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College of Engineering

Collecting Waveform through Wave Current by using Piezoelectric Sensor

Case Study Proposal

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STATEMENT OF THE PROBLEM

The primary use of piezoelectric sensor in this study is to capture the mechanical energy generated by the motion of ocean waves. Coastal structures, such as piers, breakwaters, and jetties, are exposed to constant wave movement, which exerts pressure or mechanical stress on the structure. Piezoelectric sensors are integrated into these structures to harness this kinetic energy.

This problem can be applied to various coastal structures to converge the functions of renewable energy generator and the wave reducing structure. This technique of using piezoelectric sensor is relatively inexpensive that can be used for economic purposes as well.

This study aims to understand how piezoelectric respond to mechanical stress and generate electrical energy or signals in DC form, by harnessing the properties of piezoelectric under DC conditions.

MATERIALS

- Piezoelectric Sensor (3 pieces, 50mm)
- Capacitor (470uf, 16V)
- Soldering Iron
- Lead
- Wires
- Diode 1n4007
- Toggle Switch (3 Way)
- Analog Discovery 3
- Laptop

PROCEDURES

This procedure aims to understand and optimize how materials convert to mechanical energy into electrical energy due to the movement of charged particles within their crystal structure.

1. PREPERATION AND SETUP

Piezoelectric Element Setup

- Connect the parallel piezoelectric sensor to assign bridge rectifier to convert AC to DC voltage and to store the DC voltage from rectifier.
- Used switch to control the flow of stored energy from the capacitor to the load.

Testing and Optimization:

- Connect the piezoelectric material to the oscilloscope input on the Analog Discovery 3 to measure the voltage generated by the material. Use the positive and negative probes from the oscilloscope inputs to connect across the two electrodes of the piezoelectric element.
- Connect the piezoelectric element to a waveform generator if you want to simulate controlled mechanical vibrations for testing.

2. DATA COLLECTION

Piezoelectric Sensor

- Changing the wave size causes the rack to impact and create a pressure on piezoelectric sensor.
- Record Data Points: Use the Analog Discovery 3 and analyze the waveform and frequency of the electrical signal generated by the piezoelectric material.
- Adjust mechanical stress to study the piezoelectric material's performance under different conditions.
- Conduct trials until the result outcome become consistent.

3. REPORT AND INTERPRET FINDINGS

- Collect data frequency and waveform to illustrate the difference of piezoelectric sensor in AC condition and DC condition with capacitor.
- Observe how the output voltage or current of the piezoelectric sensor changes as the frequency of the wave current increases.
- A higher amplitude input may produce a higher voltage or current output.