Engineering Biomechanics of Human Motion

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ABSTRACT

The concentration in biomechanics and human performance engineering provides the background and skills needed to create work and living environments which improve human health and enhance performance. The objectives of this is to provide a basic introduction to the anatomy and physiology of the human musculoskeletal system and then to cover the kinematics and dynamics of spatial multiple degree-of-freedom human motion.Internal and external forces acting on the human body have an impact on many factors ultimately affecting health.This study involves biomechanical influences on disease. Biomechanics can also be used to guide treatments for movement problems. Biomechanics is the science of the action of forces, internal or external on the living body.Statics is the study of forces on bodies at rest Dynamics is the study of the motion of bodies and the forces that produce the motion.

INTRODUCTION

This study deals with the equilibrium of body under action of forces.Study is done for the both either at rest or body is moving with constant velocity. Modeling of the human body is critical to understand so on the bases of mechanisms by which the structure keeps its stability and prevents damage. The application of mechanical principles and engineering techniques in biological systems.Here author studied force body diagrams for bones and muscles in which Contact forces across a joint when bone is in motion.With the help of 3D X-ray tracking Mechanical properties of tissues Max load, Stress (F/a), Strain (ΔL/L).Behavior body against the loading condition involves stress resisted by musuls of human body.This study is important for making bone implants.Force and vibrations on bones have been linked to better bone health and density.Medical device designed to mimic these vibrations during running each stride results in a cascade of forces in the joints of the body.Popularity of running has caused focus on running injuries, proper running form, and shoe technology to hopefully prevent injuries Motion capture is an important technology in the field of computer animation. In order to improve the data reusability of the motion capture, data is needed to edit the capture of motion. Sports fusion is a core technology of the sports editor. From further study of the sports fusion technology, the analysis of the data of motion capture combined with the law of human body movement, identifying method is put forward based on the law of the cycle of the joint movement. The motion cycle is determined according to the calculation of the change of the angle motion between the connections of knees and hips node, then have the deformation of the time and space, node interpolation and the reconstruction of constraints. The experiment proves that the proposed algorithm can have sports fusion quickly and create high quality fusion animation effectively.

LITERATURE REVIEW

Weiss found “Biomechanics is effectively applying the physics of mechanics to problems in biology and medicine.”The main moving parts of your body include the solid bones, the joint tissues that link bones together, and the muscles that attach to your bones. Your body has about 200 bones and more than 600 muscles. These parts all work together to help you move throughout the day.

NIH-funded studies of biomechanics have already led to better ways to prevent muscle and joint injuries in kids during sports and play, and to help older people stay more mobile and independent. Some researchers are working to develop better artificial joints. Others have devised improved treatments for movement disorders such as cerebral palsy and Parkinson’s disease.

Joints are a common source of problems and pain. Some joints, such as your shoulder joint, can move in many directions. But others, like your knee joint, can only bend one way. Any movements outside a joint’s natural range might cause injury. Dr. Timothy Hewett has long studied a part of the knee joint known as the

ACL (or anterior cruciate ligament). The ACL connects the thigh bone to the shin bone. When it stretches or tears, some people hear or feel a "pop." Athletes who need to make sudden stops or quickly change direction—as in basketball, tennis and soccer—are at risk for damaging the ACL.

VARIOUS INDUSTRIES NEED STUDY OF BIOMECHANICS

Various type of sports involve the study of biomechanics as follows. Orthopaedics needs to study Biomechanical influences on disease for Evolutionary Biologists,Bat flight aerodynamics.Medical Companies needs to study biomechanics to Making bone implants. The Military people for better gear comfort (body armor, shoes, med kits) Author need to study it to know when does the biological change is happen and what can do to solve it.Internal and external forces acting on the human body have an impact on many factors ultimately affecting health. As shown in figure 1.

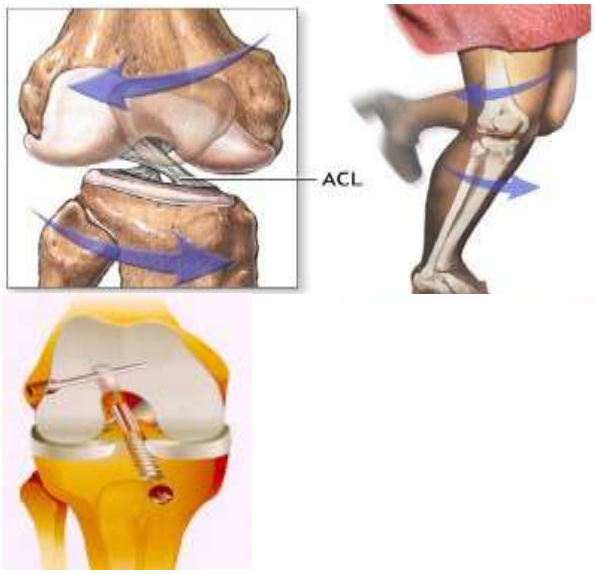


Figure 1. Bone Implant

APPLICATION OF THE BIOMECHANICS IN RUNNING

The pattern of movement observed in limbs of animals human running is the cycle of movement primarily in the lower extremities.When the foot is making contact with the ground Initial contact, Mid Stance &Take off
In Swing phase When the foot is transitioning between periods of ground contact Initial swing ,Mid swing &Terminal swing. As shown in figure 2.

