

UNDERGRADUATE THESIS PROJECTS

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Project 1: Design and Gait Comparison of a Passive Walker walking on a ramp and a Treadmill

Passive dynamic walkers are mechanisms, which can exhibit human-like walking without any actuators. Several passive dynamic walkers have been designed and built in the Nonlinear System Research Laboratory. Such passive mechanisms can reveal significant insights into the role of the natural dynamics in the motion of the mechanisms. In this project, a newly designed passive walker will be used to study its gait as it walks on a ramp and a treadmill. Several key parameters associated with the passive walker, such as mass, location of the mass center, friction of the walking surface, etc, will be changed. The gait patterns will be measured and compared. The goal is to explore/understand the mechanics of passive dynamics walking.

Number of students: 1 or 2

Project 2: Design Passive Dynamic Hoppers

Passive dynamic hoppers are mechanisms, which can hop without any actuators or control actions. Hopping motion is unstable and difficult to achieve. In this project, a passive dynamic hopper will be designed and built based on previous designs. The goal is to improve the stability of the hopping motion by manipulating the mass distributions.

Number of students: 1 or 2

Project 3: Comparison between Commercial High-heeled Shoes and Newly Designed Orthopedic High-heeled Shoes

A new type of high heel shoes have been designed, which incorporate a number of orthopedic principles, to redistribute body weight and to make the shoes more comfortable to wear over the course of a day and less damaging over the course of a career. The objective of this project is to compare the performance between the commercial high-heeled shoes and the newly designed orthopedic high-heeled shoes. The performance includes the pressure distributions between the feet and the shoes, locations of the center of pressure and the center of mass of the subjects and forces/torques at the ankle joints. The locomotion of balancing of standing and walking will be considered. The student(s) will work closely with a professional orthopedic shoe designer.

Number of students: 1 or 2

Project 4: On Accelerated Durability Testing of Ground Vehicles

One of the critical pre-launch requirements for a motor coach was passing a structural durability test equivalent to driving 1.2 million kilometers on roads in-service without experiencing any cracks in critical suspension, frame and cab systems. Executing extensive field tests to validate the durability performance of a vehicle is very expensive and time-consuming. This motivates us to develop compressed testing cycles and to design equivalent but accelerated laboratory testing.

GlyphWorks is a commercial software package for generating the loading profile used for accelerated lab testing. The acceleration data from in the baggage bay area of the motor coach during the field tests have been collected. The student(s) will use the software to generate accelerated loading profiles and carry out the mathematical analysis of the field-collected acceleration data and the synthesized accelerated loading data to (1) identify the predominant vibration modes, and (2) compare the vibration features between the two sets of data.

Number of students: 1 or 2

Project 5: Dynamic Analysis of a Kinetic Sculpture

Mr. Theo Jansen is an artist and kinetic sculptor living and working in the Netherlands. He builds large works which resemble skeletons of animals which are able to walk using the wind on the beaches of the Netherlands as shown in Figure 1. His animated works are a fusion of art and engineering. From the mechanisms design viewpoint, the “wind beasts” are multi-legged passive walking robots. We have designed one leg based on the Mechanism Design Theory, as shown in Figure 2. The animation of the motion can be found at:

http://www.umanitoba.ca/faculties/engineering/mech_and_ind/prof/wu/lab330/projects.shtml
Some critical assumptions have been made during the design. The objective of this project is to conduct a dynamics analysis of the designed “Wind Beast” to test the validity of the assumptions made.

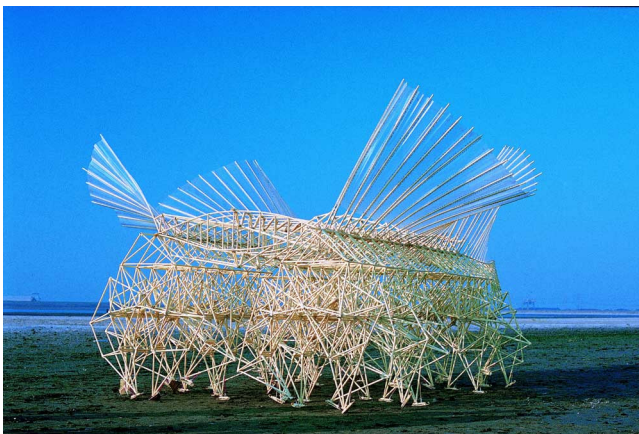


Figure 1

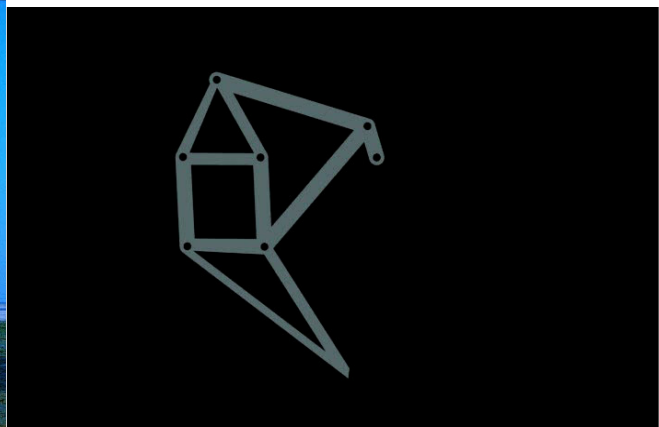


Figure 2

Number of students: 1 or 2