H51 The Utility of GIS in the Spatial Analysis of Saw Cut Marks on Bone

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After attending this presentation, attendees will have an appreciation for how Geographic Information Systems (GIS) can be used in a nontraditional manner in the identification of saw cut patterns on bone.

This presentation will impact the forensic science community by adding a new tool to the study and interpretation of saw cut marks on bone.

GIS have been used extensively for storing and analyzing raster (image) and vector (point, line, and polygon) data covering large spatial extents. Because of its ability to analyze spatial data and patterns, GIS have more recently been applied to micro-scale features of bones.

Kerf wall striations, while highly visible, have proven for the most part to be ineffective in defining saw class. GIS appears well-suited to recognize saw cut striations as spatial patterns. To test the utility of GIS, a series of test cuts were made using long bones of *Odocoileus virginianus*. In this initial study two saws were chosen with reasonably different class characteristics: 11 Teeth Per Inch (TPI) cross-cut pruning saw (blade 1); and, 32 TPI wavy set hacksaw (blade 2). Using a Keyence® digital microscope the kerf wall striations were digitally recorded in a jpeg format. The resulting jpeg images were processed to remove the background to eliminate background bleeding onto the striation surface.

Using ArcMap™ 10.1, each jpeg image was separated into three color bands (blue, green, and red). Band 3, the blue band, was not used. To analyze the variation within each image, an Isocluster Unsupervised Classification in ArcGIS 10.1 was applied. This analysis determined the maximum number of statistically similar cluster classes based upon the image reflectance patterns. The more homogeneous the image (low texture, smooth surface), the fewer classes required to represent the spectral variation in the image. FRAGSTATS spatial pattern analysis software was used to examine the pattern and spatial distribution of the cluster classes and to compare patterns produced from different saw blades.

FRAGSTATS analyzed the striation patterns using two values: Patch Richness and the Interspersion-Juxtaposition Index (IJI). Patch Richness (number of cluster classes) provides an indicator of the overall variation in reflectance within a given image. Images having a smoother and more homogenous surface will tend to result in fewer classes (lower richness), whereas those having a more textured surface will tend to produce a higher number of clusters. Eight trials using saw blade 1 (11 TPI cross-cut) produced an average of 25 classes (range 14-39), whereas five trials for blade 2 (32 TPI wavy cut) produced an average of 8 classes (range 7-9). This indicates a greater degree of variation in reflectance among the red, blue, and green bands for images from blade 1 and thus more surface variation (and shadowing) texture. Interspersion-Juxtaposition Index (%) refers to the spatial intermixing of different patch types and increases in value as patches tend to be more evenly interspersed. Potential values range from 0-100% with 100 indicating that all patch types are equally adjacent to all other patch types (maximum interspersion). This is an indicator of the total edge increasing as patch shapes become more irregular (as the image contains more edge relative to interior of cluster classes (patches). A single square patch (homogenous image) would produce a value of 1. Saw blade 1 had an average IJI of 68% while blade 2 produced an average of 77%, indicating that blade 2 produced fewer and more homogenous classes, each occupying a larger proportion of the image area and thus likely to be adjacent to different class types.

This initial study has demonstrated that GIS can be used in the pattern analysis of saw cut striations. Further analysis is needed to establish the Patch Richness and Interspersion-Juxtaposition Index for additional saw classes and formulate a methodology for testing an unknown striation pattern against known patterns.

GIS, Saw, Cutmarks

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