Climber: A Vertex-Finder

VISION FLASH 38

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Abstract

A LISP program has been written which returns the location of a vertex in a suspected region, as well as an indication of the certainty of success.

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Vision flashes are informal papers intended for internal use.

This memo is located in TJ6-able form on file VIS;VF38 >.

INTRODUCTION

A LISP program has been written to find a vertex in a given region. It employs the Winston-Lerman circular scan <Vision Flash 23> in a two-process hill climb.

Past line-drawing programs assumed that vertices did not exist per se, but could be found only as the intersection of lines. This one-level type of program meant that new information could only be found by a complete new line drawing.

This vertex finder, along with a program which detects incoming lines at a vertex, and a line tracker, is used in the new CONNIVER program WIZARD, which produces accurate line drawings of complex scenes <Vision Flash forthcoming >. Wizard is capable of handling partial information when producing line drawings of complicated scenes.

HOW IT WORKS

The Correlations

CLIMBER uses a test pattern with one outer circle and five inner circles. The change of intensity around the inner circles is compared to the change of intensity of the outer circle.

Climber then moves to the center of mass of the vectors formed by these correlations. As the feature is approached the inner circles converge to accurately locate the vertex <see Figure 1>.

Simple, Zero Mean Correlation- Phase I

$$\sum_{\theta=1}^{n} (I_1(\theta) - \bar{I}_1) \cdot (I_2(\theta) - \bar{I}_2)$$

Normalized, Zero Mean Correlation- Phase II

$$\frac{\sum (I_1(\theta) - \bar{I}_1) \cdot (I_2(\theta) - \bar{I}_2)}{\left[\sum (I_1(\theta) - \bar{I}_1)^2 \cdot \sum (I_2(\theta) - \bar{I}_2)^2\right]^{1/2}}$$

Examination of the formulas shows that they can be written in alternative forms which speed up computation

$$\sum I_1 \cdot I_2 - \frac{\sum I_1 \cdot \sum I_2}{n}$$

$$\frac{\sum I_1 \cdot I_2 - \frac{\sum I_1 \cdot \sum I_2}{n}}{\left[\left\{\sum I_1^2 - \frac{(\sum I_1)^2}{n}\right\} \cdot \left\{\sum I_2^2 - \frac{(\sum I_2)^2}{n}\right\}\right]^{1/2}}$$

One final improvement was made in the choice of correlation functions used. Assuming that the difference of the average intensity of the inner and outer circles is small, Climber simply minimizes the sum of the absolute value of the difference of intensities.

$$\min \sum \left| I_1(\theta) - I_2(\theta) \right|$$

CLIMBER has been used successfully on textured objects.

Thanks to PHW, JBL, and NC.

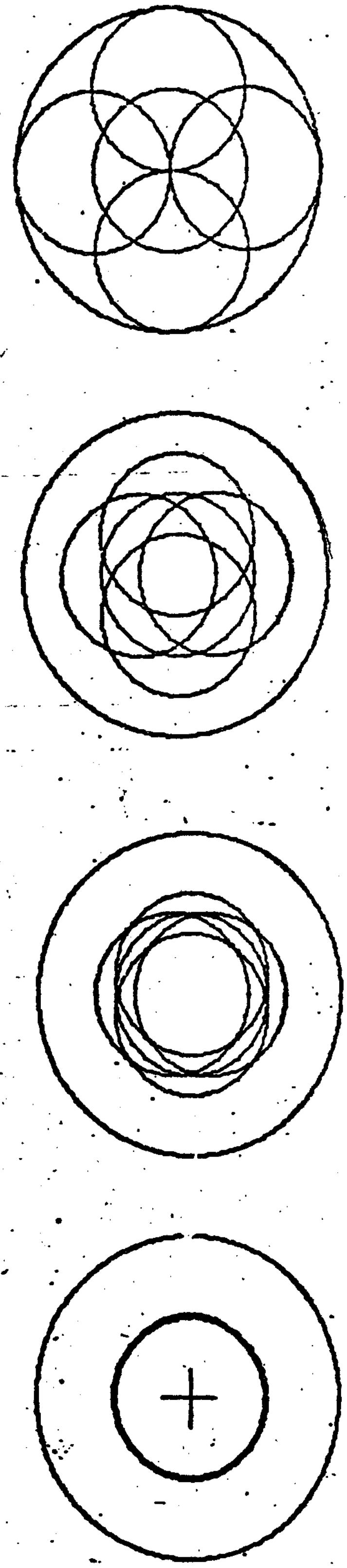

FIGURE 1: Circle Convergence