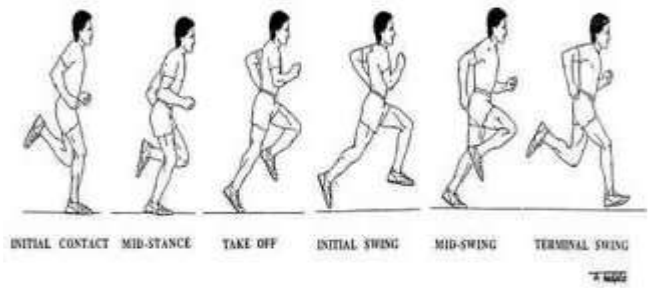


Figure 2. Foot Rest Position

Important Mechanics Terms for Running
Force : F The push or pull applied on an object
Spring :Elastic object that stores and dissipates energy.
As shown in figure 3.

If Spring Constant = k
Force/distance
Here deflecton = x
If K is high then spring is stiff and if K is low then spring is bouncy.

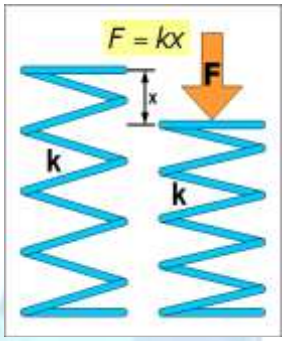
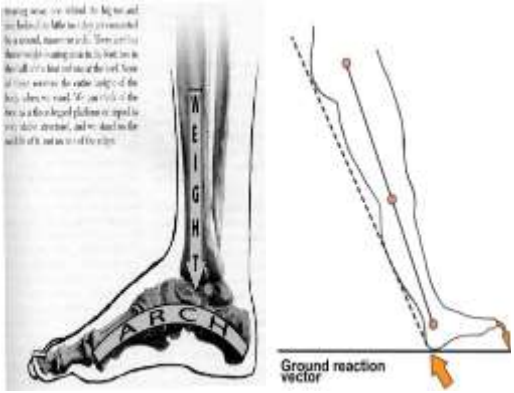


Figure 3. spring mechanics

Considering Human Leg as a Spring
Deflection = X
Muscles Tendons and Ligaments together with joints operate like a single linear spring."Humans running is like a mass bouncing along on two springs".
•Important joints
–Foot Arch/Ankle
–Knee
–Hip
As shown in figure 4



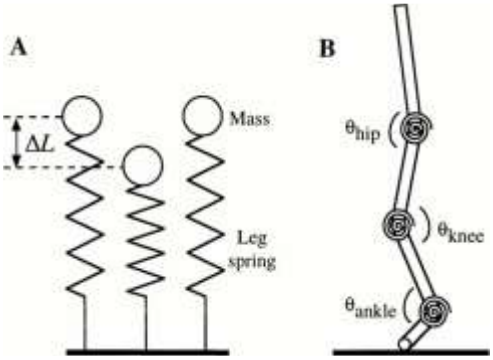


Figure 4. Human Leg behaviour

A Spring Constant

Critical thinking: This spring is to be included as the "Achilles" in a model of the human leg. A spring has a spring constant of k and 2.527 Joules of elastic potential energy. What is K if the load on the spring is 13.3 N?

F=Kx 33.60 N/cm

At time of running foot strike on surface to have do have a higher spring constant.

A.Midfoot/Forefoot

B.Heelstrike

Calculating Leg Deflection (X) ground reaction force is the same for both forefoot and heel strike.

Force= Spring Constant*Body weight (lbs)

Now using your calculated leg stiffness and F=KX

Deflection go with Forefoot Joints bend

Heel stirke Bone and cartilage deflection as per study.

BY MEASURE MUSCLE ACTIVITY (EMG)

Limb motion relative to each other ground reaction forces (initial contact).

Measure it on the bases of Chronophotography A series of photographs Label Important anatomical locations with sensors Hip, Knee, Ankle

Motion Capture

Reconstruct "stick figures"

As shown in figure 5.

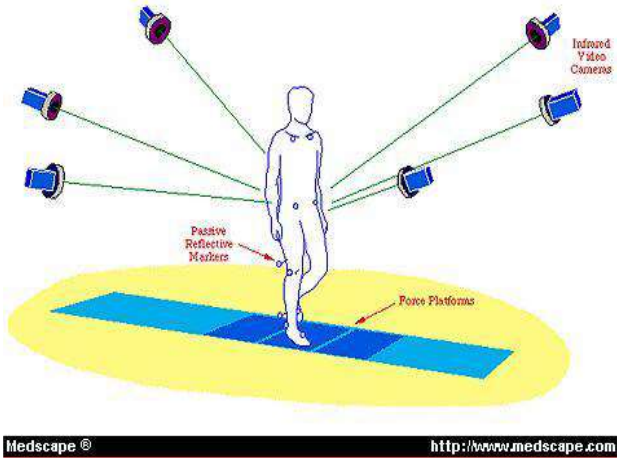


Figure 5.Gait Cronophotoghraphy

Gait Photo Collection Exercise A series of measurement activities

Choose a group representative runner

•Chronophotography - This exercise is a very simplified version of a process used in Gait labs. Author collected a series of photos of your runner's gait with shoes And without shoes.

Now Author used these photos to make measurements

Materials

–Meter stick

–Camera with continual capture function

–Post processing using IMAGE J

–Meter Stick Calibration is the process of comparing/checking measurements of a known instrument to those of unknown dimensions.

CONCLUSION

The mechanical movements of our bodies help us to be as strong, flexible and mobile as possible throughout our lives. It may be concluded that the way you move including walking, standing and bending can affect your future mobility and overall health.All systems, whether in traditional mechanics or in the human body are governed by the same basic physical laws. Body movements involve force, balance, gravity and motion. Biomechanics canbe effectively applied the physics of mechanics to problems in biology and medicine.The main moving parts of your body include the solid bones, the joint tissues that link bones together, and the muscles that attach to your bones. Your body has about 200 bones and more than 600 muscles. These parts all work together to help you move throughout the day. This study is limited to runnig mechanism only.It is also proved that there is a relation between moving parts of the body and applications of biomechanics.

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