1 Matlab correction

1.1 LBP computation

Each pixel is given a specific 8 bits value according to a code as follows. The parfor loop is used for speed.

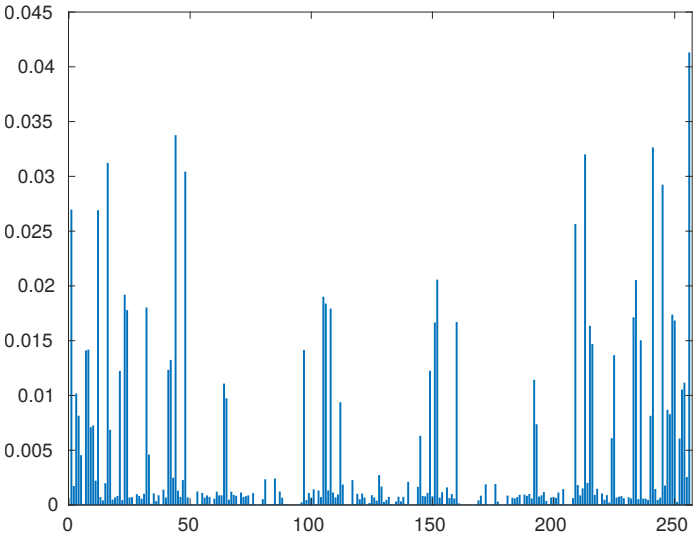
```
% binary code for pixel description
code = [1 2 4; 8 0 16; 32 64 128];

% loop over all pixels
parfor i=2:m-1
    for j=2:n-1
        w = A(i-1:i+1,j-1:j+1);
        w = (w >= A(i,j));
        w = w.*code;
        B(i,j) = sum(w(:));
    end
end
```

Then, all values (except for border values) are symmarized in the histogram.

```
B = B(2:end-1,2:end-1);
h = histcounts(B(:), 256, 'normalization', 'probability');
```

For the first image of sand, the histogram is shown in Fig.1.

(a) Texture image.



(b) LBP of texture.

Figure 1: Illustration of the Local Binary Pattern computed on an entire image.

1.2 Classification

For all images of the same family, the LBP are computed and represented in the same graph. The histograms really look similar (see Fig.2). The following code is used for the "sand" family.

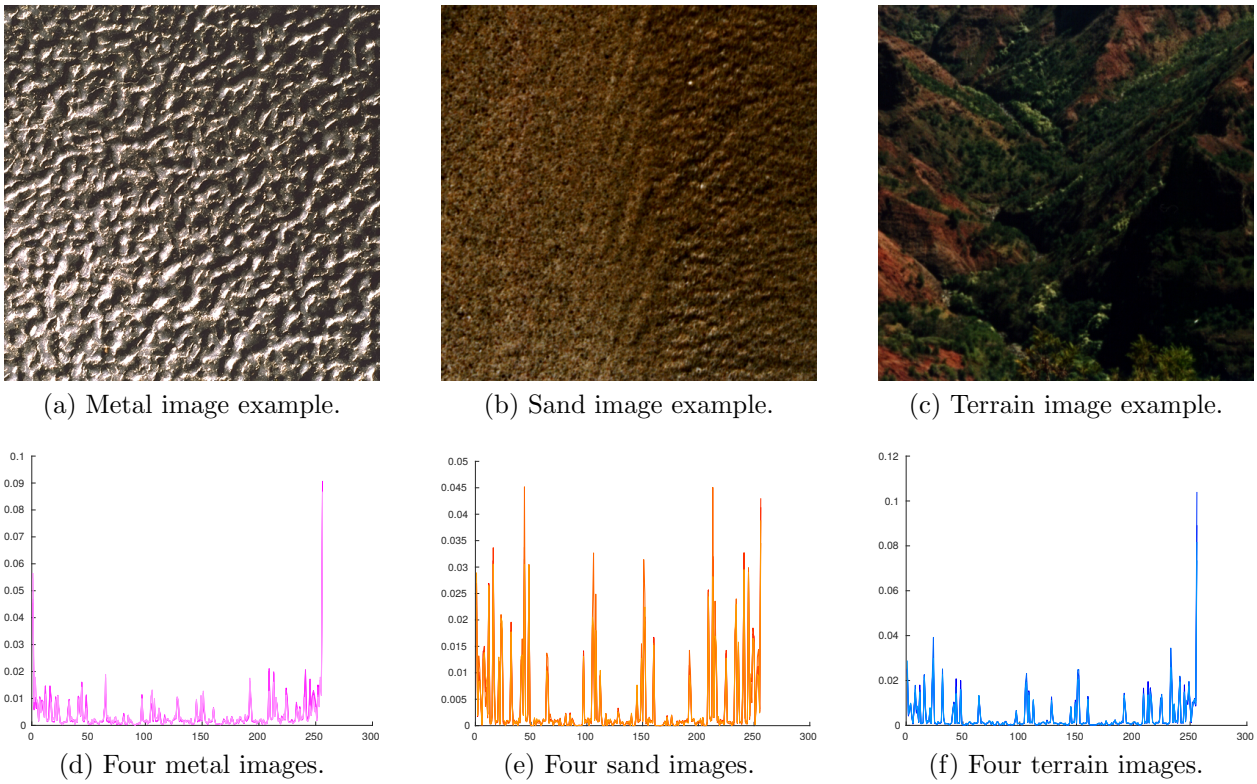
```
rep='images/';
name_image = 'Sand';
LBP_Sand = cell(1,4);

for i = 1:4
    A = imread(strcat(rep, name_image,'.',num2str(i),'.bmp'));
    A = rgb2gray(A);
    LBP_Sand{i} = LBP(A);
end

figure;
hold on;
corange = {[1 0 0],[1 0.2 0], [1 0.4 0], [1 0.6 0]};
for i=1:4
    plot(LBP_Sand{i},'color',corange{i});
end
```

