

COURSE PROJECT

BME 473/7 ~ Applied Biomechanics

Objective of Assignment

This project will give you a chance to deepen your knowledge in an area of biomechanics that interests you. I expect that you will remember what you learn from writing this paper long after the class is over. This assignment will get you into the literature where you can see for yourself the results of biomechanics research. This paper may also serve as a springboard for your future independent studies or research projects. The project will help hone your critical reading and writing skills, which are helpful in many endeavors. This will also give you some team project experience.

Overview of Assignment

Survey the literature on a specific topic in the field of movement biomechanics. Describe the current state-of-the-art and suggest areas that require further research. Then briefly describe how you would investigate a specific problem yourself.

Some general areas from which you can choose a topic include: sports biomechanics, measurement of muscle strength, development of muscle strength, motion and gait analysis, dynamic simulations of movement, biomechanics of surgical reconstructions, functional neuromuscular stimulation, joint biomechanics, electromyography, muscle biology and mechanics, muscle models, muscle injury, motion analysis equipment and techniques, animal locomotion, neural control of movement, robotics, computer-assisted surgery, medical imaging, biomedical computation and visualization, computer animation, digital creatures, evolution of gait, or other areas related to biomechanics of movement. From these general areas you should choose a specific topic to investigate. Some topics and report titles are listed below.

Example Topics and Report Titles

Gait analysis for surgical planning: benefits and limitations	Computer-assisted design of functional neuromuscular stimulation systems
The influence of energy storing prosthetic feet on knee motion in below knee amputee walking	The influence of dynamic coupling on motor planning in the upper limb
The variation of muscle physiologic cross-sectional areas with aging	Animation of body motion: from biomechanics to entertainment
Optimization techniques for calculating muscle forces	Biomechanics of bicycling: the role of two-joint muscles
Strength of muscles crossing the shoulder and elbow	Effects of bone deformities on muscle moment arms
Surgical planning using medical imaging	Robot-assisted surgery knee surgery
The role of muscles in providing joint stability	Muscle-tendon adaptation with immobilization
Robots that walk and hop	Scaling in musculoskeletal structures
Quantification of spasticity	In vivo imaging of joint kinematics
Effects of bone lengthening on muscle	Molecular motors: the engines of life
Three-dimensional models of muscle	Wrist joint replacements: successes and failures
Computer-assisted surgery	Muscle strength and its development
Adaptation of muscle with immobilization	Force-feedback devices: why fool the CNS?

Project Outline and Meetings

It is my hope that you start working on your report early. Three assignments will give us a chance to get to know you better and give you feedback that we hope will be helpful.

- Meeting in Week 5 (9/16-20). We'll talk about refining your chosen research topic and potential directions for the paper.
- Outline of your report due on 10/10. Format of the outline is described below.
- Meeting with the teaching staff in Week 11 (10/28-11/1). We'll review your outline, discuss the articles you've found, suggest additional articles, and discuss your proposed research.

These assignments comprise 5% of your grade. I will discuss the mechanics of signing-up for the short meetings with me later in the semester. I will provide many opportunities for these project meetings during the weeks listed on the syllabus, so it is expected that your entire group will attend the meeting. Failure to attend the group meetings may result in a lower grade.

Also, please feel free to discuss your topic and outline with me outside of these meetings if you would like some additional help.

Format of the Outline

The written outline should include the following three sections:

1. INTRODUCTION & BACKGROUND

Briefly describe your topic and why it is important.

2. PREVIOUS INVESTIGATIONS

List several sources that relate to your topic. For each paper try to state:

- | | | |
|----------------------------------|-----------------------|-----------------------------------|
| a. Goal(s) of the previous paper | c. Major conclusions | e. The next step in this research |
| b. How it relates to your topic | d. Major shortcomings | |

3. REFERENCES

List at least ten references that relate to your topic. This list should conform to the style of the *Journal of Biomechanics*.

This is just an outline, so it can be rough. I just want to make sure that you are on the right track and are finding references that relate to your topic.

Project Presentations

This assignment is intended to let other students know about your project and give you experience articulating your ideas to a group. The presentation will comprise 10% of your grade.

Format of Oral Presentation

Each student team will give a formal, 20-minute, oral presentation on their research topic. The presentation should state the problem you are investigating and what you have found. The intention is to let the class know about your topic and enlighten us

with your findings. I will give an example presentation before yours are due. Feel free to be creative.

Format of the Report

The paper (excluding reference and figures) **should not exceed ten, double-spaced pages**. The paper is short and needs to be extremely well written. A first draft should be written well in advance of the due date so that you have a chance to refine the final product. The paper should be written in the following form.

TITLE PAGE

ABSTRACT (about 150 words)

This is the most important section of any report and should summarize the key points of your paper.

INTRODUCTION & BACKGROUND (~1-2 pages)

Briefly describe what you will be presenting and why it is important. Relate the anatomical, biological, clinical, or business framework of your topic.

PREVIOUS INVESTIGATIONS (~4-6 pages)

Present a review of previous research on this topic. Do not simply review a number of individual papers, but try to synthesize what has been done. This section should be in a form such that the current state-of-the-art is easily appreciated. State the shortcomings in our current knowledge, and in a final paragraph or two suggest several areas that require further research.

PROPOSED RESEARCH (~2-4 pages)

From areas suggested at the end of the previous section, state concisely and specifically a particular problem that you propose to address. In broad terms, describe how you might investigate this problem with experiments, computer simulations, or both. Point out the difficulties that you may expect to encounter in this research. State what you believe will be the significance of your proposed research. Provide a realistic timetable for the completion of the work.

REFERENCES

Your paper should be referenced using primarily journal articles. References and reference citations should conform to the style of the *Journal of Biomechanics*. The following sources may be useful:

<i>Index Medicus</i>	<i>J. of Orthopaedic Research</i>	<i>IEEE Trans. on Biomedical Eng.</i>
<i>PubMed</i>	<i>Science Citation Index</i>	<i>Clinical Orthopaedics and Related Research</i>
<i>Google Scholar</i>	<i>Medical Eng. & Physics</i>	<i>J. of Bone and Joint Surgery</i>
<i>J. of Physiology</i>	<i>J. of Biomechanical Eng</i>	<i>J. of Biomedical Material Research</i>
<i>J. of Biomechanics</i>	<i>Biological Cybernetics</i> and many others