Undergraduate Research Symposium May 17, 2013 Mary Gates Hall

Online Proceedings

POSTER SESSION 3

Commons East, Easel 63

2:30 PM to 4:00 PM

Design of a Multi-Actuator Piezoelectric Stepper System

Cheryl Tan, Sophomore, Pre Engineering
Mentor: Santosh Devasia, Mechanical Engineering
Mentor: Scott Wilcox, Mechanical Engineering

A stepper system is a device that uses multiple small-scale steps to achieve large ranges of motion. There are several fields where stepper systems can be used as positioners such as micro/nano-fabrication, scanning probe microscopy, and alignment of optical components. This stepper design enables a motion stage, whose motion is generated by friction induced with piezoelectric actuators underneath, to move horizontally without vertical displacement. The objective of this research is to investigate a way to support the load of a motion stage while limiting any restriction of motion in the horizontal direction. This restriction of vertical load bearing and horizontal freedom has led to investigating bearings as a component of the support structure. There are many types of bearing designs (i.e. ball, magnetic, and air) that may satisfy the design constraints, so I have performed analysis on various types of bearings and investigated their impact on the design of a new stepper system. For instance, ball bearings support radial loads or thrust loads with forces normal to the ring pathways, but continuous compression, along with expansion, leads to fatigue of the rings, which shortens their lifetime; while magnetic bearings provide support with a distance force that is controlled by the current flow in the circuit, maintaining a more stable and friction-free motion. However, applications may be sensitive to magnetic interference and therefore magnetic bearings may not be suitable for use in some cases. Taking into consideration the benefits and limitations of the different bearing systems, my research has proposed and introduced the design of a stepper support system.

POSTER SESSION 4

Commons East, Easel 71

4:15 PM to 5:45 PM

Mechanical Linkage-Based Leg Mechanism

Kurt Joseph (Kurt) Stalsberg, Senior, Mechanical Engineering: Mechatronics
Mentor: Scott Wilcox, Mechanical Engineering
Mentor: Santosh Devasia, Mechanical Engineering

Multi-Legged terrestrial biological systems demonstrate complex forms of locomotion by utilizing different gait patterns and leg motions for different environmental conditions. Typically, the footpath of biological systems consists of a smooth flat region when the foot is in contact with the ground where the forward motion of the body occurs. The following research focuses on designing a mechanical linkage-based leg mechanism to effectively mimic the step of a biological system. A simulation of the linkage was performed using MATLAB in order to analyze the dynamics of the foot path and duration of stepping phase that the foot was in contact with the ground. After analyzing the foot motion, the linkage-based leg designs were then constructed using the LEGO Mindstorms NXT robotics kit and tested with various walking patterns. Further analysis of the linkage-based leg motion was done by comparing the resulting motion to biological leg motion; successful linkage-based leg designs should display similar stepping characteristics to the biological motion.