January 18, 2017
Lecture 1: Welcome!
Intro to biomechanics
Goals for today

- Get to know each other
- Course admin and ground rules
- Biomechanics
- Whole body biomechanics overview
- Anatomical terminology
Introductions

- Class: Whole body musculoskeletal biomechanics
- Instructors: Prof. Mariana Kersh
- TA: Lydia Bakalova
- Course webpage: https://courses.engr.illinois.edu/me481/index.html and compass2g
+ A little about me...

BS, MS Mech Eng
PhD, InterD Mat Sci

PhD with
Zimmer, GmbH

BA English

U Melbourne

http://www.vectorworldmap.com/
Introduction (you to me)

- Other side of the note card:
  - Biomechanics is …
  - Why you are taking this class?
Course admin

- Expectations
  - Mutual respect
  - Compass2g/lecture slides
  - Participation
    - Come to class
    - Ask questions!!
- **Expectations**
  - Respect at all times
  - Compass2g/lecture slides
  - Participation
    - Come to class
    - Ask questions!!
  - Timing
    - I promise to finish at 1:50 (mid-slide if need be)
    - You promise to not start to pack up early (even if I’m on the last slide)
- Email/communication policy (put ME481 in subject line)
- Have some fun!
Grading

- Homework: TBD%
- Labs: TBD%
- Semester project: 25%
- Topic tests
  - Test 1: 10%
  - Test 2: 10%
  - Test 3: 10%
- Final Exam: 15%
Project

- Hands on lab project - group work
- Peer assessment will be part of the grade
- Writing fluency will also be an important part!

**THE NEUROBIOLOGY OF WRITING**

**HOW IT’S SUPPOSED TO WORK:**
- Process Language
  - Temporal Lobes
- Execute Command
  - Prefrontal cortex
- Transmit Command
  - Brain stem
- Activate Muscles
  - Motor neuron

**HOW IT USUALLY WORKS:**
- Insecurity
  - Limbic system
- Confusion
  - Prefrontal cortex
- panic
  - Sympathetic system
- Fear
  - Amygdala
- Hesitation
  - Inferior frontal gyrus

WWW.PHDCOMICS.COM
Project

- Hands on lab project - group work
  - Peer assessment will be part of the grade
  - Writing fluency will also be an important part!
- How it will work
  - Ground reaction force
    - Your peers will be the subjects
  - Data collection prior to Spring Break
    - Formal written report
    - Presentations at the end of the semester
What is biomechanics?
What is biomechanics?
Giovanni Borelli
1608-1679

‘On the Movement of Animals’ ca. 1680
Biomechanics at different scales

Whole body: speed, joint angles, balance, etc

Systems:
- Muscular
- Skeletal
- Hepatic
- Nervous

Tissue:
- Bone
- Air
- Fluids
- Nerves

Cellular traction
- Membranes
- Transport
Research Aims

Clinical needs

Prevention

Treatment

Diagnosis

Basic science and technology advancement

Slide courtesy Prof. Marcus Pandy
Joint tissue failure: a growing problem

- 8,000,000/year by 2050
- 25% mortality within 1 year
- 50% permanent disabilities

Hip fractures

- 1-3% of GDP of industrialized nations treating rheumatic disease (mostly OA)
- US costs
  - 1997: $233.5B
  - 2003: $321.8B

Osteoarthritis

1. Sernbo et al., 1993  
2. Cummings et al., 2002  
3. Leardini et al 2004  
4. Yelin et al., 2007
Whole body biomechanics
Engineering approach

Experiments

Modeling

Numerical simulations

Model evaluation

Slide courtesy Prof. Marcus Pandy
Approach to studying whole body biomechanics

- Ground reaction force
- Joint angles (inverse kinematics)
- Joint accelerations
- Inverse dynamics
- Power, Moment, Work
- Gait or Movement Patterns
- Muscle Contraction, Activation
- Tendon, ligament, cartilage, bone
- Static (balance)
- Dynamic (walking, running)

Musculoskeletal model + θ knee (a knee)
+ A common language...
Musculoskeletal system

Human movement

Gait lab

Background readings will be linked on course webpage