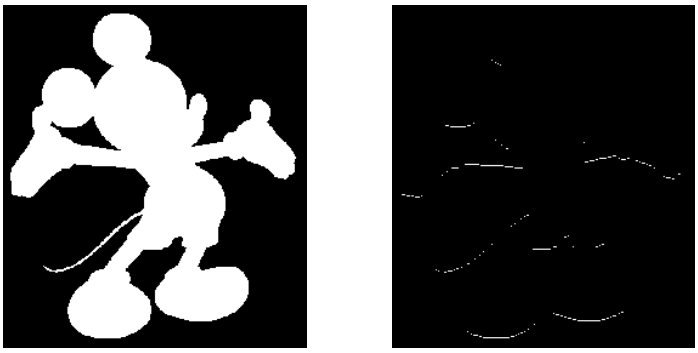
1 Matlab correction

Informations

Please notice that when using boolean arrays in matlab, the notations $1-X$ and $\sim X$ are equivalent. When using uint8 arrays, verify that the values range into [0;1].

1.1 Hit-or-miss transform

The hit-or-miss transform is illustrated in Fig.1.



(a) Original image. (b) Hit or miss result.

Figure 1: Hit or miss illustration for a given orientation.

```
function B=hitormiss(X,T)
% X is the binary image (values 0 or 1)
% T is the structuring element

T1=(T == 1);
T2=(T == -1);
B=min(imerode(X,T1),imerode(~X,T2));
```

1.2 Thinning and thickening

Thinning and thickening are dual operations. The second function could make a call to the first one. The code elementary follows the definition. The illustration is presented in Fig.2.

```
function B=elementary_thinning(X,T)
% thinning function
% X: binary image
% T: structuring element
B=X-hitormiss(X,T);
```

```
function B=elementary_thickening(X,T)
% thickening function
% X: binary image
% T: structuring element
B = min(X, ~hitormiss(X,T));
% equivalent notation:
% B = X-hitormiss(X,T);
```

(a) Thinning.

(b) Thickening.

Figure 2: Thinning and thickening.

1.3 Skeletons

The pairs of structuring elements are defined like this, in the 8 directions:

```
TT=cell(1,8);
TT{1}=[-1,-1,-1;0,1,0;1,1,1];
TT{2}=[0,-1,-1;1,1,-1;0,1,0];
TT{3}=[1,0,-1;1,1,-1;1,0,-1];
TT{4}=[0,1,0;1,1,-1;0,-1,-1];
TT{5}=[1,1,1;0,1,0;-1,-1,-1];
TT{6}=[0,1,0;-1,1,1;-1,-1,0];
TT{7}=[-1,0,1;-1,1,1;-1,0,1];
TT{8}=[-1,-1,0;-1,1,1;0,1,0];
```

Thus, the thinning operation is coded as:

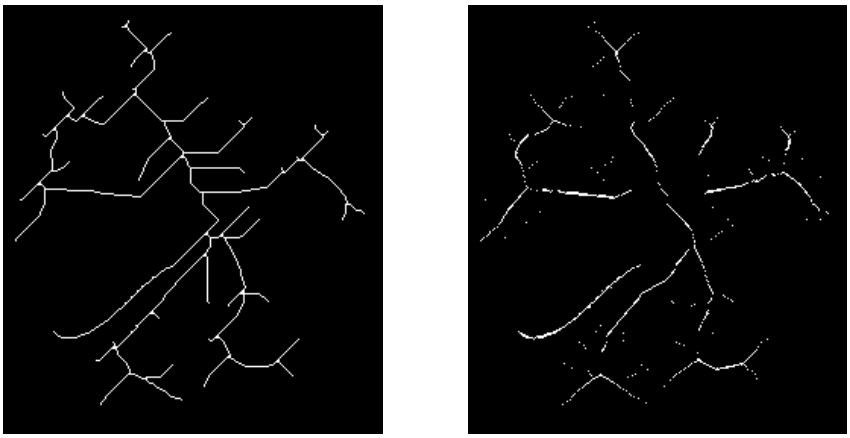
```
function B=thinning(A,TT)

B=A;
B=B-hitormiss(B,TT{1});
B=B-hitormiss(B,TT{2});
```

```
B=B-hitormiss(B,TT{3});
B=B-hitormiss(B,TT{4});
B=B-hitormiss(B,TT{5});
B=B-hitormiss(B,TT{6});
B=B-hitormiss(B,TT{7});
B=B-hitormiss(B,TT{8});
```

The topological skeleton is the iteration of the thinning with structuring elements in all 8 directions. It has the property of preserving the topology of the discrete structures, contrary to the morphological skeleton (see Fig.3.

```
% topological skeleton function
% X: binary image
% T: structuring element
function B=topological_skeleton(X,TT)
B2=X;
B=~B2;
while (isequal(B,B2)~=1)
    B=B2;
    B2=thinning(B,T);
end
```

```
function S=morphological_skeleton(X)
% morphological skeleton function
% X: binary image
S=zeros(size(X));
strel_size=0; % size of structuring element
pred=true;
while pred
    strel_size=strel_size+1;
    E=imerode(X,strel('disk',strel_size));
    if sum(E(:))==0
        pred=false;
    end
    S=max(S,E-imopen(E,strel('disk',1)));
end
```



(a) Topological skeleton. (b) Morphological skeleton.

Figure 3: Skeletons. The topology is not preserved in the morphological skeleton.