CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY

Name(s)

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Project Number

S0202

Project Title

Good Vibrations II: A Two Year Study of a New Method of Vibration Suppressino Utilizing Piezoelectric Patches

Abstract

Objectives/Goals

The objective is to determine if the piezoelectric patch will attenuate the vibratory forces by at least half at temperatures between 0 degrees F and 110 degrees F.

Methods/Materials

Materials used were a small scale model of a plane's ventral fin attached to a metal base, three piezoelectric patches attached to the model fin, a Fluke 19xC-2x5C Scopemeter, an 80 MHz Function/Arbitrary Waveform Generator, a Smart Material voltage amplifying device, a portable digital dish heater, a freezer, a Craftsman Digital Multimeter, and a Resistance Temperature Detector (RTD) model Pt 385. One patch acted as an actuator and was used to introduce vibratory forces, created by the Function Generator, onto the mini-fin. The second patch was used as an attenuator by creating a vibration force 180 degrees out of phase of the actuating force. The last patch was the sensor that detected the vibration remaining in the fin from the actuator and the dampening forces. Testing consisted of sine-waves of varied amplitude and frequencies (as shown on the data tables) applied to the actuator patch.

Results

The results of the tests were compiled into average percentages of vibration reduction for the three different categories and the three voltage settings within each category. At room temperature (approx. 68 degrees F), the average was: 100 V - 46.03%; 200 V - 42.06%; and 300 V - 40.65%. At 110 degrees F, the average was: 100 V - 47.85%; 200 V - 36.69%, and 300 V - 46.45%. At 0 degrees F, the average was: 100 V - 50.68%; 200 V - 50.59%; and 300 V - 50.13%.

Conclusions/Discussion

The hypothesis was not entirely supported by the data. While the piezoelectric patch was able to attenuate the vibratory forces by a little more than 50% when it was at 0 degrees F, the most being 50.68%, it failed to do so during the room temperature tests and the heated tests. It was noted the patch performed more effectively when it was colder. The metal is denser and less flexible when colder, so the patch can exert its force and have transmitted along more of the fin and have it distribute more evenly than when it is hotter. When the fin was heated, the metal became more flexible and the first motion of a force from the actuator was probably absorbed and unevenly dispersed throughout the metal.

Summary Statement

Test the effectiveness of the piezo-electric patch's power to dampen vibrations at 0 degrees F, room temperature (67 degrees F), and 100 degrees F.

Help Received

Lionel Banuelos helped with information on project knowledge; AFFTC Test Pilot School provided patch and equipment for testing; Maria Caballero (mother) helped with the data; and Roberta Ross (mother) helped type the data.