

- Vein Extraction
- Shape Analysis
- Other Ongoing Work

Evolved Vein Classifiers

- Classifiers
 - Genetic algorithm is used to evolve a set of classifiers for detecting veins
 - Each classifier consists of a pair of bounds for each of the features used
 - If the values of all the features for a pixel fall within all the bounds for a classifier, then it is classified as vein

Evolved Vein Classifiers

- Features used:
 - Grey-scale value
 - Edge gradient magnitude (from Sobel)
 - Neighbourhood grey-scale average
 - Difference between grey-scale value and neighbourhood average
 - Difference between grey-scale value and lamina average

Evolved Vein Classifiers

- Features used:
 - Difference between pixels either side of potential vein
 - Difference between pixels in each direction along potential vein
 - Difference between grey-scale value and average of pixels either side of potential vein
 - Difference between grey-scale value and average of pixels in each direction along potential vein

Evolved Vein Classifiers

- Genetic Algorithm
 - Evolve population of classifiers, adding best to a set of classifiers for use.
 - After adding classifier to set, re-initialise population, and repeat until no more good classifiers are produced.
 - Classifier fitness is based on how much it would contribute to the set of previously selected classifiers

Evolved Vein Classifiers

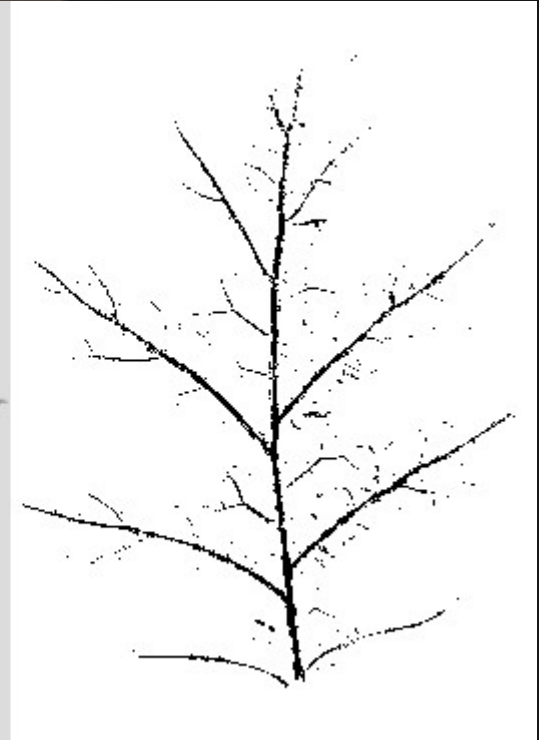
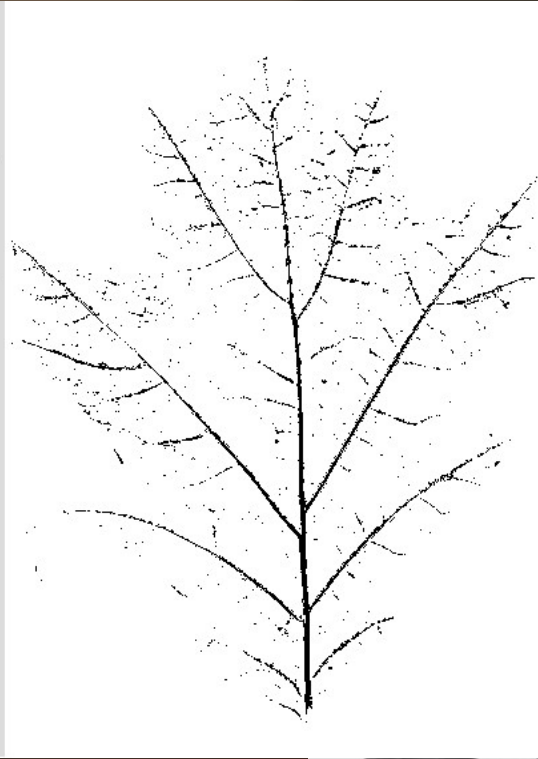
- Fitness function:

$$fitness_i = \frac{|T_i \setminus \bigcup_{j \in C} T_j|}{|F_i \setminus \bigcup_{j \in C} F_j| + k}$$

