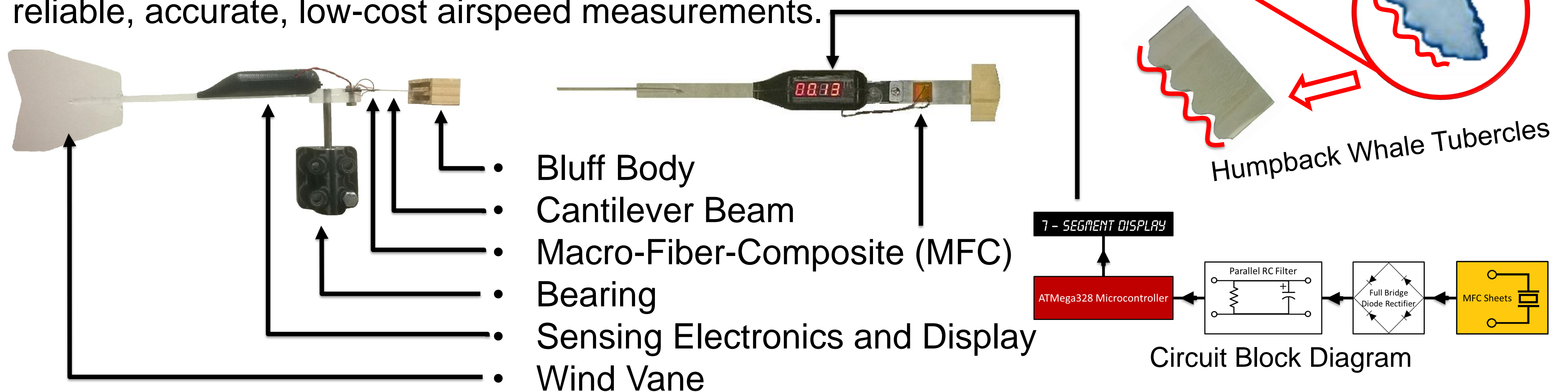


Development of a Bio-Inspired, Low-Cost, Piezoelectric Airflow Sensor

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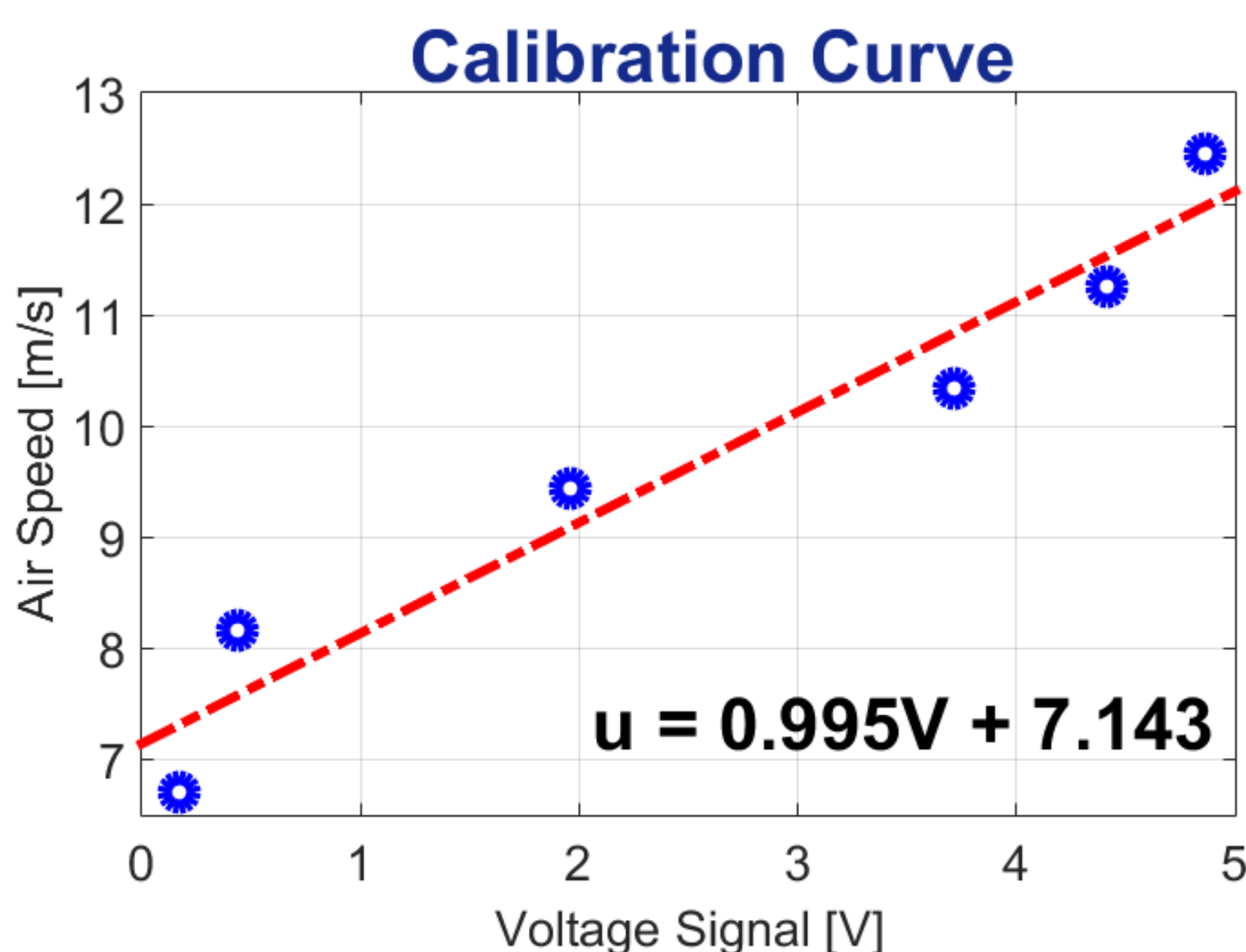
Overview

