

Modeling and Construction of a Mechatronic Frog

P. N. Wijesooriya¹, L. Udawatta², J. M. L. C. Piyathilaka¹, R. M. T. C. B. Ekanayake¹ and A. R. Nihmiya¹

¹Uva Wellassa University, Sri Lanka

² University of Moratuwa, Sri Lanka

Energy is a limited resource for almost every application in the world. Most of the researches are going on to introduce energy conserving solutions for many day to day applications. These new concepts are presented by applying to robotics which later are applied to machines and equipment of daily use. In this research the objective was to apply the concept of storing energy for a certain time period and release it instantly in order to perform some useful action. Accordingly, a jumping robot was constructed. Jumping is considered to be very efficient and energy conserving locomotion type for various robot applications, which is much suitable for rough unstructured terrain. There are many micro robots of this type. But this robot was constructed using junked items which can be easily found.

A mechanism was modeled and constructed that could store energy effectively as well as release energy instantly to make the robot move. The robot motion undergoes four phases as Ground contact, Hind limb contraction, Take-off and Air borne phase. The proposed model has four limbs. Hind limbs are used for jumping, which is analogous to frog jumping. They contain two similar linear type springs that were used to store energy. The fore limbs were used for balancing the platform. A click mechanism was used to store energy linearly in the springs as well as release them instantly. It was a rotating cam actuated by a motor (12 V, 0.3 A). Its diameter is gradually increasing while it rotates. So the springs are compressed thus energy is stored. Finally it comes to a disengaging point where the releasing process takes place. There the springs are stretched out at once and the rod which has passed through the springs, hit the ground. Thus the robot takes the ground reaction force for its takeoff. Most of the robot parts were made from low weight materials such as aluminium and plastic base material. But some parts were necessarily to be made of iron (the cam). Though weight limits jumping performance it is a considerable factor to make a good ground reaction force. The robot weighs about 1.5 kg. For the stability of jumping and landing the center of mass was laid backwards which was experimentally decided. The hind limbs were fixed near to the center of mass for higher jumping performance. The robot has 20 degrees of incident angle. Theoretically for spring elongation of 0.1m about 2.5J amount of energy was stored in springs which then converts into the Kinetic energy of the robot. Using a 12 V, 7 A DC battery robots can jump about 350 times. The modeling and result analysis were done using the MATLAB software.

This mechanism would be advantages not only for robots but also for mechanical application in machines which need repulsive action.

Key words: Jumping robot, Cam mechanism, Frog robot, Locomotion