– Where

- T_i is the set of pixels correctly classified as veins by classifier i
- F_i is the set of pixels incorrectly classified as veins
- C is the set of previously selected classifiers
- K is a constant

Evolved Vein Classifiers



Vein Tracing

- Filtering

- Rotatable, elongated Gaussian filters passed over classification output

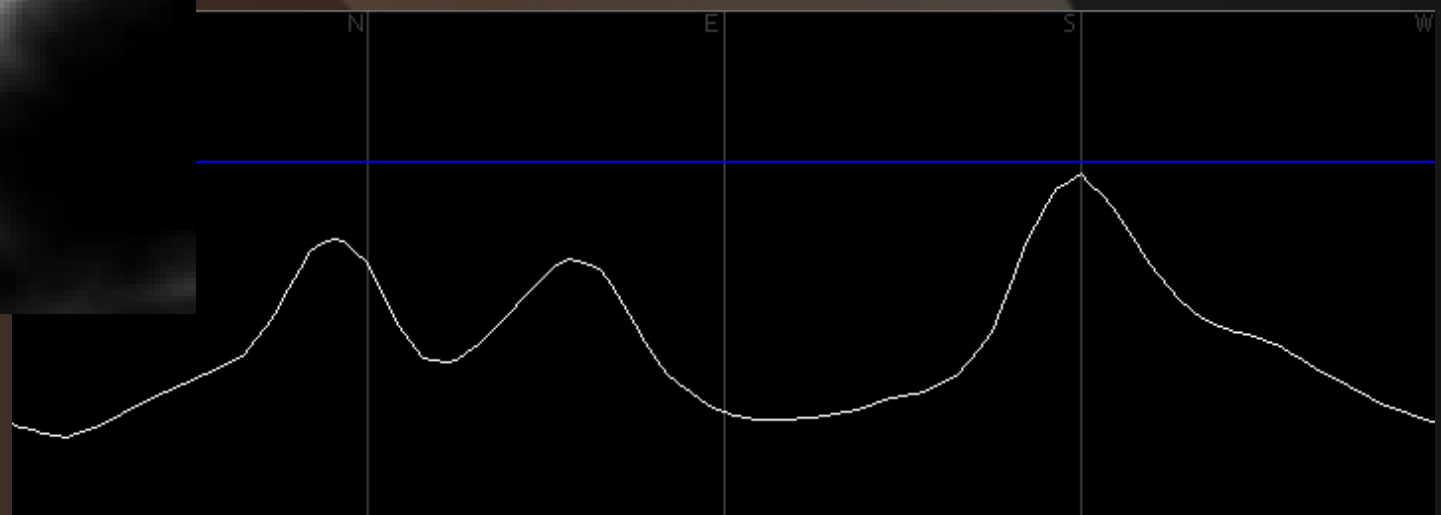
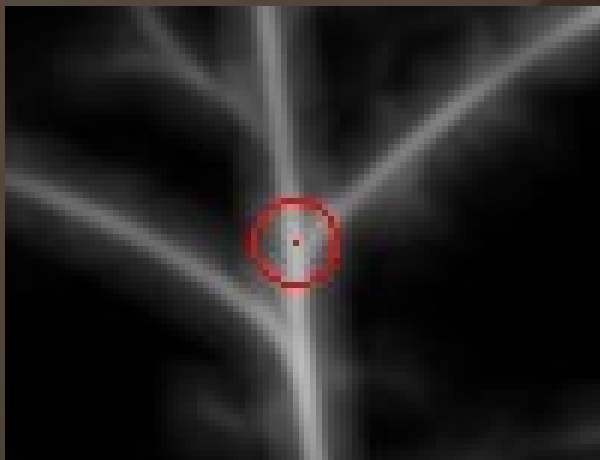


