COLLEGE OF ENGINEERING
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The Use of Polyvinyldene Flouride (PVdF) Films for Pressure Measurement

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Overview

This study investigated the feasibility of the use of piezo-electric materials as aerodynamic pressure sensors. Piezo-electric materials generate a low-magnitude AC signal when mechanically strained under a force or pressure, making them natural pressure sensors [1]. This study focused on the use of Polyvinyldene Flouride (PVdF) film, one piezoelectric material, for its flexible nature. In order to ascertain whether this material could be used for application as pressure sensors for aerodynamic pressure, a testing stand was developed and constructed for wind tunnel testing (Fig. 1).

Conceptual Framework

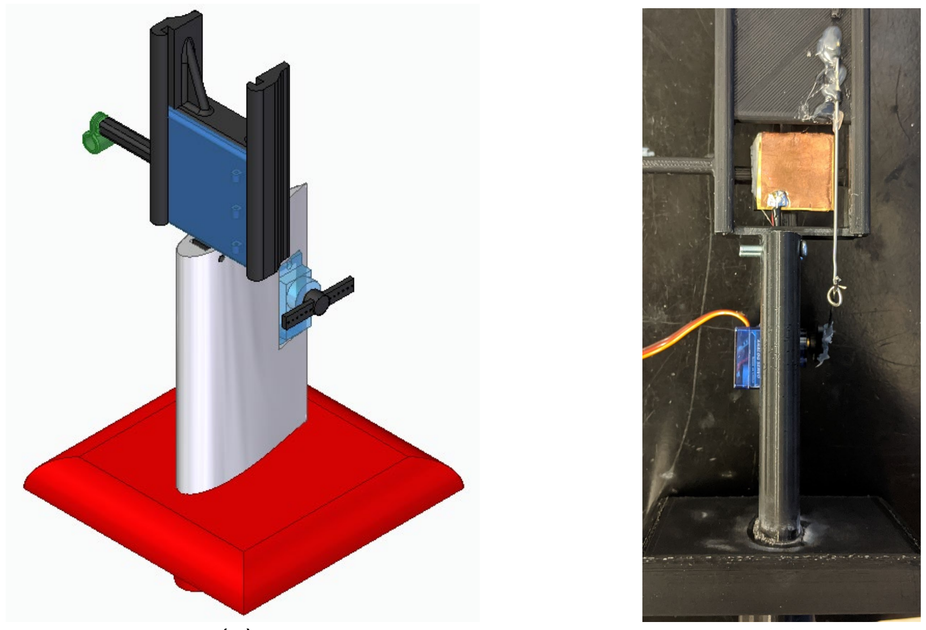
By measuring the pressure around the surface of an airfoil, it's lift and drag can be approximated and the state of the flow around it can be known. The current method of measuring pressure are by tapping, or placing pressure taps in, the surface of the airfoil and using pressure transducers to convert pressure to an electrical voltage. This method, while conceptually simple, creates discontinuities on the airfoil's surface that negatively affects aerodynamic. PVdF film sensors could be a potential pressure sensing alternative that does not have the negative effects of surface discontinuities.

Key Findings

The aerodynamic pressure acting on the sensor was applied and removed cyclically at 0.25 Hz by pulsating the airflows that had dynamic pressure values from 0 to 308.4 Pa. The result of the pulsated flow was a signal that was like the waveform in Fig. 2. By measuring the peak-to-peak voltage of the signal, a correlation curve can be obtained and is shown in Fig. 3. This relation shows a linear behavior, which implies a that these sensors have the potential to be considered for aerospace applications.

Impact

PVdF films show promise in their capabilities in measuring pressure in the ranges of aerodynamic pressures. However, due to the signal's decaying nature and the sensitivity of the sensor to electrical and vibrational noise, further work is needed to better implement these sensors.



(a) (b)

Figure 1 – (a) CAD Design of Wind Tunnel Test Stand; (b) The Constructed Test Stand with PVdF is Shown

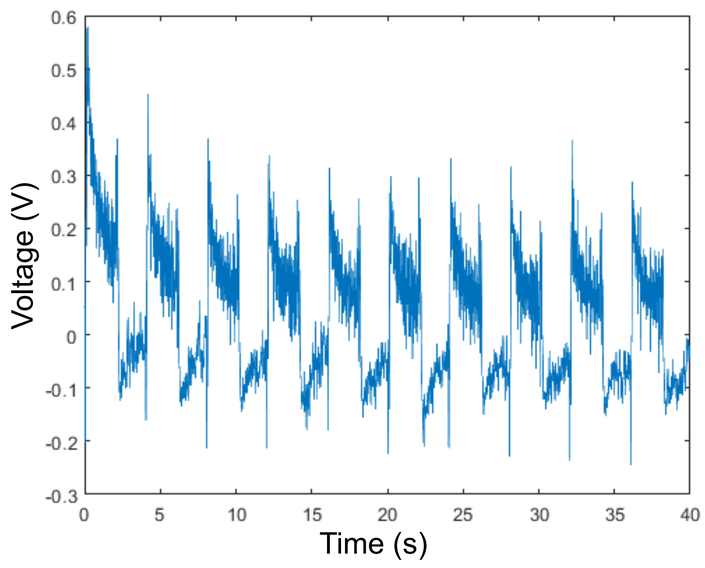


Figure 2 – Sample PVdF Signal

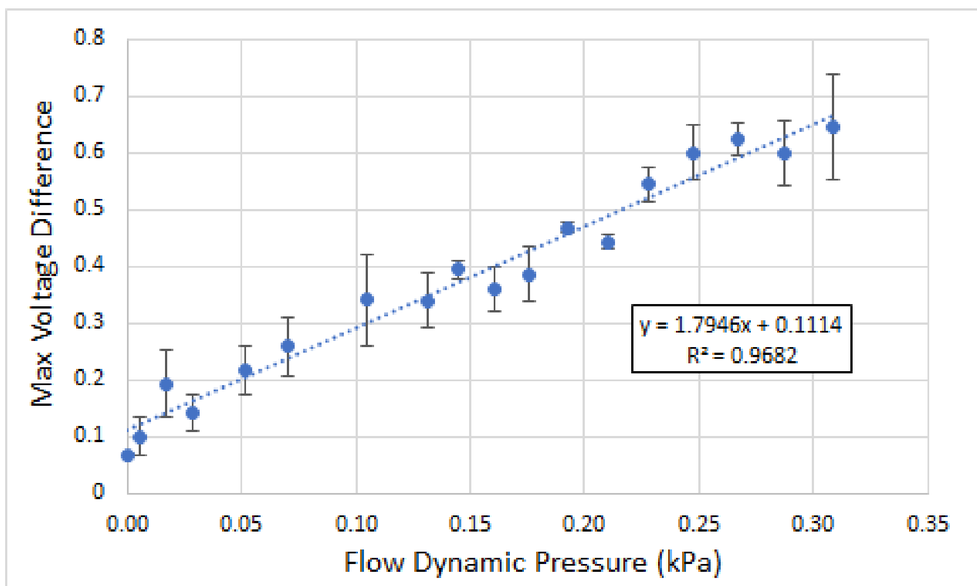


Figure 3 – PVdF Correlation Curve

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