UNC CHARLOTTE
The WILLIAM STATES LEE COLLEGE *of* ENGINEERING

UNC Charlotte – Lee College of Engineering Senior Design Program

Senior Design Project Description

Company Name	*Atrium Musculoskeletal Institute, Atrium Health*	**Date Submitted**	*11/26/2019*
Project Title	*Finite Element Analysis in Orthopaedics* **(AH_FEA)**	**Planned Starting Semester**	*Spring 2020*

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills:

Discipline	Number	Discipline	Number
Mechanical	3	Electrical	
Computer		Systems	
Other (Biomed)	1		

Company and Project Overview:

The Atrium Musculoskeletal Institute was established to be the first and best choice for musculoskeletal care in our region. The MSK Institute includes orthopaedic surgeons, primary care sports medicine, and other health professionals treating a wide range of injuries and conditions. As part of our focus on translational research, biomechanical studies are often undertaken within our engineering department. There is often the need to investigate new procedures/processes, implants, and techniques. Comparing a novel procedure or application for a device against the gold standard or against competing products are tasks regularly conducted in our lab. Often, the variance afforded by human specimen is needed and desired for reporting outcomes; other times, it is beneficial to limit the number of variables when investigating true differences between a device or procedure—finite element analysis is an attractive method of limiting certain variables. Additionally, there are some questions, specifically intraarticular ones, that are better suited to the realm of finite element analysis due to the complexity of applying sensors within smaller human joints.

Project Requirements:

Develop a finite element model for the biomechanical topics listed below. The model should include a 3-dimensional CAD model where applicable, proper assignment of physical properties, as well as appropriate forces, stresses, and strains applied or generated.
Students will have the option to design a physical setup to test their computational model if desired.

- Modeling anterior instability recurrence/forces after a labral repair based on exact percentage amounts of glenoid bone loss.
- Antero-Medial (AM) VS Transtibial (TT) VS HTT anterior cruciate ligament (ACL) repair

techniques: forces on graft/knee/meniscus and degenerative changes over time.
- Bone-tendon-bone (BTB) interference fit VS suspensory fixation and forces on graft/knee/meniscus and degenerative changes over time.
- Meniscal root tears:
    - Medial tears +/- fixation and degenerative changes thereafter.
    - Lateral tears +/- Wrisberg ligament injury and degenerative changes thereafter.

Expected Deliverables/Results:

- Finite element model of biomechanical topic
    - Report of properties used
    - Report of constraints forces applied
    - Report of methods attempted
    - Analysis/results obtained
    - All code and recorded journal
- Design of physical experimental setup if attempted
    - Apparatus design
    - Sensor specifications

Disposition of Deliverables at the End of the Project:

Handover within a reasonable timeframe following the expo is acceptable.

List here any specific skills, requirements, specific courses, knowledge needed or suggested (If none please state none):

Requirements:
Some travel to meet with Atrium Health technical contacts and representatives may be required.

Skills/Courses:

- Programming (Finite element analysis software; Matlab, CAD)
- Firm grasp of dynamic systems (MEGR3122) and Biodynamics (MEGR3234)
- Beneficial courses: MEGR 3233 MEGR 3225 MEGR3234