- Filter orientation corresponds to highest response



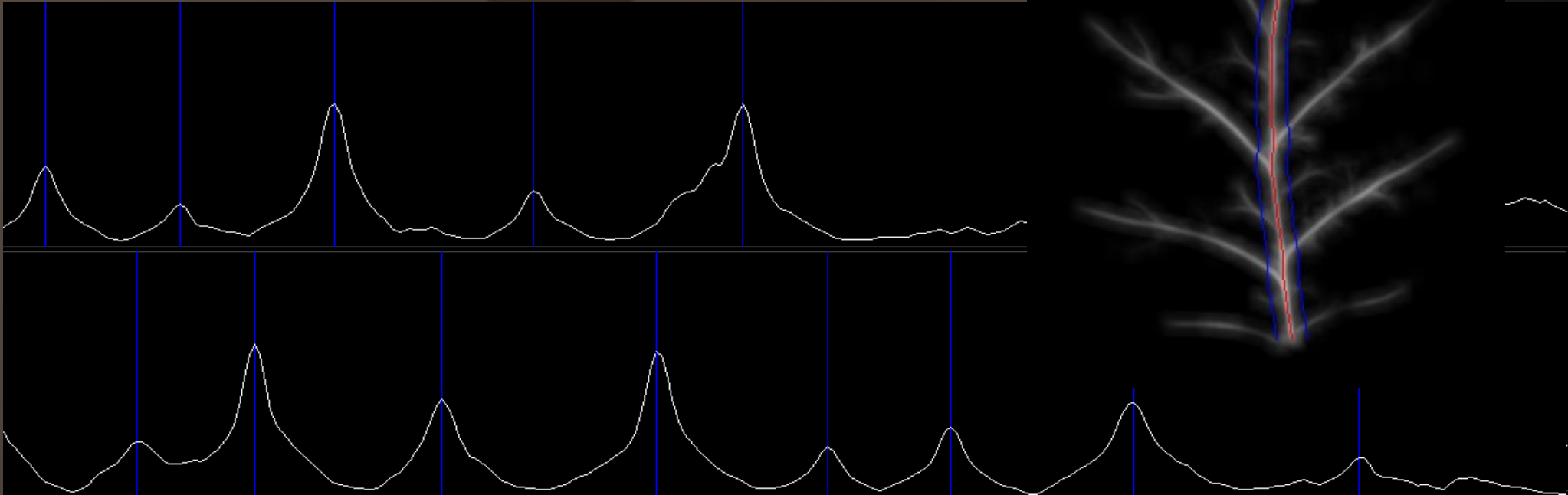
Vein Tracing

- Tracing
 - Scan circle around pixel to find ridges
 - Trace along ridges to find complete veins



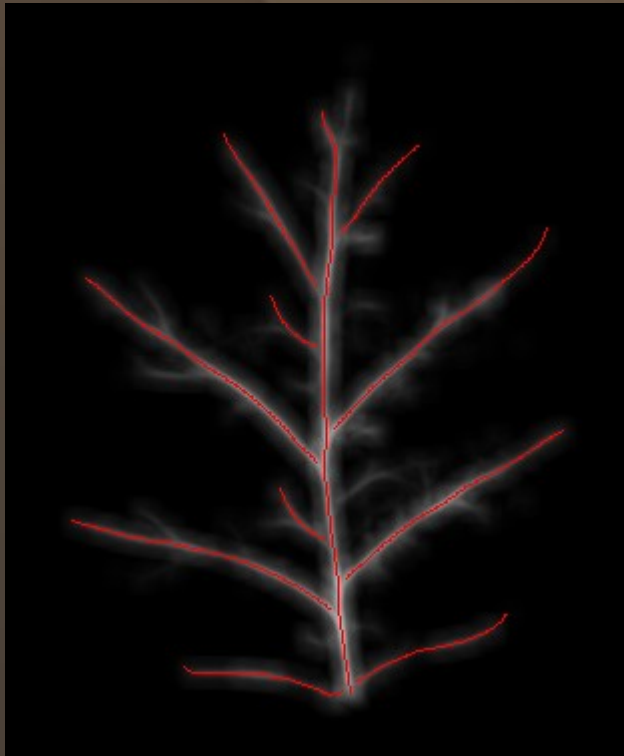
Vein Tracing

- Find and trace main vein based on vein width
- Search either side of main vein to find peaks indicating secondary veins



