Segmentation and edge extraction

Transition from Bild'be'arbeitung to Bild'ver'arbeitung.

① Segmentation is the process of transforming an image into a collection of disjunct elements which have some common property.

Elements are separate and individually addressible

$$f \xrightarrow{\text{seg}} \{ f_n \mid n = 1 \dots N \}$$

$$\bigcup_{n=1}^{N} f_n = f \rightarrow \text{If we unify all elements, we get the image}$$

$$f_V \cap f_\mu = \emptyset \; \forall \; \mu \neq V$$

if they're different.

② Similarity (common) property → all image elements which fulfill the prescribed condition or possess a prescribed property belong to the corresponding segment.

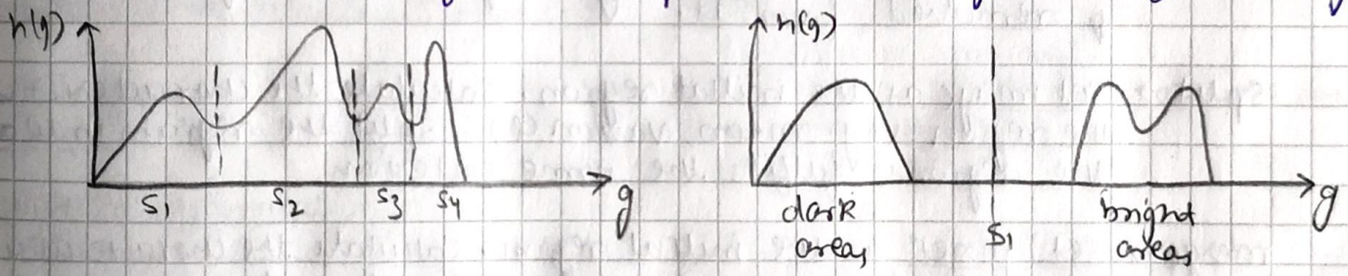
Eg. color, Grey value, Texture parameters, etc

③ Methods of segmentation

(A) Based on histograms → Threshold and multithreshold method (global, local, dynamic)

Histograms represent the frequency (no.) of pixels with a greyscale value but do not show their position (location) in the image.

assumptions → ① Subsequent processing of the result is needed.
② Performance depends on the brightness of the image.



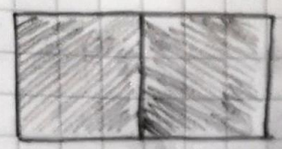
problems → insufficient separation due to overlapping segments
→ disturbances are carried over to resulting image.

solution → consideration of more information (shape, size,)
→ Elimination of disturbances (eg. morphological filtering)

(B) Texture based methods → In these methods, a feature of the texture is selected on the basis of which the regions are identified and segmented.

How → A parameter vector ($m^T = (m_1 \dots m_N)$) is defined for the textures which occur in the image, such that ranges of parameters correspond to the possible textures.

The texture is then assigned to a pixel depending on the range to which the texture parameter m_k of the area around the pixel belong to.



$\|m - m_1\| < \delta$ → Pixel belong to texture1

$\|m - m_0\| < \varepsilon$ → " " " 2

(a) Region growing procedure → starting from a pixel chosen at the outset, the region around the pixel is enlarged such that all the pixels in the enlarged area fulfill a prescribed criterion. (eg. have a grey value in a prescribed interval)

★ A method of connecting all the pixels into an area is "labelling".
★ only by doing this, various objects in the image can be distinguished from each other.

Transition from greyscale values to object value.

→ Watershed algorithm

useful for segmenting objects that r touching each other.

we have → Catchment basins (non-zero)
→ watershed ridge line (0)

★ Generally for binary image
★ see the youtube video.

(b) Split and merge → is an extension of the region growing method: A pixel erroneously assigned to a region can be removed from it.

Split → Set image as the initial region, Calculate the characteristics of the region (eg. mean, variance). Split the regions until all the regions fulfills the same criterion.

merge → Set "pixel" as the initial region, Calculate the characteristics of the region (eg. mean variance). Calculate and compare the characteristics of the neighbouring region. Fuse the regions if they are sufficiently similar.

(c) Neighbourhood relationships