Research at the UAH Adaptive Structures Lab has led to the development of a proof of concept system to demonstrate a unique flow sensing solution. Based on the galloping piezoelectric energy harvester (GPEH) previously developed at the lab, the sensor uses a cantilever beam with surface-bonded piezoelectric sheets and a bio-inspired tip bluff body to obtain reliable, accurate, low-cost airspeed measurements.



Key Findings

- Successful integration of the sensor on a wind vane allows for accurate determination of both airflow speed and direction.
- Sensor displays airflow speed for quick, visual determination.
- Universal calibration curve obtained from multiple tests.
- Simultaneous use as both a renewable energy source and a flow sensor.



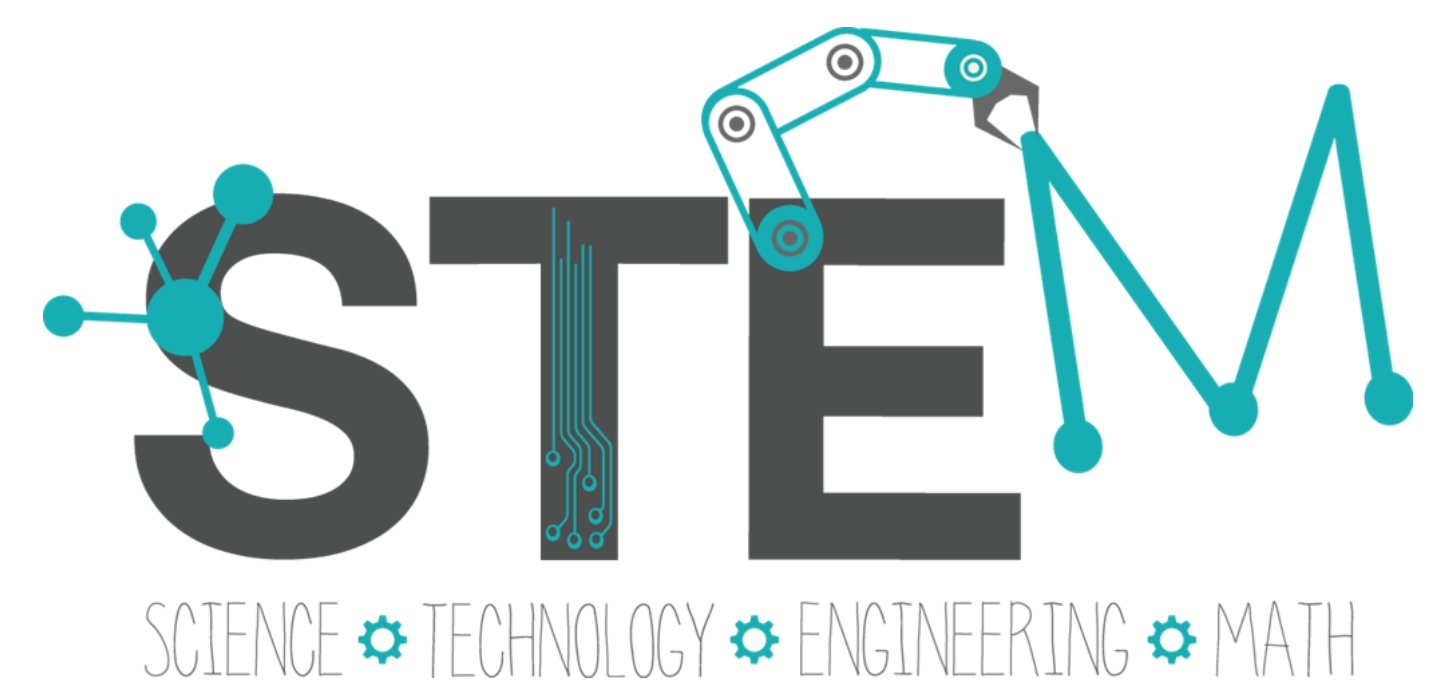
Acknowledgements

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Impact

- Airflow sensing option capable of cost-effective deployment for air field surveys especially in destructive, high wind environments.
- Can be used as a STEM educational resource to explain fluid-structure interaction.



Explanation

- Humpback whale pectoral fin tubercles are mimicked as sinusoidal wavy leading edges on the bluff body.
- Amplitude and wavelength of tubercles used to tune response of the sensor to desired airspeed range.
- Airflow induces galloping oscillation which is converted to AC voltage by piezoelectric cantilever beam.
- Rectifier and RC Filter conditions AC signal.
- ATmega 328 reads the electrical signal, computes airspeed, and displays it on the attached display.