Vein Tracing

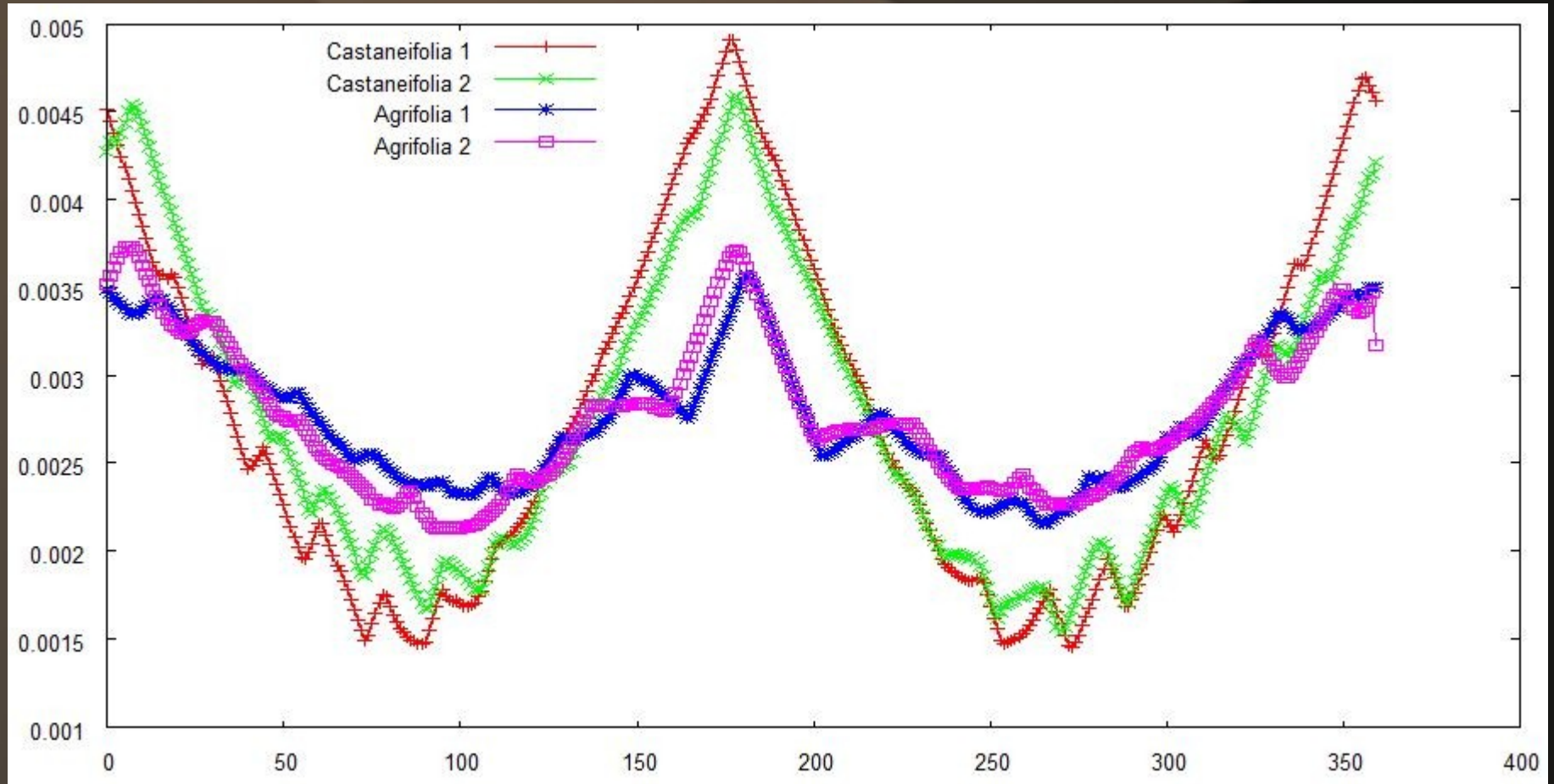
- Results:



