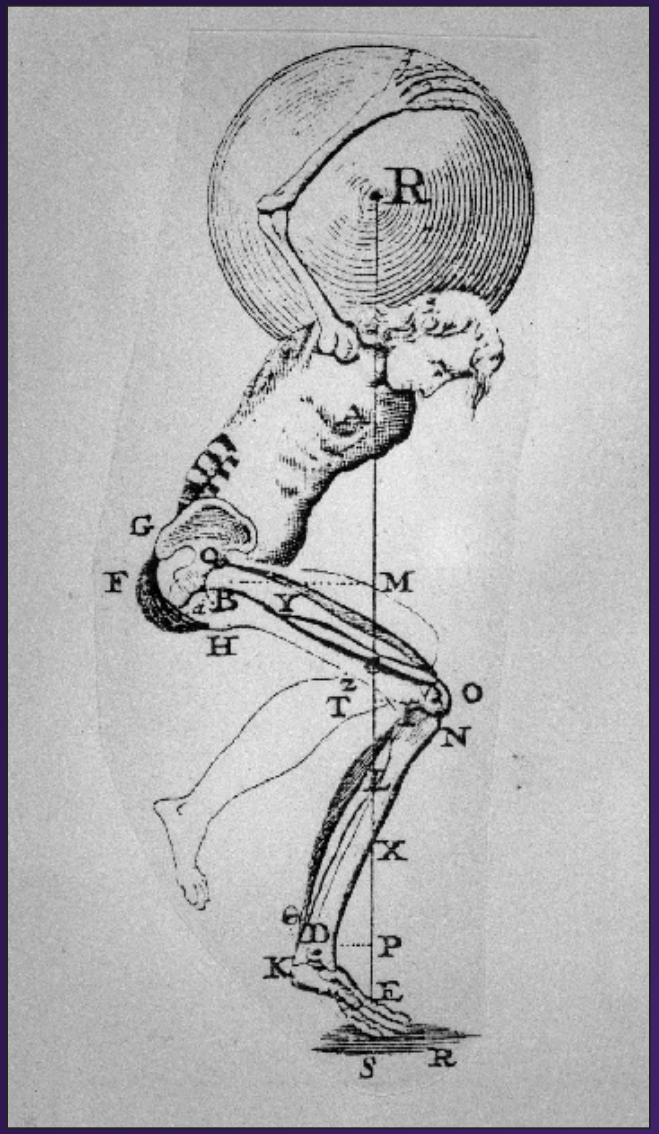


Musculoskeletal Biomechanics

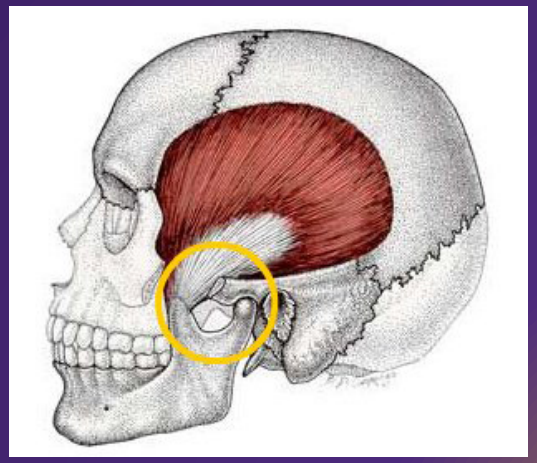
BIOEN 520 | ME 527

Session 6B

3D Chewing Kinematics

Purpose

- Take kinematic data collected by externally-mounted sensors and transform it (via fiducial points) to determine the 3D motion of the jaw
- Why?

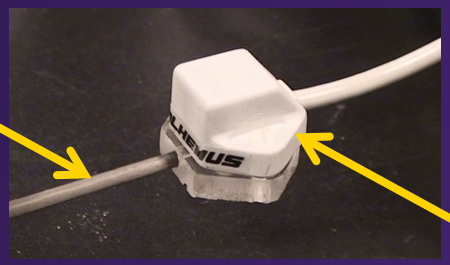


Methodology

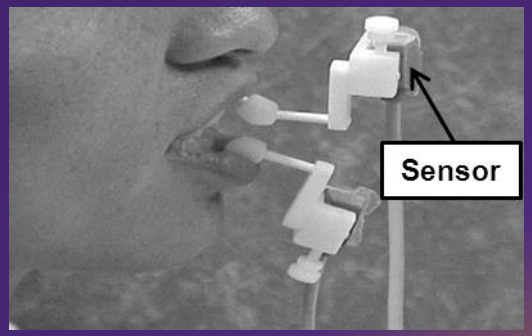
- One subject
- Custom oral stents (retainers) for the upper and lower teeth

Acrylic mounting block

Carbon fiber "pin"



Polhemus sensor



Similar set-up from a study by Yoon et al.[1]

[1]Yoon H, Zhao KD, Rebellato J, An K, Keller EE. Kinematic study of the mandible using an electromagnetic tracking device and custom dental appliance: Introducing a new technique. J Biomech 2006;39;2325-30.