A distance criterion is used to compare the different histograms: the classical SAD (Sum of Absolute Differences) gives a numerical values. All pairs of distances are concatenated in a matrix, displayed as an image in Fig.3.

```
LBP = [LBP_Terrain,LBP_Metal,LBP_Sand];
dist = zeros(12,12);
parfor i=1:12
    X(i,:) = LBP{i}';
    for j=1:12
        dist(i,j) = sum(abs(LBP{i}-LBP{j}));
    end
end

figure;
imagesc(dist);
colormap('gray');
```

The kmeans algorithm uses such a distance, and we can verify that the clustering process works as expected. The result is presented in the next box.

```
% labels 1-4, 5-8, 9-12 should be equal, respectively
label = kmeans(X,3,'replicates',5)'
```



(a) Metal image example. (b) Sand image example. (c) Terrain image example.

(d) Four metal images. (e) Four sand images. (f) Four terrain images.

Figure 2: Illustration of the LBP of 4 images of each family. The histogram are almost equivalent, which shows that this descriptor can be employed to discriminate between the different families.

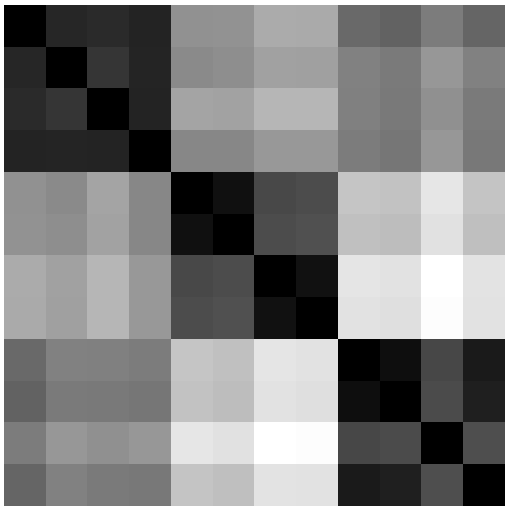


Figure 3: Sum of Absolute Differences between the different LBP histograms of each image. 3 families of 4 textures are represented here, terrain images are in the first part, metal images in the second and sand images in the last. Black represents 0 distance and white is 1 (highest distance, the values are normalized).

Command window

```
% the 3 families are well classified
label =    3    3    3    3    2    2    2    2    1    1    1    1
```