Public Abstract
First Name:Andrew
Middle Name:Joseph
Last Name:Hanson
Adviser's First Name:Yuyi
Adviser's Last Name:Lin
Co-Adviser's First Name:
Co-Adviser's Last Name:
Graduation Term:FS 2009
Department:Mechanical & Aerospace Engineering
Degree:MS
Title:Kinematic Analysis of Cam Profiles Used in Compound Bows

The first compound bow was invented in Missouri in 1969. Compound bows are uniquely different from other types of bows in that they use a set of cables, cams and pulley, and two elastic limbs that act as springs, to create a mechanical advantage while the bowstring is being drawn. In what is known as the let-off (draw force verses draw length) curve, this allows the archer to hold the bow at a fully drawn length with significantly less force than the maximum draw force. This design is advantageous for hunting, where arrow speed, accuracy, and holding weight become important requirements in being successful. Since the invention, technology has progressed in improving the bow's efficiency, accuracy, and arrow speed through patented empirical methods. However, very little has been shown in analytically modeling and optimal design of this complex mechanical system.
A preface to various types of bows as well as subtypes of compound bows will be introduced. A kinematic analysis will be shown for an eccentric-circular cam design and a one-cam one-pulley design. By iteratively determining the bow limb, cam, and cable positions a relationship between the drawn length and drawn force will produce a draw-force curve. In fact, this curve represents the strain energy stored within the system, and upon arrow release will be transferred into kinetic energy. Like all mechanical systems, there is a loss in energy and efficiency. A method for accurately determining efficiency will be explained. Experiments are also conducted using carbon fiber composites to create an adequate limb design.