SES Lab 2: Amplifier Design

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Electronics and Electrical Engineering Discipline

Week 1

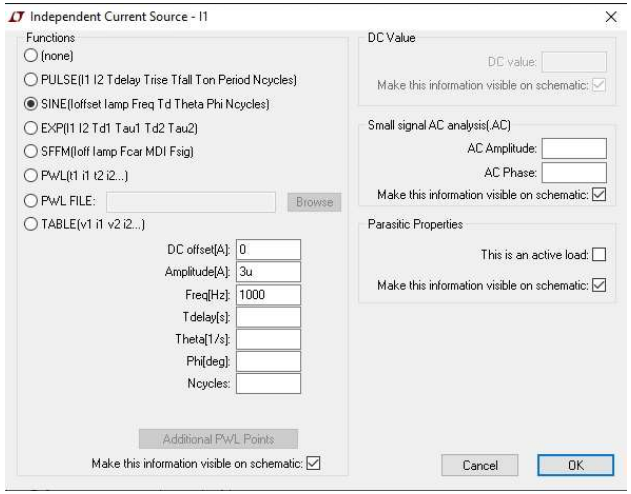
Week 1: Amplifier Design

We will design an audio amplifier in LT-Spice to:

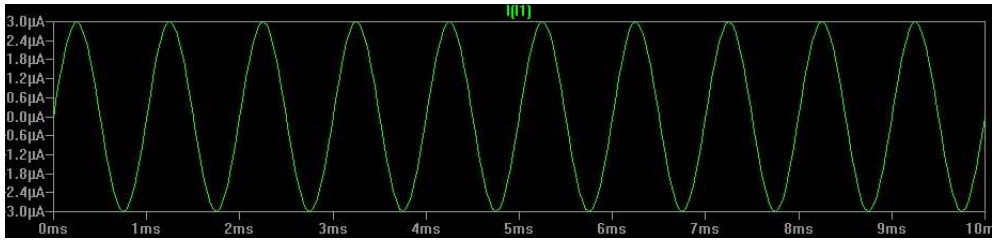
- Amplify low current microphone signal – voice signal may be assumed to be 3μA AC
- Use a simple operational amplifier circuit
- Output will be connected to an analogue-to-digital converter (ADC) on the STM32 board: expects a signal between 0-3.3V
- You will then build and test the amplifier in **Week 9** and submit a short report on its performance

Sine-waves

- The most important type of analogue signal is the **sine wave**
- It represents a single frequency when designing circuits
- **Fourier transforms** show that all signals can be built up using sine-waves of different frequencies
- In LT-Spice, voltage and current sources can generate an AC sine wave with a given frequency/amplitude



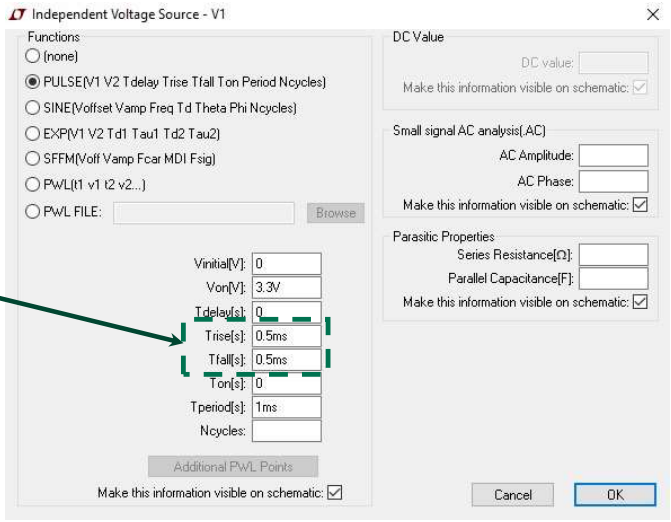
Example of generating a 3 micro-amp sine-wave current signal with 1kHz frequency in LT-Spice



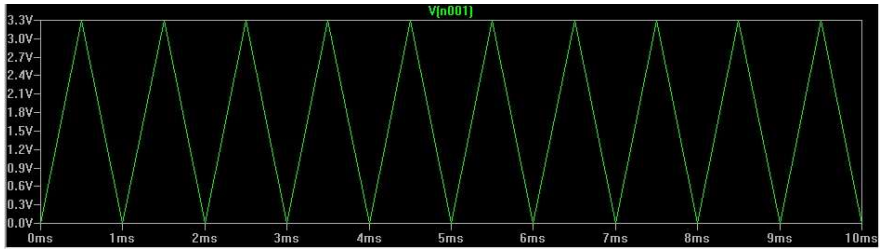
Square and Triangular waves

- In digital circuits, **square waves** are frequently encountered as clock signals or for conveying information
- **Triangular waves** are sometimes useful in analogue circuits to look for distortions in the circuit or in equipment
- These can be generated using the LT-Spice Pulse Option:

Hint: For a square wave, make the rise/fall time very small time values (but not zero)



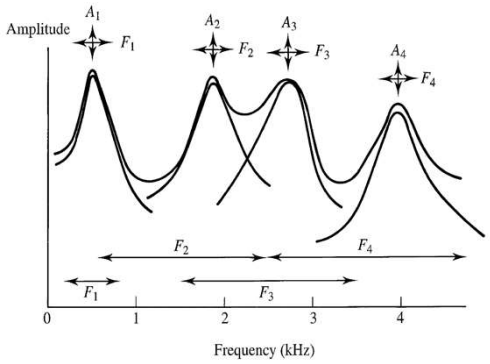
Example of generating a 3.3 volt triangular wave with period 1ms in LT-Spice



Speech Signals

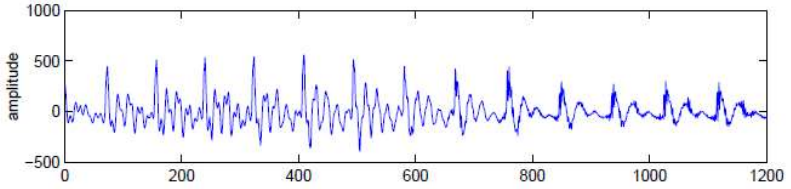
The human voice may be modelled as follows:

- Major frequencies are typically in the range 300 Hz – 3 KHz
- In reality, our voices usually contain 3-4 **formants** or **resonant frequencies**
- We don't need to simulate the voice structure in detail: for LT-Spice testing, begin with a sine wave of **1 kHz**



Frequency Plot showing Voice Formant Peaks

Time-Domain Voice Samples:



Time-Frequency Voice Signal: