

“Three Dimensional Deformation Analization of Dielectric Electro Active Polymers and Di-Conical Application for Artificial Muscle”

Steven Frehn and Andrew Deagon, Highland High School, Palmdale, CA – 2004-05 National Team Finalists

Abstract: Dielectric Electro Active Polymers (EAP) are an emerging technology with high potential in a variety of applications. This paper will report on the discoveries made in the area of shape deformation that Dielectric EAP’s experience when and electric field is applied to them. Once this was completed, existing EAP actuators were analyzed and previously unseen problems were identified involving the wasting of force and mechanical energy. It was then discovered that for optimum energy efficiency the best shape deformation to utilize is contraction. This is apparent because regardless of which direction the EAP is expanding it will only contract in one linear direction resulting in zero loss of mechanical energy and force. Using these discoveries an actuator was designed that is capable of not only utilizing contraction but also expansion and converting all of the three dimensional shape deformations into one linear direction. This Design is extremely useful in that it is able to mimic the motion and qualities of real biological muscles and shows promise in a variety of other industrial applications

“Ice Crawler: The Rescue Robot for Snow, Ice, and Glaciers”

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Abstract: The purpose of this engineering project was to design, build and test Ice-Crawler, a fully mobile robot capable of rescuing a person who has broken through ice on a frozen lake — a situation in which direct human intervention could be fatal to the rescuer.

Ice-Crawler was designed to efficiently traverse harsh winter conditions. Its basic structure consists of two silicon-reinforced rubber tracks connected end to end. Ice-Crawler uses three motors: two for the drive system and one for steering. On the center of Ice-Crawler, a small video camera is mounted. A Basic Stamp II microcontroller, in conjunction with two Motor Minds, controls Ice-Crawler’s speed and allows encoder feedback. The Basic Stamp II is programmed in PBASIC code. A double pole-double throw relay circuit triggers Ice-Crawlers steering mechanism. Ice-Crawler connects to a small control box through a tether, which provides both an electrical connection and a means of pulling the victim to safety.

After testing the first prototype of Ice-Crawler, many modifications were made. Through numerous trials and alterations, Ice-Crawler became a fully functioning rescue robot with the following characteristics: portable, lightweight, cold resistant, and versatile. Ice-Crawler demonstrates the potential of rescue robots and their future role in society.