Assignment 1, Digital Signal Processing: Fourier Transform

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This assignment is about the Fourier transform and how to use it for audio processing.

Form groups of two and work together. However, each student is required to submit a unique report and use a separate WAV file.

Biomedical students record either heartbeat or Kortkoff sounds and make them sound nice.

1. Record a sound sample: the biomedical students records their heartbeats or Korotkoff sounds with a stethoscope / blood pressure cuff. All other students record their voice with one of the supplied headsets, microphones or apps. Make sure that you record at least at 10kHz or higher sampling rates.

2. Load the audio sample into python and plot the audio signal in the time domain and in the frequency domain with proper axis lables (time,frequency,amplitude). [20%]

3. Enhancing the sound by removing low frequencies from the sound recordings which cause just baseline shifts and/or pop-sounds. Justify your cutoff frequency by referring to the original timedomain and frequency plots. Enhance the perception of the sounds by raising the amplitudes around 2-5kHz. Again, justify your choice of centre frequency and bandwidth. Remember that this needs to be done with the help of the Fourier Transform. [30%]

4. We have dialled numbers with a touch tone telephone and sampled them at a sampling rate of 1kHz (which causes fold down). Find out which number have been dialled. We have recorded 10 different numbers. Use the file on moodle according to the last digit of your matric number. Find out who we've dialled. [20%]

5. Enhancing the sound by adding non-linearities: The so called aural exciter sends the sound through non-linearities and then adds these to the original audio to make it sound more exciting. Try out different non linearlities (atan, cube, etc) and then add small amounts to the original audio to see which work best. Some of them add DC to the signal so that you need to remove the DC. In general sending the sound through a non-linearity will create harmonics which will be perceived as louder (see, for example a guitar amp in overdrive). [30%]

   Note this is a research project. There is no simple solution to it and you need to experiment.

The report should briefly explain the methodology used. Complete PYTHON codes should be included as an appendix. Add high quality figures to your report in *vector format* which stay sharp when zoomed into them. Blurry jpeg figures or screenshots will result in zero marks. Upload your original wave files and the filtered results on moodle.

Deadline: 23rd Oct, 3pm, Hand in your reports at the teaching office in the James Watt building and upload a PDF and the sound files on moodle.