

Winter Newsletter 2017

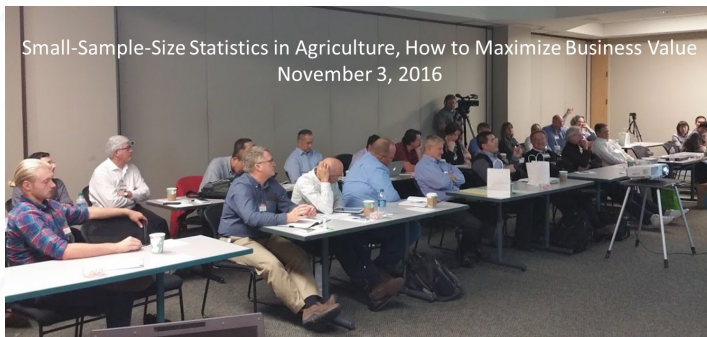
About Us

Phenotype Screening Corporation provides whole plant characterization services for agriculture, horticulture and environmental communities. Established in 2004 we serve an international clientele with customized facilities and equipment to assess genetic, environmental and treatment effects on plant health and development.

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PSC's Small-Sample-Size Statistics in Agriculture Workshop a Big Success



Representatives from twelve Ag-chemical companies attended our workshop in November, "Small-Sample-Size Statistics in Agriculture, How to Maximize Business Value." PDF versions of the presentations are available on our website and video recordings of the presentations are available at our YouTube site, https://www.youtube.com/channel/UCnV9i4eMPU_XrwiBuQUZzOw. The workshop was highly interactive and combined reviews of the basics and introductions to new methods.

Techniques in Imaging—Color Segmentation

There are times when it is necessary to separate a region of a narrow color range out of an image containing many colors. One way to do this is to

select an exemplar color and specify a range of acceptable color variation around that exemplar. This may be done by considering the dot product of two (r,g,b) vectors.

$$\mathbf{a} \cdot \mathbf{b} = \|\mathbf{a}\| \|\mathbf{b}\| \cos(\theta)$$

See: https://en.wikipedia.org/wiki/Dot_product for details.

In this application each of vectors \mathbf{a} and \mathbf{b} is a three element vector containing the red, green, blue values of the pixel that the vector represents. Angle θ represents the closeness of the two colors; the smaller the angle θ , the closer the colors match, independent of level of illumination.

Note that the dot product equation is valid for a Euclidean vector space of any dimension. Therefore, it can be applied to a multi-spectral or hyper-spectral image as well as a standard RGB color image.

Example 1: Lepidoptera Color Segmentation



Figure 1. Original Color Image of Lepidoptera Larvae

Often insect larvae are grown in well plates on plant leaf tissue. Many larvae have a color close to their background environment. This is a protective adaptation, and it does make it harder to

(continued)

distinguish the larva from the background.



Figure 2. Segmented Image of Lepidoptera Larva on Leaf

In Figures 1 and 2 an example image is shown along with the segmented image. Because the color of the larva and the color of the leaf are close, the choice of exemplar color and range of acceptable color variation is very important.

Example 2: Aerial View of Field



Figure 3. Aerial View of Field with Green Plants (image courtesy of WinField Solutions, LLC)

In this application, it is desired to segment out the green vegetation in order to determine the percentage of green coverage. In this instance, the resolution of the image is such that many leaves are not more than one pixel wide. This means that pixels at the edge of a leaf will have a color blended from leaf and background. This requires precise control of the exemplar color and angle θ in order to discriminate leaf from background.

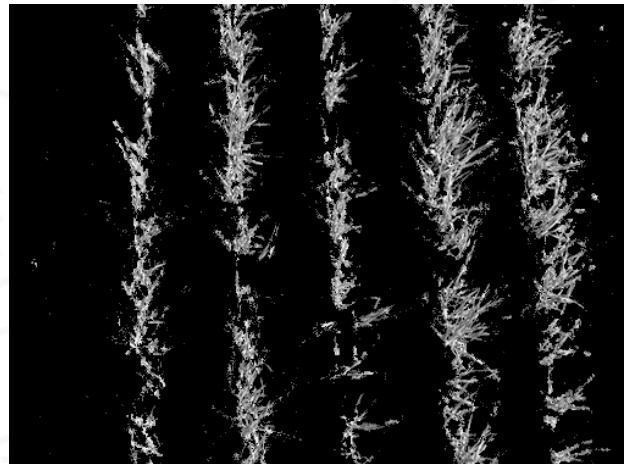


Figure 4. Segmented Image of Field

Demonstration Software Available

PSC has written a demonstration software application in C to do color segmentation, of regions in an RGB color image. This demo is available on our website and is designed to run under 64 bit Linux; however, it can be recompiled to run on Mac OS-X, and may run on Windows 10 with the BASH shell interpreter installed. Many refinements are possible, but are not included in this demo.

PSC has also developed software that performs morphological (shape) segmentation. PSC software is unique in that it is designed and built to work under very high noise conditions.

If you have a process that requires the reliable, automated segmentation of many images based on color or shape, or both, Phenotype Screening Corporation is ready to craft a high throughput software application for your use.