Introduction to Modulation: Amplitude Modulation(AM)

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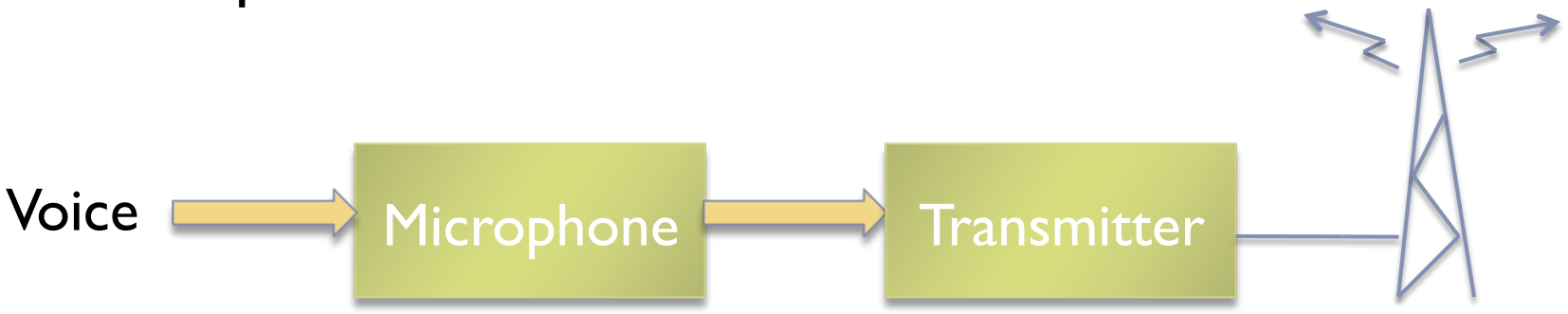
Overview

- Modulation Overview
- Basics of Amplitude Modulation (AM)
- AM Demonstration
- GRC Exercise

Why do we need Modulation/Demodulation?

- Example: Radio transmission



At 3 KHz: $\lambda = \frac{c}{f} = \frac{3\times10^8}{3\times10^3} = 10^5 = 100km$

$\Rightarrow .1\lambda = 10km$

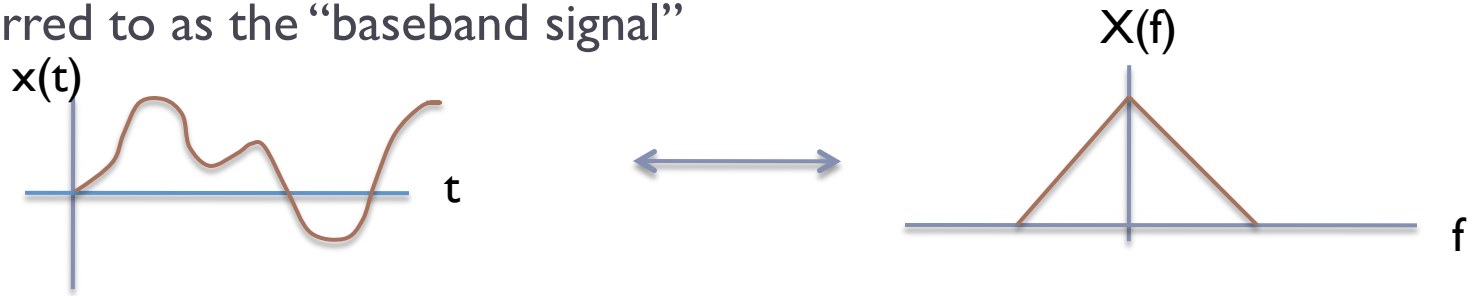
Antenna too large! Use modulation to transfer information to a higher frequency

Why do we need Modulation/Demodulation? (cont'd)

- Frequency Assignment
- Reduction of noise/interference
- Multiplexing
- Bandwidth limitations of equipment
- Frequency characteristics of antennas
- Atmospheric/cable properties

Basic Concept of Modulation

- The information source
  - Typically a low frequency signal
  - Referred to as the "baseband signal"



- Carrier
  - A higher frequency sinusoid
  - Example: cos(2π10000t)

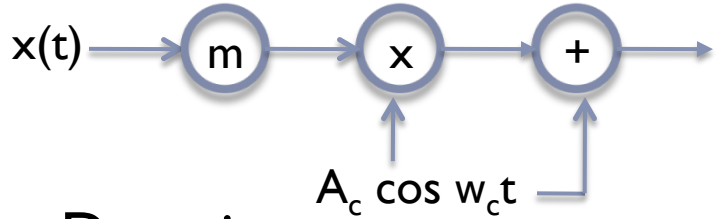
- Modulated Signal
  - Some parameter of the carrier (amplitude, frequency, phase) is varied in accordance with the baseband signal

