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## Introduction to biomechanics and role of computer science in biomechanics for enhanced accuracy and performance of a sportsman

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### Abstract

Biomechanics is interdisciplinary approach that is based on other Sciences like Biology, Physics Mathematics, Computer Science and even on the Psychology. If we compare today's fast competitive and populated world with ancient time, ancient time was peaceful, healthy and less populated that practiced traditional techniques while working or playing, they had their own ideology how to sit & sleep. In today's scenario, we are running to catch a bus or train, working day & night and sleep whenever wherever we find a place after long sitting and exhausting mind. We don't care about the posture of sleeping, place etc., therefore molding our healthy active posture to lazy or curved or Sleepy. This is a common problem more specifically if we talked about the professional sportsmen who have to perform specific activities for their regular exercises and fit for their sports. Now competition is more, sportsman, coaches trying hard to innovate new techniques for better outcomes. They demands sophisticated environment, instruments for exercises, play efficiently and achieve better results. Biomechanics is the study & analysis of human body, its structure, physical parts, behavioral aspects, energy level and required force for a particular motion while making balance between the power of bones, muscles and movement of joints. Computer science aids in Biomechanics to study, analyze and compute results more accurately while maintaining the consistency in different circumstances. Advent of advance computing tools, information technology it is easier to calculate the required energy percentile and force absolutely along with taking qualitative factors in consideration. Computing Technology gives quick display of certain activities from different angles of motion and distance from the target outcome. Computing technology in biomechanics helps in designing & development of new equipment, advanced instruments depending on the investigation of the participants. Present paper highlights the introductory part of biomechanics, its advantages and applicability of computer science in enhancing the performance along with the major issues of concern.

**Keywords:** Biomechanics, human body, physics, computer science, information

### Introduction

India is known for its traditional muscular games and yoga that makes human mind and body fit in every aspect. Now the era of fast lifestyles, automatic instruments, smart equipments, luxurious drives & homes, advent of information technology, software developers and researchers sitting for long time to be winner of the competitive races losing health day by day. Human start ignoring health, getting several diseases that was not present in the past. If we concentrate on children, advance parents would not let them out in fear of diseases, safety and they forget to play in the mud that was best exercise for body to become active. In metro cities, tall building flat systems, air-conditioned malls, everyone forgot ancient game activities and world is going to face the lazy bodies that even cannot work for themselves and depend on others to get their food. So as a result body become slothful, minimized movements, continuously sitting posture make their backbone band, soldier down and tired eyes. Youngsters go to gym to looks superior physically but they as well as their tutor do not know the right exercise to fit an individual problem. Further lack of knowledge about right body movements, right activities, balanced diet problem become more hazardous. If a person has some physical problem or some movement problems, wrong treatment may increase problem. Thus biomechanics as a body science helps in selecting the right activities, right motion of body parts, most effective body movements for a healthy physique and right selection of

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equipment for exercising, safest patterns for a period and inculcate the information regarding human body. Study of bio includes all living beings human plants and animals; biomechanics is a field which includes bio as well as mechanics applied to human body. Mechanics is a branch of applied mathematics & physics that concerned with energy, forces which create motion in a body. It describes how the forces can produce a particular motion to get desired outcome, quick heal from an injury and for fine stimulus <sup>[1]</sup>. Biomechanics can also be considered as a sub-module of Kinesiology. Kinesiology deals with scientific study and examination of anatomy of human body and their organic processes <sup>[2]</sup>. Kinesiology can be divided into two parts anatomy kinesiology and mechanical kinesiology, mechanical kinesiology can be considered as biomechanics. Therefore biomechanics just focus on forces, matters and motion with their effects on human body in both the cases i.e. active and at rest. Biomechanics is introduced in 1970 and able to answer many questions like why to purchase new shoes, Why to purchase different shoes for different games, why to purchase new badminton rackets <sup>[1]</sup>, why to study on table, why drive bicycle if I have a car, why Indian classical dance is better than latest disco etc. these questions are answered under biomechanics. Biomechanics is not a standalone subject; it is interdisciplinary approach that comprises biology, Physics and Mathematics, advanced computing Technologies to study the body motion and generation of forces that causes right motions in a person or a patient. Study of mechanical forces, there resultant motion that affect human body in active or inactive state, biomechanics is divided mainly into two main parts. First is kinematics that describes motion of a body and its key elements. Kinematics focuses on study of motion disregarding the force that is used to generate a motion <sup>[1], [2]</sup>. Second is kinetics that study forces causing motion in a body. <sup>[1]</sup> Kinematics is further divided into a quantitative study as well as qualitative descriptions. Kinetic is further divided into two interesting forces static that deals with the state of equilibrium caused by balanced forces and another is dynamics that deals with the change in motion due to unbalanced forces <sup>[2]</sup>, locomotion or musculoskeletal system <sup>[2]</sup>, musculoskeletal means skeleton or all bones of body, muscles of body is known as the muscular system and joints connect the bones and act by muscular power <sup>[2]</sup>. Biomechanics comprises of biology and mechanics; biology deals with anatomy and tissue mechanics, origin, behavior, distribution, physiology and study of living organisms <sup>[7]</sup>. It interprets structure, chemical processes developments and evolutions <sup>[8]</sup>, also includes energy acquisition and transformation through genes <sup>[9]</sup>. Mechanics with forces energy motion matter and practical applicability in design and construction of machines and exercises <sup>[5]</sup>. Mechanics deals with the behavior of human body subject to a particular force in rest or in motion state thus acquiring knowledge about the physical nature of human and conducting experiments on them <sup>[6]</sup>. Physics as a part of natural science that deals with study of matter comprising a mass and weight, atoms & particles, motion i.e. change of position of an object with respect to change in surroundings and defined in terms of mathematical notations like distance, speed, time and velocity through space and time. Energy that can be transferred to an object to perform a particular task and can be converted as per the force required for a motion. It is an interaction that changes motion of another object and has a magnitude, direction and point of origin, for example push and pull of an object <sup>[10]</sup>. All these are studied and analyzed in biomechanics

where mechanical principles are used to study human structure and its functions <sup>[11]</sup>.