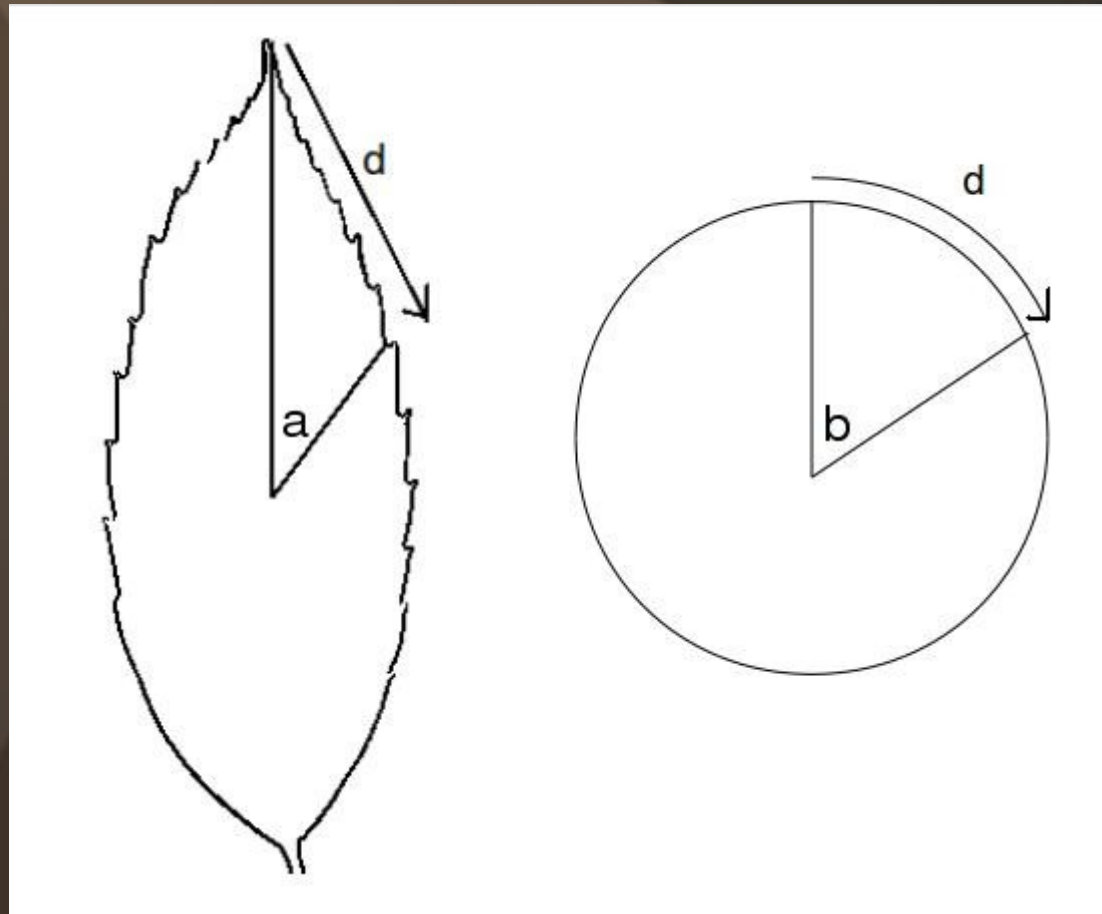
Contour Analysis



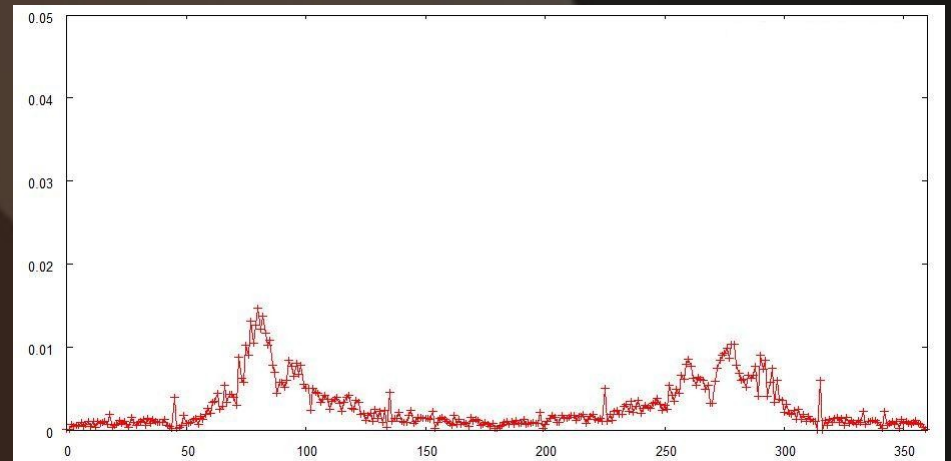
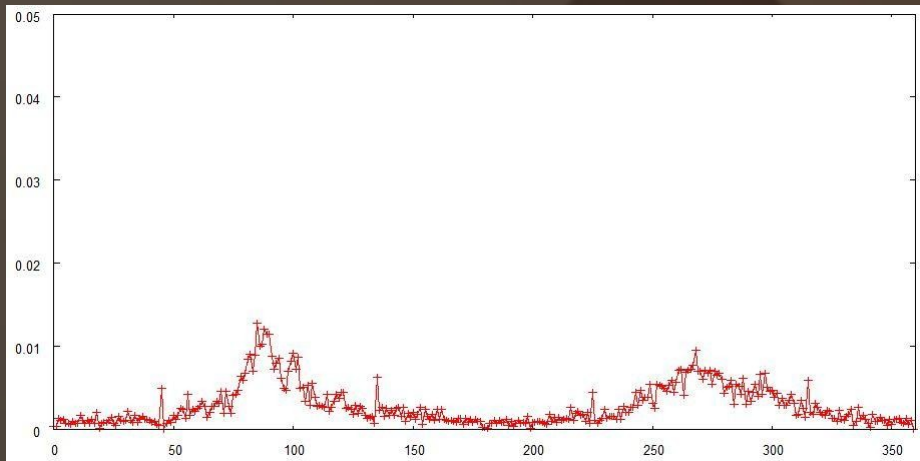
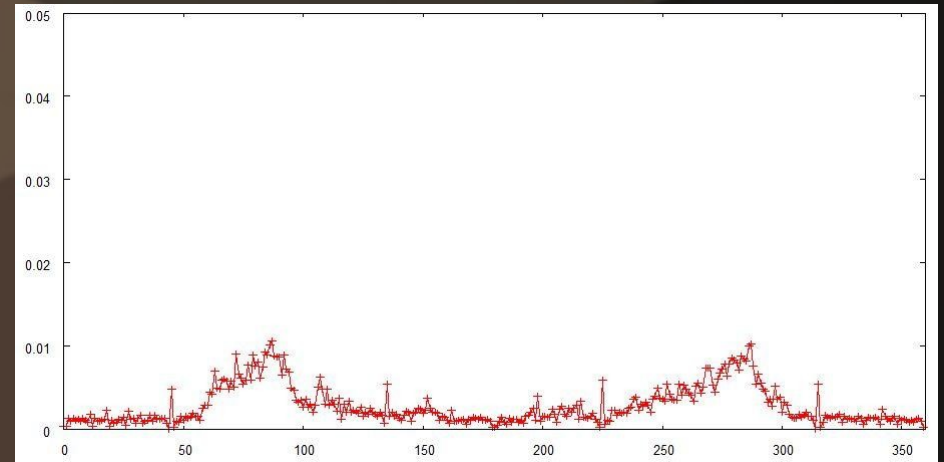
