Sports Injuries

Challenge Problem and Resources

Developed by:

The teachers, students, and mentors in the
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1. CHALLENGE PROBLEM: SPORTS INJURIES THROUGH COMPUTER SIMULATION

For many people who like to stay active and healthy, or for athletes who play sports for a living, a physical injury can be a major trying time in their life. Active people and athletes rely on physical fitness procedures and training in order to stay in shape and help improve their overall mental health and stability. Sports-related injuries represent an estimated 10% to 19% of all injuries treated in emergency rooms. For some athletes, such injuries can signal the end of a season or, in severe cases, a career.

For half a century, crash test dummies and computer simulations have been used to save lives and prevent injuries in automobile accidents. The same kind of approach may be used in the field of sports biomechanics to provide a 3D computer simulation in which others can learn certain aspects of control for sporting movements of a sport related injury.

Most musculoskeletal injuries happen when the stress applied exceeds the strength of the tissue. The extent of the damage is related to the magnitude, rate, and frequency of loading. Preventing and recovering from an injury must incorporate the body's ability to adapt to these mechanical loads (including the body's adaptations to over and under use). An anterior cruciate ligament (ACL) injury, for example, occurs when the load exceeds the strength of the ligament, taking into consideration factors such as posture, muscle forces, and ligament strength. To prevent such an injury, an athlete needs to reduce external loads (by improving perception skills to anticipate movement), improve muscular support of the external loads (through appropriate training programs), and/or grow stronger ligaments. If the ligaments get stronger with the "loading", then they will adapt to their mechanical environment. This will decrease the possibility of either getting injured or re-injured. For example, a study was done where a doctor used a 3D motion capture to evaluate the movements of a professional quarterback before and after a shoulder surgery. Although markers on the skin were not identical to underlying bone movements, using an approach applied in robotics, the researchers were still able to reconstruct the athlete's motion and determine if he was throwing at his ideal capacity, minimizing energy cost, and maximizing joint accelerations.

If people can understand the mechanisms behind an injury, then they can prevent it. Computer simulation is a powerful tool that can be used to gain insight into sport related injuries for both prevention and rehabilitation.

1.1. TOOLS

This challenge problem is focused on the development of simulating a body part in motion for a specific sport related injury, learning about how much stress, force, and torque is being applied to replicate the injury to learn prevention strategies, and simulate the body part in motion to

ensure full recovery. These simulations need to be formatted to facilitate import into a newly created webpage that will start compiling a database of body injuries and allow for user navigation control to change the amount of stress, force, and torque applied to that body part. Once this new resource is created, medical personnel, parents, coaches, athletes, and others interested in this topic will learn and utilize these simulations for sports injury prevention and rehabilitation. The tools will include use of a 3D modeling software at minimum that best highlights this challenge.

1.2. THE SOLUTION

This solution must contain at least a 3D virtual working model of a body part of your choice before being injured, a simulation of the stress, force, and torque being applied to this specific body part to replicate to cause the injury, and that specific body part after being injured to determine and model the factors contributing to a full recovery and if this person has gained back a full range of motion. This particular body part that is chosen must be of a real-life person having that injury that one can obtain some type of x-rays to show the injury, if possible. The factors of age, weight, and activity level must be included in the pre-injury/post-injury models and of the stress, force, and torque simulation.