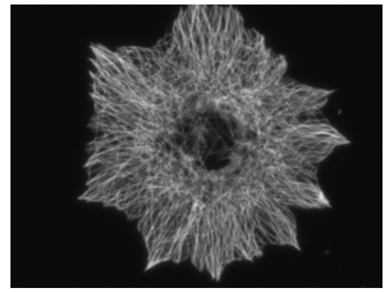
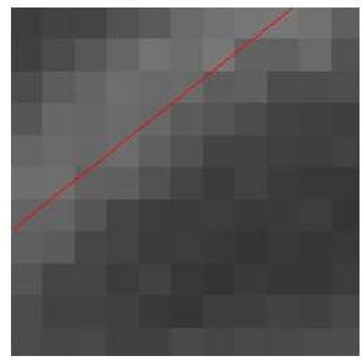
SENIOR RESEARCH PROJECT

Title: Data Analysis from Photographic Images I—direction statistics

Supervisor: Prof Donald Drew



Description: Many biological images show one-dimensional structures, such as the image of microtubules in the first Figure. It is relatively easy to follow the curves with one's eye, but it is not easy to extract numerical angle data. One difficulty is seen in the second Figure, which is a blowup of a region in the first Figure, and shows a line with an estimated angle.



Outcome: There are several possibilities for applying knowledge gained from Numerical Computing, Linear Algebra, Multivariable Calculus and/or Differential Equations. A start might to be to fit a line (or other curve) to the grayscale structure in a "window" (such as that shown in the second Figure). A challenging problem seems to be how to fit the line segments in each "window" together to form a curve, or set of curves, that represents the structures.

SENIOR RESEARCH PROJECT

Title: Data Analysis from Photographic Images II--branching

Supervisor: Prof Donald Drew

Description: Many biological images show one-dimensional structures, such as the image of trees in the first Figure. It is relatively easy to follow the curves with one's eye, but it is not easy to extract data describing the curves. One difficulty is that the curves branch, so if one is traversing a curve in a SSW to NNE direction, as seen in the middle of the second Figure, one encounters a branch pointed in a more northeasterly direction. Creating an algorithm to deal with branching would impact the analysis of such data. A second issue is the two-dimensional nature of the photograph, as compared to the three-dimensional nature of the tree. If one assumes that the statistical properties of the curves is homogeneous in the azimuthal direction, can one use two-dimensional data to infer three-dimensional statistics?

Outcome: There are several possibilities for applying knowledge gained from Numerical Computing, Geometry, Linear Algebra, Multivariable Calculus and/or Differential Equations. A start might to be to fit a line (or other curve) to the black structure in a "window" of a few pixels. It seems possible to fit two intersecting lines to a branching curve. The three dimensional nature might be treated by assuming that a line segment in two dimensions (of the form $y = m x + b$) represents a line of the form $(y-b)/m = (x-a) = (z-c)/n$, where we assume something about the relation between a, b, c, and m and n.