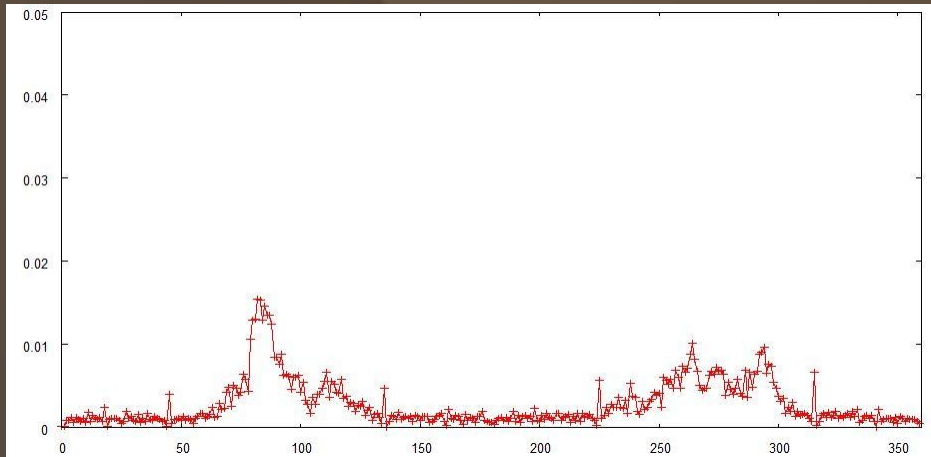
Distance Signature



Angle Signature



Histogram of Gradient Directions



Other Ongoing Work

- Vein descriptors
- Texture analysis
- Literature review