Image Processing Techniques for Bone Cell Analysis

Wenhan Huang[1], Qian, Enlin[2]
[1]Department of Electrical and Computer Engineering, Purdue School of Engineering and Technology;
[2]Department of Biomedical Engineering, Purdue School of Engineering and Technology

Osteoblast and osteoclast are two different types of bone cell that are responsible for bone formation and bone resorption, respectively. Both cell types are very critical in maintaining, repairing, and remodeling of the skeleton in the human body. Moreover, they are involved in skeletal diseases such as osteoporosis and osteoarthritis. To absorb bone matrix, pre-osteoclasts infuse into one large multinucleated mature osteoclast. The area of the large multinucleated cell is measured to represent the formation and the activity of mature osteoclast cells. The number of osteoblast cells is a key factor that determines the rate of bone formation. Thus, the area of mature osteoclast and the number of osteoblast are two critical parameters to decide the effect of a stimulus on bone remodeling.

In order to automatically obtain the number of osteoblast cells and the area of the osteoclast cells from bright field images, an image analysis technique, implemented in OpenCV, was developed.

After cells are stained and photographed, edge maps of the acquired images are obtained using edge detection techniques such as the Canny edge detector. The scheme requires a threshold value from the user and employs it to determine an initial edge map, that is displayed to the user. If the user is not satisfied with the outcome they can request the threshold value to be adjusted and new edge map is consequently obtained. If the edge maps are satisfactory, they are subsequently converted into segmentation masks. The purpose of this step is to eliminate noise in the background while retaining objects/cells of interest. Once the cells have been identified the technique employs the Hough Circle Transform to identify and count the number of osteoblast cells present in the image. For the osteoclast cells, the scheme permits the user to manually select specific cells in order to determine their size as a ratio of the total image size.

Mentors: Yokota Hiroki, Department of Biomedical Engineering, Purdue School of Engineering and Technology, IUPUI; Paul Salama, Department of Electrical and Computer Engineering, Purdue School of Engineering and Technology, IUPUI