Proposal for The SMIF Undergraduate User Program (SUUP)
Soft Tissue Differentiation through Phase Contrast Analysis Using Micro CT

Sarah Glomski – Biomedical Engineering Undergraduate Pratt Fellow *in association with*
Cameron R. 'Dale' Bass – Research Associate Professor in Biomedical Engineering

Introduction: Using traditional methods of CT imaging when examining organic soft tissue specimens yields very strong contrast between bone and soft tissues. However, the traditional use of magnitude analysis has shown to poorly depict contrast between soft tissues, such as brain/cerebrospinal fluid/membranes and meninges. The Bass laboratory has theorized a potential method of differentiating soft tissue using phase contrast analysis with microCT. As depicted by the lack of intensity contrast on current CT scans seen in Figure 1, various soft tissues attenuate similar amounts of x-ray waves. However, our theory is x-rays will pass through various soft tissues at different speeds, resulting in phase offsets based on the soft tissue. While MicroCT does not directly determine phase data, we intend to "back out" the phase information by taking scans of the specimen at various distance intervals between the specimen and the detector. Current clinical CT scanners are insufficient for this testing, as they are limited by both their fixed specimen to detector distance and resolution. The SMIF MicroCT has the capability of varying the distance between the specimen and the detector, and provides the resolution necessary to capture soft tissue damage of interest.

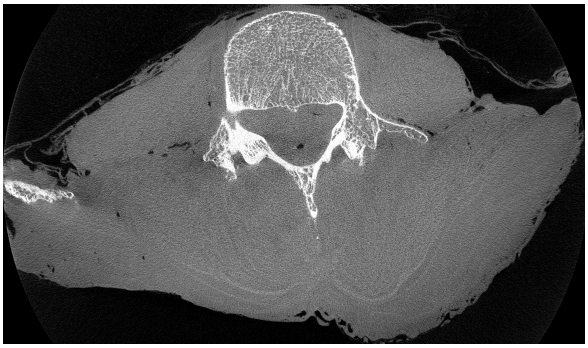

Figure 1: MicroCT Scan of Lower Lumbar; Minimal Differentiation between Muscle, Skin, and Fat

Methodology: Specimens will include either human or animal cadaveric samples, small enough to fit in the viewing field of the MicroCT, that contain various types of soft tissue such as cadaveric heads of surrogate animals. Initial testing will aim to determine the plausibility of the phase contrast method with more rigorous detailed testing to follow after a proof of concept is developed. The specimen will be placed a given distance from the detector and scanned. Next, the specimen will be moved a particular interval and the process is repeated until three scans of different distances are completed. Following each scan, the reconstruction computers will be used to convert two-dimensional slices into a three-dimensional image. The initial distance and movement intervals from the detector will be optimized during initial testing. After taking scans, the magnitude data of the three distances, interval lengths, and prior knowledge of x-ray frequency and amplitude will be used to construct phase information in different soft tissues. The phase information will then be analyzed across several specimens for soft tissue differences.

Projected Expenditure: Each scan will take approximately two hours. At $73.60 per hour plus one hour per specimen on the analysis workstation ($12.51/hour), each specimen will cost ~$160. The goal is to scan at least three to four samples a month; because of this the requested amount of funding is $2000.