CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)

Mike Zhao

Project Number

S0923

Project Title

A Novel Method of Lens Velocity Detection in the Vibrating Linear Motor

Abstract

Objectives/Goals

The Voice Coil Motor is a miniature autofocus component widely used in cellular phones and tablets, with yearly shipment close to 1 billion units. However, the VCM has two main drawbacks: lens tilt and high power consumption.
Galaxycore Inc. (an image sensor company) is developing a next generation miniature autofocus component called the Vibrating Linear Motor. The VLM#s design avoids the VCM#s two main drawbacks. Also, the VLM is able to increase its lens height during operation. The increased lens height will significantly improve camera module performance.
In the VLM, a series of springs clamps the lens assembly in place. Permanent magnets surround a coil of wire, which is attached to the lens assembly. Applying current to the coil of wire will generate force to move the lens assembly along the optical axis. Once optimal focus is obtained, the series of springs holds the lens assembly in place via friction. Autofocus in this manner is precise and energy efficient.
Precisely moving the lens assembly step-by-step is very challenging. Galaxycore Inc.#s engineers suggested vibrating the lens assembly to achieve step-by-step lens motion. Therefore, successful detection of the lens assembly#s vibrations is the key to building the next generation miniature autofocus camera component.

Methods/Materials

Instead of adding extra components for motion detection, which was recommended by Galaxycore Inc.#s engineers, I considered the possibility of using the existing coil of wire (which is used to move the lens assembly) for motion detection. To prove my hypothesis, a weight was super glued to a VCM camera module lens assembly, and the VCM was flipped upside down and set between two stands, and on a table. The wire leads of the VCM were connected to an oscilloscope. Knocking the table gently with a mallet would cause the table to vibrate, and so would the lens assembly. Lens assembly vibration would create induced current, which would be recorded by the oscilloscope.

Results

Because the lens assembly was attached to a coil of wire, when this coil of wire moved inside the VCM#s magnetic field, the change in magnetic flux would create induced current.

Conclusions/Discussion

By measuring this induced current and analyzing the data, we can conclude that we can indeed use the coil of wire during vibration to detect the lens assembly#s velocity.

Summary Statement

I am trying to find a new way to detect lens motion inside miniature cameras.

Help Received

Used lab equipment at Stevenson School under the supervision of Mr. McAleer, Used lab equipment at the company Galaxycore Inc.