Methodology

- Electromagnetic tracking systems
- Basic components: active transmitter and passive sensor(s)

Advantages

- *High precision and accuracy with proper set-up*
- *No line-of-sight problems*

Disadvantages

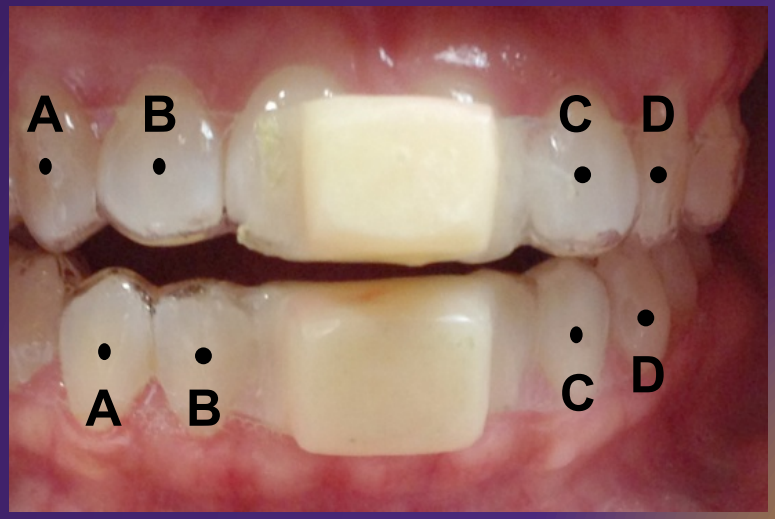
- *Cannot have metal in the field*
- *Precision and accuracy decrease as the distance between the transmitter and sensor(s) increase*

Polhemus FASTRAK system

Methodology

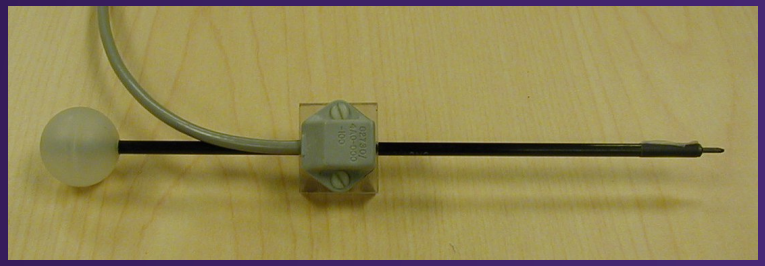
- Fiducial points
  - Purpose: Landmarks which are used to define the local, embedded coordinate systems for the segments of interest
  - 8 total (4 on upper teeth and 4 on lower teeth)

Black dots denote the approximate positions of the fiducial points on the teeth



Data Collection

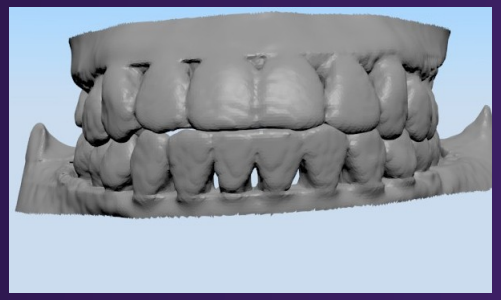
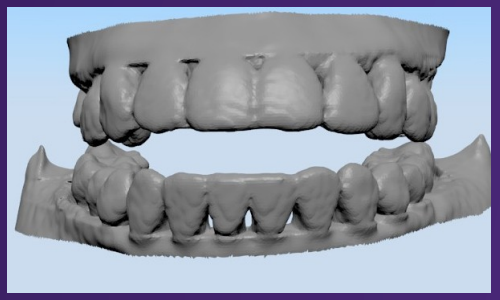
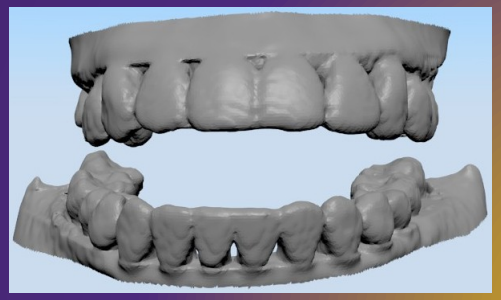
- Digitization of the fiducial points
  - Purpose: Establish the position of each fiducial point relative to its Polhemus sensor
- Chewing trials
  - Trial #1: Control
  - Trial #2: Gummy bear
  - Subject chewed at a self-selected rate for ~15-30 sec
  - Polhemus data acquired by a laptop sampling at 17 Hz



Polhemus digitizing stylus

Data Analysis

- This is where YOU come in…
- Steps
  - Part I:
    - Transform the sensor kinematics to the fiducial points
  - Part II:
    - Define local, embedded coordinate systems
    - Determine the 3D kinematics of the lower teeth relative to the upper teeth
  - Part III:
    - Animate subject-specific models of the upper and lower teeth

Resources

- Class handouts
  - “Joint Coordinate Systems”
  - “Spatial Descriptions and Transformations”
- Me!
  - simsdahl@uw.edu