Zürcher Hochschule
für Angewandte Wissenschaften

School of
Engineering

Laboratory 3B
Applications of the FT: AM-Radio

Experiment Description

a) As warm up solve the exercise 7 from the list of exercises :
sisy-en-material\EXERCISES\SiSy_exer4 .

b) Generare with the signal generator TTI-FuGe TG5011 the following signal:

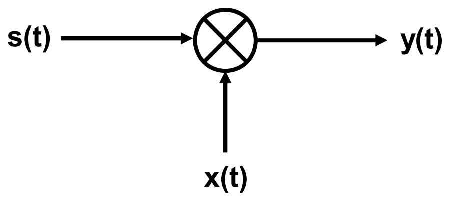
$$s(t) = S_0 + A_1 \cdot \cos(2\pi \cdot f_0 \cdot t) = S_0 \cdot (1 + A_1/S_0 \cdot \cos(2\pi \cdot f_0 \cdot t)$$

with DC-Offset $S_0 = 1V$, Amplitude $A_1 = 0.5V$ und Frequency f_0 = 1 kHz
This is our message signal.

c) The signal s(t) should be now multiplied with the carrier-signal x(t) , which is defined below:

Carrier-Signal : $x(t) = \cos(2\pi \cdot f_c \cdot t)$

For x(t) take Amplitude 1V und Frequency f_c = 10 kHz



Hints:
- Generate first **x(t)** and double-check the signal characteristics in the oscilloscope (in the time domain)
- Select now in the FuGe the configuration „Modulation", „AM", „internal source", „Modulation Depth A_1/S_0 = 50%" und „Modulationsfrequency f_0 = 1 kHz".
- Trigger the oscilloscope with the sync-output of the FuGe.

d) Observe now the resulting signal y(t) in the oscilloscope (in the time domain)

$$y(t) = s(t) \cdot x(t) = [1 + 0.5 \cdot \cos(2\pi \cdot f_0 \cdot t)] \cdot \cos(2\pi \cdot f_c \cdot t) .$$

Can one observe the course ("Verlauf") of the message-signal s(t) somewhere in the modulated signal y(t)?

Could you retrieve s(t) , the message signal using a simple envelop detector?

In case yes, vary the modulation depth and check, for which values of the modulation depth is it possible to retrieve s(t) with an envelope detector?

How could one implement a simple envelop detector with diode, resistor plus condensator?

e) Observe now y(t) in the frequency domain, using the FFT function of the oscilloscope.

Explain the form of the amplitude spectrum of the AM signal, using properties of the FT. Which property is here applicable?

Check the amplitude of the different spectrum components, and their relative difference (in dB), and compare with your setup used to generate y(t).

Vary the frequencies of the message-signal f_0, and the frequency of the carrier-signal f_c, and observe the corresponding changes in the spectrum.

f) Change now the carrier-signal frequency to f_c = 1 MHz, and transmit the resulting modulated signal y(t) over an wire-wrapped antenna, and listen to the received signal via an AM-Radio (which is mostly an envelope detector).

Change the frequency f_0 of the message signal s(t) , and hear the difference.

Change the modulation depth A_1/S_0 of the modulated signal y(t) , and hear the difference.

Change now the channel frequency of the AM-Radio.
What do you think, how wide is a AM radio channel?

Change the form of the message signal from a sinus to a square, and hear the difference.

g) You can also transmit a Radio-Announcement, bei connecting a microphone amplifier system (ECM8000 – MPR1/Stage Line) to the external modulation signal input (in the back side of the FuGe). Plus select modulation source external.

Check the corresponding modulated signal in the time domain in the oscilloscope.