BME375 Fundamentals of Biomechanics (Due: May 4,2021)

Project: Measurement of 3-Dimensional Distal Femoral Surface

The objective of this project is to reconstruct the 3-dimensional (3-D) surface of femoral condyles using stereophotogrammetry. Images of femoral condyles with grid lines and 8 calibration markers are taken from different angles. The actual 3-dimensional coordinates (X,Y,Z) of 8 calibration markers are provided on Blackboard. The 3-dimensional surface of femoral condyles can be constructed using images taken from at least two angles or more based on the theoretical formula that was shown in the Lecture #10. The following is the general procedure:

1. Digitize images to obtain the local coordinates (x, y) of the calibration markers and grid intersection points on the surface of femoral condyles from individual images using Image J which can be downloaded from http://rsbweb.nih.gov/ij/download.html.
2. Use Matlab to calculate the 3-D coordinates of the grid intersection points on the surface of femoral condyles:
    i. Determine camera parameters for different angles (at least 2 angles) based on the local coordinates (x,y) and actual 3-dimensional coordinates of the calibration markers (at least 6 markers);
    ii. Calculate the 3-D coordinates of the calibration markers using the theoretical method based on the camera parameters and then determine errors in 3 coordinate axes: error (%) = (calculated 3-D coordinate – actual 3-D coordinate)/ actual 3-D coordinate *100 ;
    iii. Determine the 3-D coordinates of the grid intersection points on the surface of femoral condyles (at least 180 points) using camera parameters.

3. Reconstruct the 3-D surface of femoral condyles using Matlab, Pro-E, or other software.

The following components should be included in the report:

1. Original images used in the project
2. Matlab program
3. Camera parameters
4. Error calculation based on the 3D coordinate determination of calibration markers
5. Data of 2-D digitization and 3-D reconstruction of the femoral surface
6. Three-dimensional surface plot of the femoral condyles

The electronic copies of the report, Matlab program and 2-D digitization data should be emailed to c.huang1@ miami.edu.

Extra credits:

Comparison of the 3-D coordinates calculations between different combinations of images (e.g., different images from angles or different numbers of images)