

Exercise 2

1 Aliasing

- (a) Generate a 10Hz sine wave, which is sampled at 100 samples/seconds. Does aliasing happen? What if the frequency of the sine wave was 40Hz? Plot the sampled 10Hz sine wave both in time and in frequency domain (Hint: `freqz(sig,1,512,Fs)`).
- (b) Sample a 50Hz sine wave at the same sampling frequency. What do you notice now? Plot the sampled sine both in time and in frequency domain.
- (c) Sample a 90Hz sine wave at the same sampling frequency. Does aliasing occur? If so, what is the aliased frequency? Plot the sampled sine wave both in time and in frequency domain.

2 Filter Specifications:Ripple

- (a) Convert the following from linear scale to dB scale:
 - 0.01 in the passband
 - 0.01 in the stopband
- (b) Convert the following from dB to linear scale:
 - 0.1 dB in the passband
 - 60 dB in the stopband

3 Implementing Digital Filters and Z-Transform

- (a) Consider the following difference equations:
 - $0.5x[n-2] + 3x[n-1] + x[n] = y[n]$
 - $x[n] = y[n] - 2y[n-2]$
 - $2x[n-2] + 3x[n-1] + 2x[n] = y[n-2] + 2y[n-1] + y[n]$

Show the implementations (block diagrams) for each case, using the difference equation (Lecture notes: Part 1, pp 3 - 4)

- (b) Write down the transfer function for each case.

4 Stability

Consider the filter (difference equation):

$$x[n] = y[n] - ay[n - 1]$$

- (a) Write down the transfer function of the system and find the value of its pole(s).
- (b) What is the relation between the variable a and the stability of the system?
- (c) For the special case $a = 1$, is the system stable or unstable?

Food for Thought

- Consider the MATLAB expression `sin = 16`. Is this expression allowed in MATLAB?
- Now consider an expression `sin(90)`, what will be the result of this expression? If you do not get a meaningful result, what will be your solution to this problem?
- Consider the two MATLAB expressions `12/6` and `6?12`, replace the `?` with an expression in such a way that we end up with a result of 2 when MATLAB evaluates both the expressions.