

Audio- / Videosignalverarbeitung Advanced Digital Signal Processing Digital Signal Processing 2

Seminar 3 WS 2017/2018

Homework assignment

1. Write a framework to simulate real-time audio reading-processing-playing back:
 - a) read audio file
 - b) take piece by piece this audio file (in literature or Internet it is called CHUNCK)
 - c) choose reasonable CHUNCK size (explain your choice)
 - d) process it
 - e) play it back
 - f) implement several control buttons

Homework assignment

In the framework has to be implemented following signal processing:

1. Filter the speech signal before downsampling with the given FIR and IIR filters (button switch)

Hint: use `signal.lfilter(b, a, speech)`

2. Downsample the given speech signal (32kHz) to 8 kHz
 - a) Use the .wav-file which is uploaded at moodle in unit „Seminar 3“
 - b) Downsampling by the factor 4
 - c) Plot real-time spectra of the original and processed signal

Hint: use `signal.freqz(...)` for creating the spectrum

See additional slide for animation

Homework assignment

In the framework has to be implemented following signal processing:

3. Upsample the signal to reconstruct original sampling rate
4. Filter the Upsampled speech signal with the given filters (button switch)

Hint: use `signal.lfilter(b, a, speechUp)`

5. Play back the filtered signal after downsampling and after upsampling

Homework assignment

FIR lowpass filtering

- a) Implement the **FIR lowpass** filter with the following difference equation:

$$y(n) = 0.3235 * x(n) + 0.2665 * x(n-1) + 0.2940 * x(n-2) + 0.2655 * x(n-3) + 0.3235 * x(n-4)$$

- b) Plot the impulse response (first 50 samples)
c) Plot the frequency response

Homework assignment

IIR lowpass filtering

- a) Implement the **IIR lowpass** filter with the following difference equation:

$$y(n) = 0.256 * x(n) + 0.0512 * x(n-1) + 0.256 * x(n-2) + \\ + (1.3547 * y(n-1) - 0.6125 * y(n-2))$$

- b) Plot the impulse response (first 50 samples)
c) Plot the frequency response

Homework assignment

Compare FIR and IIR lowpass filters:

- Transfer functions
- Make your own conclusions about comparison
- Which filter is better? Why?

Homework assignment

Real-time animation

```
import matplotlib.animation as animation

fig, (p1, p2) = plt.subplots(2, 1)
fig.set_size_inches(15, 8, forward=True)
original_spectrum, = p1.plot(data, animated=True)
processed_spectrum, = p1.plot(data, animated=True)

p1.set_xlim(x_min, x_max)
p1.set_ylim(y_min, y_max)
p1.grid(True)
p1.set_title('Title')
fig.subplots_adjust(hspace=.5)

p2.set_xlim(x_min, x_max)
p2.set_ylim(y_min, y_max)
p2.grid(True)
p2.set_title('Title')
fig.subplots_adjust(hspace=.5)

def animate(i):
    # updated global variables

    original_spectrum.set_ydata(global_variable_name)
    original_spectrum.set_xdata(range(len(global_variable_name)))

    processed_spectrum.set_ydata(global_variable_name)
    processed_spectrum.set_xdata(range(len(global_variable_name)))

    return [variable_name]

ani = animation.FuncAnimation(fig, animate, range(10000), interval=25, blit=True)
plt.show()
```