave rectifier, assuming $f(t) \geq 0$, is:

$$f(t)|\cos(\omega_c t)| \;=\; \frac{2}{\pi} f(t) \;+\; \sum_{n=1}^{\infty} c_n f(t) \cos(n 2\omega_c t + \theta_n)$$

    for some constants $c_n,\ \theta_n$, corresponding to Fourier series coefficients of $|\cos(\omega_c t)|$.

  - If $f(t)$ is both negative and positive, then need to add a D.C. component, α, large enough so that $f(t) + \alpha \geq 0$

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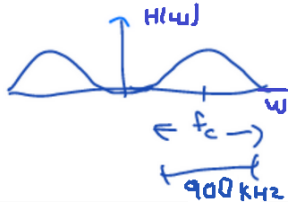
- Superheterodyne AM receiver with envelope detection
  - Envelope detection only works if signal is isolated
  - Will isolate in three steps:
    * Pre-selector filter at f_c to remove part of the other signals. Not sharp but tunable.

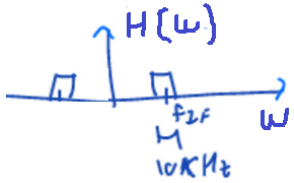


      · Mainly want to remove the image station, which would otherwise land on top of our desired signal. The frequency of the image station is

$$f_{IM} = 2f_{IF} + f_c$$

      · Allows filter bandwidth $\Omega < 2f_{IF} \approx 900$kHz, compared to 10kHz of signal.

    * Local oscillator mixer at f_{LO} to heterodyne (move) signal to f_{IF}
      · Use $f_{LO} = f_c + f_{IF}$ instead of $f_{LO} = f_c - f_{IF}$. Easier and cheaper implementation
    * Intermediate frequency filter at f_{IF} to isolate signal. Very sharp but not tunable.



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