Watershed: Minimum Following Algorithm

Step 1: You need to form the image gradient magnitude (also known as, edge strength) *E* of a given image *I*. Suppose *E* is a 6-by-5 matrix formed as follows:

10	100	20	2	15
75	6	30	11	3
19	43	38	45	5
1	22	0	17	100
12	7	5	100	88
16	66	59	44	23

Step 2: If no connectivity type is given, assume a connectivity type, such as 4- or 8-connectivity and find out the local minima of *E*. For example, I assumed 8-connectivity and found out the following minima on *E*. Color each local minimum uniquely.

10	100	20	2	15
75	6	30	11	3
19	43	38	45	5
1	22	0	17	100
12	7	5	100	88
16	66	59	44	23

Step 3: *Simulate* a motion for each pixel in *E* by this following rule.
For each pixel construct a path of pixels as follows:

A. Start the path by adding the current pixel to it.
B. If current pixel is a local minimum stop, and paint the initial pixel with the color of its local minimum. Else go to step C.
C. Find a pixel with minimum pixel value in the 8-neighborhood (or, 4-neighborhood, as the case may be) of the current pixel. Call this new pixel as the current pixel and go to step B.

To give you an example, when I started this above procedure at the pixel with value 88, I got:

10	100	20	2	15
75	6	30	11	3
19	43	38	45	5
1	22	0	← 17	100
12	7	5	100	88
16	66	59	44	23

After repeating this for all the pixels, I finally obtained the following watershed segmentation:

6	6	2	2	2
6	6	2	2	2
1	0	0	0	2
1	0	0	0	2
1	0	0	0	0
0	0	0	0	23