
If we are successful in isolating objects of interest in a binary image, we can use computationally efficient algorithms to find the location of the object(s) and characteristics (descriptors) of the objects. Unfortunately, noise is in many instances introduced when converting images to binary images. Following is a technique that will help eliminate noise or identify flaws in say manufactured objects.

Morphology - Contraction/Expansion/XOR (PS19 Text)

**Contraction** (Binary Images Only)

Noise/Defect outside of object removed.

\[ P^* = P_1 + P_2 + P_3 + P_4 + P_5 + P_6 + P_7 + P_8 + P_9 \]

Logical AND

3 x 3 Wipe

Noise-Free Image

Object of Interest

Shrink object

Expand

Expand (Binary Images Only) 

Contract

Add 

Eliminate Noise/Defect inside of object

\[ P^* = P_1 + P_2 + P_3 + P_4 + P_5 + P_6 + P_7 + P_8 + P_9 \]

'OR' all pixels under an '1' in the wipe.
The contraction and expansion windows can be any array.

For example:

\[
\begin{bmatrix}
0 & 1 & 0 \\
1 & 0 & 1 \\
0 & 1 & 0 \\
\end{bmatrix}
\]

A "1" in the window means perform the logical operation.

\[ P^* = P_2 \cdot P_4 \cdot P_5 = P_6 \cdot P_8 \]

\[ \implies P^* = P + P_3 + P_5 \]

The figure on the following page indicates a process for detecting and removing noise defects in objects. Note that the process is sensitive to the window selected.

Edges using binary image

Given

\[ I_0 \]

Contract

\[ I_1 \]

\[ I_2 = I_0 - I_1 \text{ or } I_2 = I_0 \oplus I_1 \oplus \text{exclusive OR} \]
FIGURE 9.14
(a) A simple binary image, with 1’s represented in white. (b) Result of using Eq. (9.5-1) with the structuring element in Fig. 9.13(b).
DETECTION OF DEFECTS

NOTE: SENSITIVE TO WINDOW SHAPE AND SIZE

Figure 57: Left: Illustration of shrink/expand and expand/shrink smoothing. Right: An example showing the order dependence of such smoothing methods.
2. 25pts. An object in a binary image below has an inside defect as shown. Computer generate the defect image using the smallest logical wopr possible (smallest number of wopr elements).