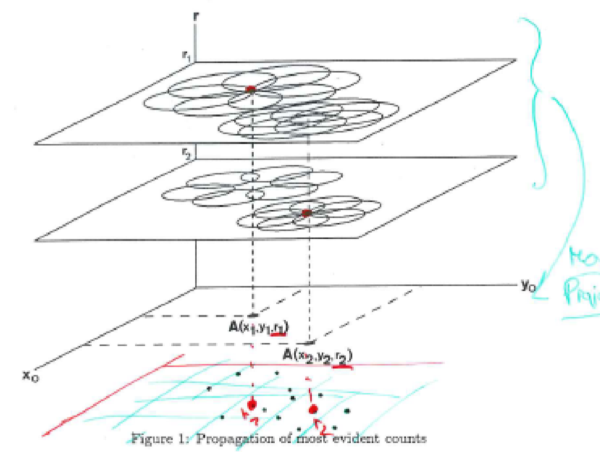
Projection Strategy for Reducing Dimension of Parameter Space

Gerig, G., Klein, F., 1986. Fast contour identification through efficient Hough transform and simplified interpretation strategy. In: Proc. Of the 8th Int. Conf. on Pattern Recognition, pp. 498–500.

In this paper, we proposed not to store the whole high-dimensional parameter space (3D for circles, 4D for general 2D objects with scale and rotation), but to keep only a 2D accumulator. This can be done by a maximum projection of subsequent accumulations, but requires a second 2D buffer that encodes the scale/rotation parameters associated with each maximum (see sketch).



2. PROJECTION STRATEGY FOR REDUCING DIMENSION OF PARAMETER SPACE

Assumption: Concentric curves excluded

$$\bar{a} = (x_0, y_0, r) \rightarrow (x_0, y_0)$$

$$A(x_0, y_0) = max\{A(x_0, y_0, r_i), \quad r_i = r_{min}, \ldots, r_{max}\}$$

Figure 1: Propagation of most evident counts

Define three empty accumulators, one for current processing (A_c) and one for projected results A_p and a third to store the code for scale and rotation information P_{param}.

Iterate over all templates (scale, rotation):

1. Start with a first template and increment A_c
2. Calculate maximum of A_c and A_p and update this maximum in A_p.
3. Update the scale/rotation parameters associated to the updated maxima in buffer P_{param}.
4. Go to next (scale/rotation), build new template, go to 1 till all scale and rotation parameters are completed.

Please note that for circles, you only need a scale parameter “r”, so that the buffer P_{param} directly encodes the radius of the circle associated with the projected maxima. The buffer for maxima (A_p) contains all maxima calculated across the range of radii.
For scale and rotation, you need to find an encoding that uniquely stores scale and rotation in one number that can be stored in buffer P_{param}. This buffer is later used to interpret the structures which are now encoded by its reference center (location of maxima in A_p) and its parameters, so that they can be reconstructed.

(This strategy excludes detection of concentric objects, as they would would create maxima at the same spatial location but with different scale parameters.)