Energy Through Wind Induced Oscillation: Investigating the Effectiveness of Various Oscillatory Amplification Methods of Polyvinylidene Fluoride Piezoelectric Strips when Applied to a Bladeless Wind Harvester as well as the Employment of Flow-Induced Vibrations to Further Increase Oscillation

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Energy through Wind Induced Oscillation Junwei Tan Florida Southwestern Collegiate High School, Fort Myers, Florida, United States The goal of this project was to investigate the effectiveness of various oscillatory amplification methods for a wind-based energy generator using polyvinylidene fluoride (PVDF) piezoelectric elements to create prototypes for a piezoelectric wind harvester. Potential gains resulting from the addition of sails and extensions to the piezoelectric element were investigated. A clasping mechanism was constructed to hold the piezoelectric strip in place. To simulate wind, a centrifugal fan was used along with an anemometer to verify wind speed. Circular, square and linear extension sails were tested. All sails had a constant surface area. Due to the anisotropic structure of PVDF, each piezo-sail model was tested in five different orientations. This experimentation concluded that the addition of any sail would increase the voltage generated by the PVDF piezoelectric element in the range of 156% to 7150% depending on wind speed and orientation. The orientation of the modified PVDF strips had a significant impact on the energy output. Overall, the most effective orientation was facing the edge of the PVDF strip directly at the wind. The best sail for the piezoelectric element model was the circular sail. The employment of flow-induced vibrations as a result of vortex shedding was also researched. Optimal configuration of the blunt body was created using CFD simulations and CAD software. Based on observations from simulations, the most effective placement of piezoelectric elements was determined and a prototype for the piezoelectric wind harvester was developed.