Visualize image in 3 dimensions - topographic interpretation

Consider 3 types of points:

a) Points belonging to a regional minimum.

b) Points at which a drop of water, if placed at the location of any of those pts., would flow with certainty to a single minimum.

c) Points at which water would be equally likely to flow to more than one such minimum.

For a particular regional min., the set of pts. satisfying (b) is called the catchment basin or watershed of that min.

The pts. satisfying (c) form crest lines on the topographic surface and are termed divide lines or watershed lines.

Goal: find watershed lines

Dam filling analogy Fig. 10.54

Watershed segmentation tends to extract nearly uniform (blob-like) objects.

Since regions characterized by small variations in intensity have small gradient values, watershed segmentation is often applied to gradient of image rather than image itself.

Dam Construction

Fig. 10.55(a) shows portions of two catchment basins at step $n-1$.

Fig. 10.55(b) shows result at next flooding step n.

Let M_1, M_2 denote points in two regional minima. Let pts. in corresponding catchment basins at stage $n-1$ be $C_{n-1}(M_1)$ and $C_{n-1}(M_2)$.

Since flooded region has become a single component at stage n indicates a dam must be built.

Let q = connected component at stage n.
Dilate connected components in Fig. 10.55(a) subject to:

1) The dilation is constrained to q (center of structuring element can only be located at pts. in q)

2) Dilation is not performed on pts. that would cause the sets to merge.

Fig. 10.55(d) shows results after 1st (gray) and 2nd (black) dilation passes.

Dam is identified as those pts. that satisfy 1) but violate 2).

Set value of dam pts. to max. value and proceed.

Note: Watershed segmentation results in connected boundaries.

Fig. 10.56 example

Scripts.

Lung cell example.