Types of Modulation

- Analog Modulation
  - Amplitude Modulation, AM
  - Frequency Modulation, FM
  - Double and Single Sideband, DSB and SSB
- Digital Modulation
  - Phase Shift Keying: BPSK, QPSK, MSK
  - Frequency Shift Keying, FSK
  - Quadrature Amplitude Modulation, QAM

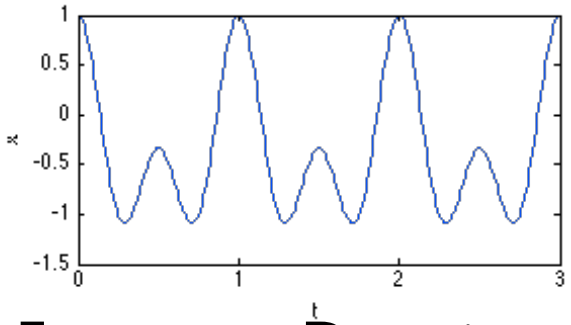
Amplitude Modulation (AM)

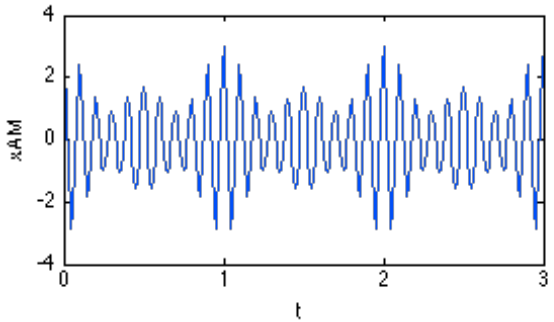
- Block Diagram



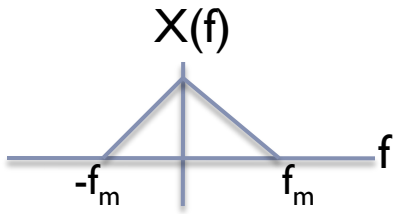
$x_{AM}(t)=A_c\,[1+mx(t)]\cos w_c t$