### **Significance of Biomechanics in Sports and advantages of computing tools & techniques in Biomechanics**

Biomechanics has a great importance in physical education in preparation of players, their training and practices and kind of exercises or motions they have to do for better performance as professional comparative to others. Every sports has its own locomotion, required forces to get proper energy level for example, a sportsman may belongs to Judo, Weightlifting, Wrestling or an athlete. Following are the advantages of biomechanics:

- Biomechanics provide the knowledge of basic biological factors like anatomy, tissue, mechanical factors like force, matter, motion, energy etc. <sup>[1]</sup>
- Provide the quantitative and qualitative descriptions of motions <sup>[2, 3]</sup>.
- Give information about the static and dynamic forces that affect a motion of a body <sup>[2, 3]</sup>.
- Examine the body motion during working or rest <sup>[1, 2]</sup>.
- Investigate the skeletal system: joints, muscles, bones and give insights through scientific knowledge of internal structure of human body <sup>[2]</sup>.
- Biomechanics help in selection of particular sports as per the physical characteristics of a person.
- It improves professional performances.
- Study and applicability of biomechanics helps in avoiding injuries during practices or competitions for even can recover from injuries faster through proper motions <sup>[1, 3]</sup>.
- Study of kinetics and kinematics <sup>[11]</sup> and further the angular or linear motions, straight or curved line motion, translations or rectilinear (straight line) motion, curved line translation for curvilinear motion, angular or rotatory motion of a sportsman in detail is possible in biomechanics <sup>[3]</sup>.
- Biomechanics interlinked different streams or subjects like Biology, Physics, Engineering or Computer Science, Mathematics increased an interdisciplinary knowledge of different fields <sup>[1-3]</sup>.
- Provide the knowledge of absolute or relative forces for example absolute force is the maximum forces, center of mass in exact value where relative force is not absolute and counted in ratios like percentage of height, percentage of weight etc. <sup>[3]</sup>
- Biomechanics study the different variables in mathematical form for example, scalar variables in terms of size or magnitude whereas vectors contain size, direction and point of origin <sup>[3]</sup>.
- It further uses the mathematical terms that if you know the value of two variables then how we have to find the value of the third variable and angle made between sides or the different motions with graphical and trigonometric methods <sup>[3]</sup>.
- Biomechanics beautify the body through the better moments.
- Biomechanics can help in experimenting new techniques through calculated force and their resultant motions in body.
- Biomechanics further include psychological factors like attitude, behaviour, social status and their effect on forces, as human itself is psychological subject. It is quite

easy to balance between mind and force with small adjustment and resultant in overall improvements.

- Through the use of computing Technology, advanced software and tools, it is better to find accurate data regarding human body posture, percentage of forces, kind of forces and their absolute and dynamic effects on motion. The information can be used to develop or create new equipment for exercise, new patterns of practices & overall change in performance in given period of time. This study can be done on each individual to decide the activity requirements, timings in performing a particular activity, timely recordings of the activity and change effect to get the desired outputs.
- Biomechanics with computing technology can open new business and marketing scope, thus creating trade secrets of success. Manufacturers of equipments, dresses, environmental surroundings and infrastructure for playing or doing rest.
- The use of biomechanics and computing technology improve the performance of players, and individual, new market for business communities, experimental approach for psychologist, diversity in Science from Physics, Mathematics, Computer Science or Biology to form Bioinformatics.
- Biomechanics help in study of pivot points (rotation of joints) that is used to measure range of joint motion.
- Biomechanics signify the importance of motion and kind of forces applied on human body and there analysis.

### Major issues and Requirements

One basic rule of nature - if you play with nature, nature destroys you. So it is good that if we are walking through the era of biomechanics i.e. siblings of all major Sciences - Physics, Biology, Mathematics for Computer Science and Psychology, experimenting too much or extreme use of biomechanics make a opposite u curve of performance, health, success, profits, competitive gain. At initial point, Biomechanics aids in refined performances & activities, however, with use of computer equipment, automatic controller etc., making more dependent humans or players. Specifically it lacks or minimizes the original theme or the nature of the game or an activity. So balance must be there between science and nature.

### Conclusions and future scope of work

Biomechanics take physics, Biology, computer, psychology under one umbrella and apply all the mechanics in enhancing working & performance of human body. It deals with the study & analysis of human skeletal system in order to decide the energy level, forces required to build particular motion while in rest or working plus activity pattern developments. This is a region where manufacturer, coaches, professionals, promoters, government and other organizations are concentrated for efficiency and efficacy in outcomes. However too much is bad for everything. As biomechanics is interdisciplinary approach and takes the advantage of major Sciences for analysis & computing, nevertheless down you must be prevented. Applicability of scientific concepts always shapes life easy but play with nature, lots of experiment with body may negatively impact the body and environment.

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