Examples of how image intensity statistics lead to an "interest point" or "corner" detector

Developments attributed to Forstner & Harris

The Harris corner detector and the Forstner interest operator both utilize the covariance matrix of the shift terms from least squares matching. That covariance (2x2) is constructed from image gradients in a small window around a givien point. A covariance matrix can always be represented as a "confidence region" or "confidence ellipse". For a corner or interest point, we want that confidence ellipse to be (1) small, and (2) nearly circular.

$$\Sigma_{\begin{bmatrix} \Delta X \\ \Delta Y \end{bmatrix}} = \frac{\begin{bmatrix} \sum g_y g_y & -\sum g_x g_y \\ -\sum g_x g_y & \sum g_x g_x \end{bmatrix}}{\sum g_y g_y \sum g_x g_x - \sum g_x g_y \sum g_x g_y}$$

One typically devises 2 measures of smallness and circularity and the computes these statistics at every point in an image. Then by thresholding, one selects a subset of these points which have the best values to then use for (1) pass point selection, (2) matching, or (3) high level feature recognition, detection, and delineation.