

Q10

$$f_s = 1000$$

$$t = 0 : \frac{1}{f_s} : 1 - \frac{1}{f_s}$$

$$x = \cos(10 \times \pi \times t)$$

① plot fft of x

② $x_m = \text{modulate}(x, t, 100)$ ^{Carrier freq}

plot fft of x_m

③ play x_m

Q28

- 1) read audio file: $[x, fs] = \dots$
- 2) plot fft of x
- 3) $f_{sd} = f_c = 8000$, $t = (0:\text{length}(x)-1)/f_s$
 $t_d = 0 : \frac{1}{f_c} : \text{max}(t)$
a) resample: $x_d = \text{interp}(t, x, t_d, \text{'linear'})$
b) plot fft of x_d

$\frac{8000}{2} = 4000$
 $\rightarrow 8000$
- 4) $f_{sd} = 2 * f_c + f_{sd} - f_c$
 $t_u = 0 : \frac{1}{f_{su}} : \text{max}(t_d)$
 $x_u = \text{interp}(t_d, x_d, t_u, \text{'linear'})$
 $x_m = \text{modulate}(x_u, t_u, f_c)$
plot fft of x_m

$$f_s = 1000$$

$$f_c = 100$$

3) $x_m \rightarrow$ signal from Q2

a) demodulate x_m : $x_2 = x_m \cdot \cos(2\pi f_c t)$

plot x_2 in freq domain

b) pass x_2 through a low-pass filter with cut-off freq $= \frac{f_c}{2} = 50 \text{ Hz}$

define a function: low-pass-filter($\underset{\text{signal}}{x}$, f_s , cut-off freq)

plot (Signal before filtering & signal after filtering)

Compare original signal ($\cos(10\pi t)$) with demodulated filtered signal

a) load file $\Rightarrow [x, fs]$

plot x in freq domain

b) demodulate x : find f_c

$$x_d = x \cdot \cos(2\pi \cdot \overset{???}{f_c} \cdot t);$$

plot x_d in freq domain

c) filter $x_d \Rightarrow \text{low-pass-filter}(x_d, fs, \text{cut-off})$

↓
???

d) play signal:

$$x_f = \text{real}(\text{ifft}(\text{demodulated filtered signal}))$$