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COMPUTER LOCATION OF CITRUS TREES USING COLOR AERIAL INFRARED TRANSPARENCIES

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ABSTRACT

An algorithm is described designed to determine automatically citrus tree locations from color aerial infrared transparencies. It permits further processing to be performed to check trees for three major types of citrus infestations: Brown Soft Scale, Gummosis, and Citrus Mealybug, which cause millions of dollars of damage annually in the Rio Grande Valley of Texas. It would be advantageous to detect these infestations in the early stages.

Capability to locate and bound each tree would have several benefits. First, a significant amount of computation and computer storage could be saved since only the data within the tree boundaries need be stored and processed for subsequent operations. Second, ambiguities in color between the background information and the trees could be avoided and infestations located on a tree by tree basis. Third, processing would be expedited since only the information in one dimension of the original three dimensional space would be needed to find the tree boundaries.

On color infrared film, the three infestations manifest themselves by distinct color characteristics. Color is also a better feature for finding edges than is black and white.

When a picture is digitized, the output at each digitized point is in the form:

$$X = \frac{R}{R+B+G}$$

$$Y = \frac{G}{R+B+G}$$

$$I = R+B+G$$

where R,G,&B are the red, green and blue outputs from the film scanner

X is the normalized red output in the CIE coordinate system

Y is the normalized green output in the CIE coordinate system

I is the intensity (brightness) output.

Consequently, the intensity information in one dimension is separated from the chromaticity information that lies in the other two dimensions of the three dimensional space.

Experimental results have shown that tree information can be adequately described by a plane in the three dimensional space by reducing the X and Y chromatic information into a single dimension. Edges in the picture can then be found using the single chromatic dimension, and a tree size window can be used to determine whether a tree is present. Thus only a single dimension is necessary to locate the tree.

The algorithm has been successful in locating trees using a minimum amount of processing and storage. Trees that are somewhat but not completely grown together were distinguished from each other and infested and non-infested trees were located using color differences as a determining criteria. This work is a first step of an investigation to detect the three types of infestations on a tree by tree basis.