3-D Reconstruction of Trabecular Bone Tissue

We are developing a new instrument that should be assembled by December for slicing bone cross sections for use to compare and measure bone response to mechanical and hormonal (PTH) stimuli. This experimental project would help us to characterize the new instrument and to use it to generate 3-D reconstructions of bone. The methods would include developing and executing MATLAB image processing routines and operating the instrument to section bone specimens. The output will not only be in terms of never-before seen 3-D images of fluorescing new bone, but lead to developing analytical models.

Bone Models

In the past several years, we have purchased high-resolution 3-D scans of bones (cervical vertebra, pelvis, arm and leg bones) and have used some for generating 3-D finite element models. The process had been quite complex, and not all of the scans have been used. We have recently purchased a program (Geomagic) that can generate complex models from "point clouds" that can easily be extracted from the bone scans. The project would be to use Geomagic with several of the 3-D geometry scans to generate high-resolution finite element models for analysis in a variety of loading conditions (in preparation for a follow-up project to analyze with implants).

Scans and models of Total Joint Replacements

In order to generate accurate 3-D geometries of Total Joint Replacements, accurate measures of the geometry are needed. We have recently purchased a PICZA Pix-4 3-D scanner with X/Y-axis direction resolution of 0.05 (steps of 0.05mm) and Z-axis direction resolution of (0.025mm). This project would generate 3-D surface geometries of several total hip and knee replacement components using the 3-D scanner. Output will be processed using the Geomagic that can create surfaces in 3-D based on the digitized points for incorporation into finite element models.

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