Projection Strategy for Reducing Dimension of Parameter Space


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).

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 $P_{\text{param}}$.

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 $P_{\text{param}}$.
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 $P_{\text{param}}$ 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 $P_{\text{param}}$. 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 create maxima at the same spatial location but with different scale parameters.)