

ECE 321 - Homework #3

Audio Sensors, Calibration, and Noise. Due Monday, November 19th, 2018

Audio Sensors

Problem 1) Assume a microphone has a resistance which varies with the audio signal

$$R = 1000 \cdot (1 + 0.01\varepsilon) \Omega$$

where ε varies from -1 to +1 (the audio input). Design a circuit which amplifiers this signal to a 4Vpp AC signal.

Problem 2) Design an envelope detector to convert the output of the circuit from part 1) to a 0V to 2V DC signal.

Problem 3) Check your design for problem 1 and problem 2 in PartSim. To do this,

- Use an AC source to model the audio signal (the output of the voltage divider)
- Pick a 'normal' frequency, such as 500Hz

Calibration

Determine a calibration function to approximate the relationship between voltage and temperature for the following circuit:

$$R_1 = 1000 \cdot \exp\left(\frac{3905}{T} - \frac{3905}{298}\right) \Omega \quad \textit{thermistor}$$

$$R_2 = 700 \parallel (R + 500) \quad \textit{linearizing circuit}$$

$$V = \left(\frac{R_2}{R_2 + 1000}\right) \cdot 10V \quad \textit{voltage divider}$$

Problem 4) Determine a linear approximation for this relationship over the range of -20C to + 20V

$$T \approx aV + b$$

Plot the resulting curve fit and actual temperature vs. voltage.

Problem 5) Determine a cubic approximation for this relationship over the range of -20C to + 20V

$$T \approx aV^3 + bV^2 + cV + d$$

Plot the resulting curve fit and actual temperature vs. voltage.