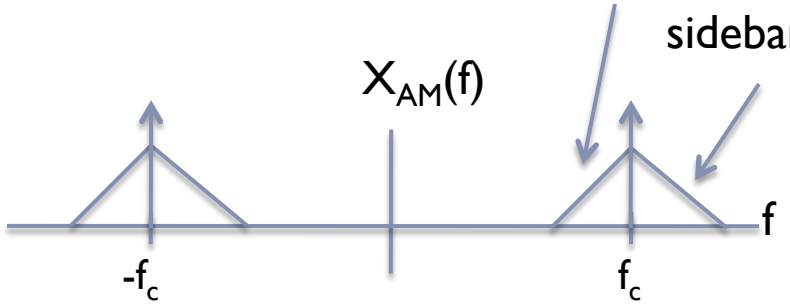
- Time Domain





- Frequency Domain

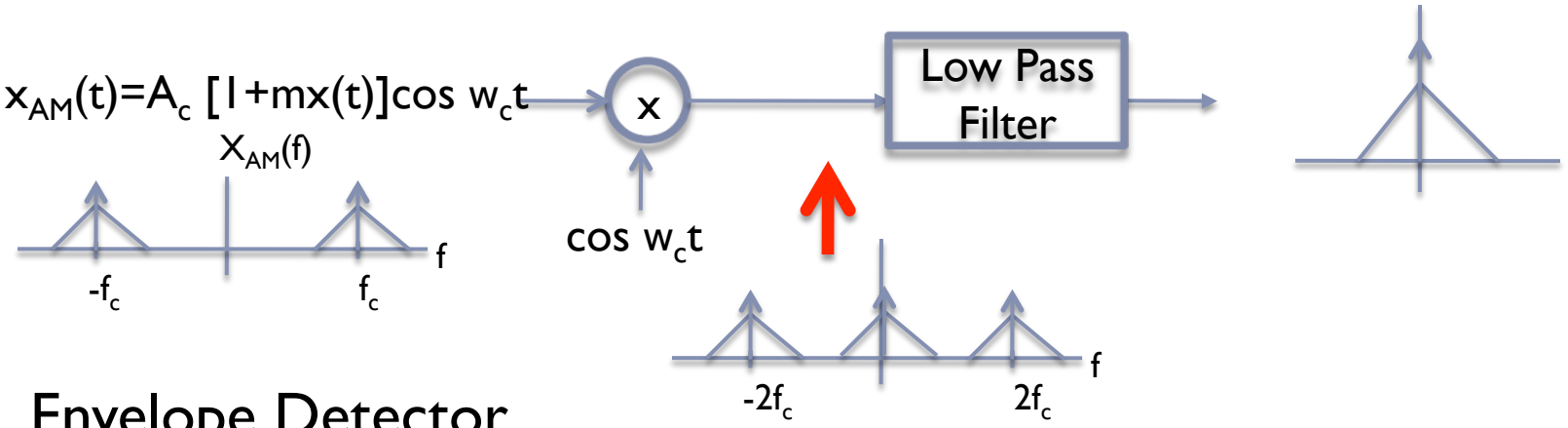




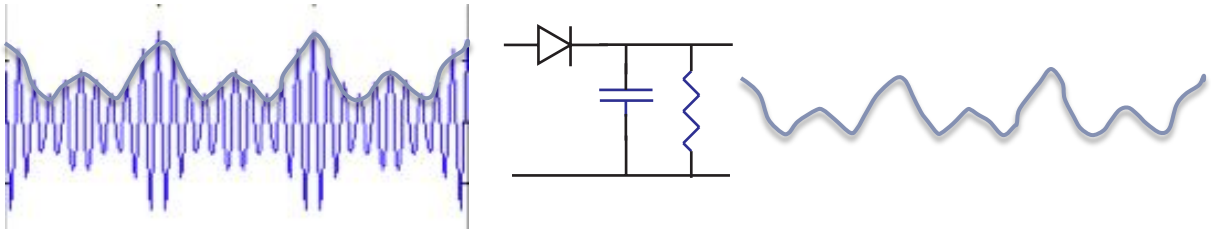
Signal information is contained in the sidebands

Traditional AM Demodulators

- Synchronous Detector

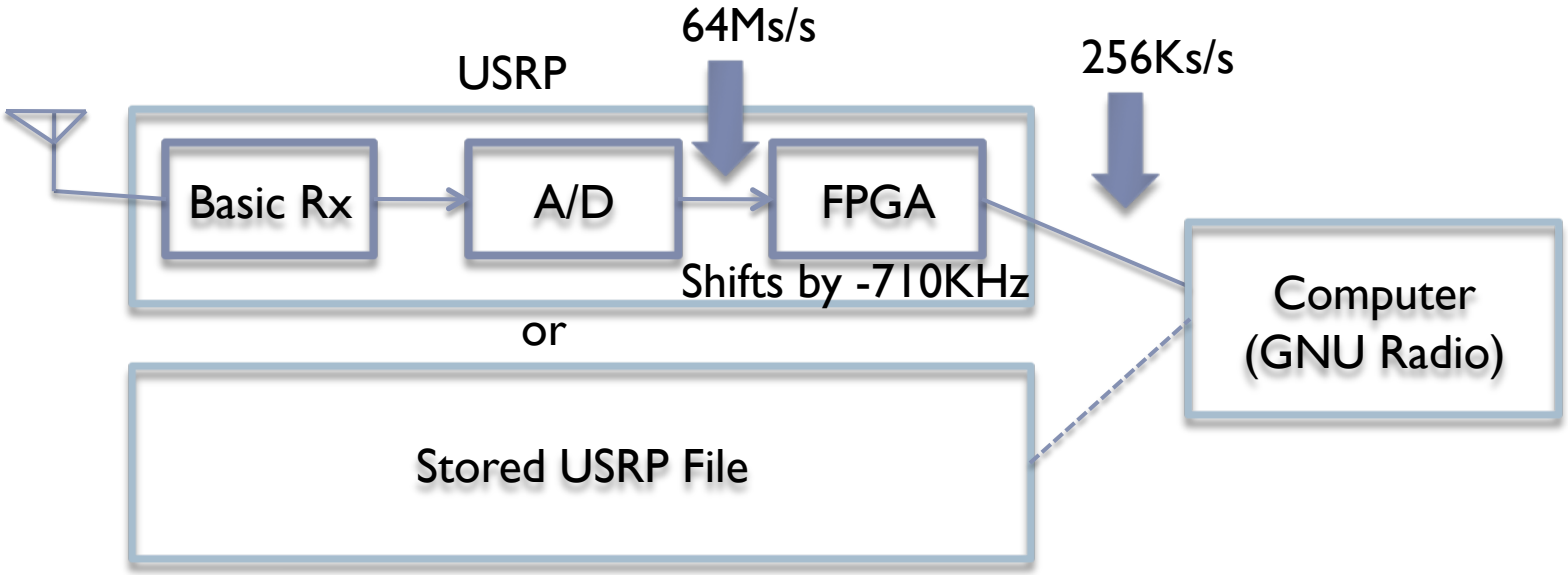


- Envelope Detector



Receiving AM with SDR

- USRP and Computer with GNU Radio Software



AM Modulation

- Demonstration
  - Receiving off-air signals
  - Using a captured file source
- GRC Exercise

Questions?