



CALIFORNIA STATE SCIENCE FAIR 2009 PROJECT SUMMARY

Name(s) Jacqueline R. Sly	Project Number S0221
Project Title Mechanical Analogs Model the Relationship between the Period of the Graph of the Snake's Movement and the Snake's Speed	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The purpose of this project was to model the relationship between the period of the sine graph representative of the snake's movement and the snake's speed. This project also explored the biomechanics behind the locomotion of snakes and sought to accurately model this motion through a mechanical analog. It was believed that the sine graph with the smallest period would be the most efficient in consideration to speed. A compressed sine graph of motion will result in a higher number of critical contact points between the mechanical analog and the surface. It was believed that a higher number of critical contact points would result in a greater speed. Thus, it was believed that this smallest sine graph of motion would produce the greatest speed in the resulting mechanical analog.</p> <p>Methods/Materials Both a virtual and a mechanical analog representative of the locomotion of a snake were designed and constructed based on preliminary observations of snakes through media sources. For the virtual mechanical model, the java program Sodaplay was used to create a system of mass points and springs. Using the Computer Aided Design (CAD) program Solidworks, the initial designs for the mechanical model were finalized and rendered in a 3D computer environment. For the mechanical analog, a circuit board was built to control a series of eight servo (stepper) motors and was then programmed in AVR Studio.</p> <p>Results The experiments were run using the virtual mechanical analog and the data collected from these tests supported my original hypothesis. A series of ten tests were run, at different periods, these tests were captured on video and then the speed of the virtual mechanical analog was calculated. The slowest virtual mechanical analog was trial three of period 4.5 cm, the fastest was trial two of period 0.25 cm.</p> <p>Conclusions/Discussion The relationship between the period of the representative sine graph of the snake's movement and the snake's speed was found to inverse linear. The sine graph with the smallest period was the most efficient in consideration to speed. As the period of the sine graph became smaller, the behavior of the virtual and mechanical analog became more erratic and the movements lost their original fluidity. In real-world conditions, a smaller representative period would not always result in a greater speed.</p>	
Summary Statement Using virtual and physical mechanical analogs, my project sought to model the unique biomechanics of snake locomotion and the relationship between the period of the representative graph and the snake's speed.	
Help Received Parents funded project; Father assisted in circuit-board debugging process	