Team 16

Acoustic Position Sensor

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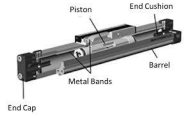
PROPORTION-AIR

Project Background

In this century, many engineers are brainstorming ways acoustics can be implemented to replace various applications. Acoustics can improve energy efficiency, improve accuracy, reduce expenses, and enhance communication. As a result, Proportion-Air introduced the idea of using acoustics to determine the position of a rodless pneumatic cylinder.

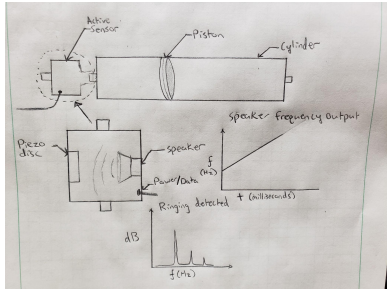


Problem Statement

The aim of this study is to use a combination of sound, microphones, sensors, integrated circuits (IC) , processing, data, physics, and qualities such as resonance and harmonics to prove a concept and develop a prototype. If successful, there will be a way to accurately detect the position of a rodless pneumatic cylinder.

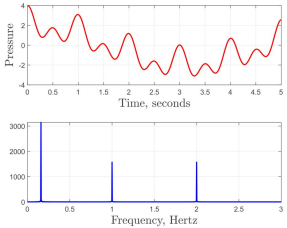
Requirements

- Conceptualize a sensor that utilizes acoustics to determine piston position
- Prototype the sensor

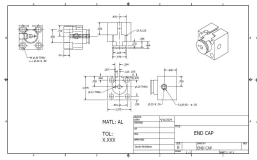


Prototype Initial Design

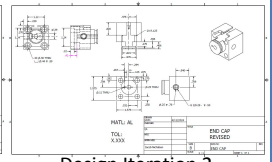
Design Concepts & Experimentation



Fourier Transform



Design Iteration 1



Design Iteration 2

$$f_n = \frac{nv}{2L}$$

n = 1,2,3…
v = speed of sound (343 m/s)
L = length of travel (m)

Final Design

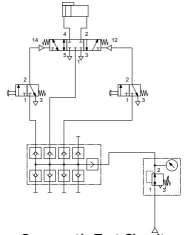
- Created working prototype
- Achieved expected data through the final design
- Ready for sweep input to determine distance

Prototype Cylinder Data

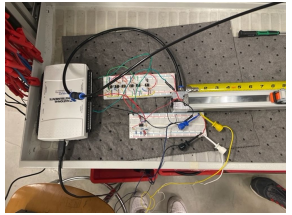
F1 (Hz)	F2 (Hz)	F3 (Hz)	Length (ft)	Length (in)
3000	6000	9000	0.183	2.2
1500	3000	6000	0.367	4.4
1000	1500	3000	0.55	6.6

Sealed Pneumatic Cylinder

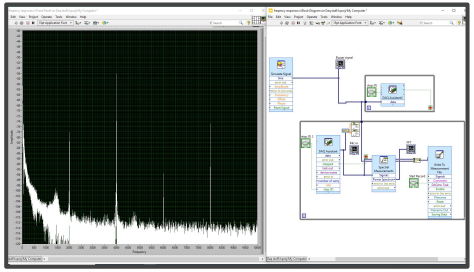
Testing



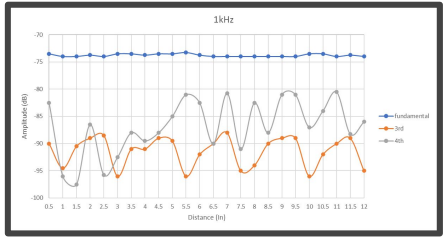
Pneumatic Test Circuit



Post-processing Circuit Setup



Sensor Output with LabVIEW



LabVIEW Data for 1kHz