1 Matlab correction

1.1 Morphological granulometry

The code is straightforward from the definition. It consists on a loop over the different sizes of the structuring element.

```
% read image
A=imread('simulation.bmp');
A=logical(double(A)/255);

% visualisation
figure;imshow(A);
title('Original simulated image');
```

Different structuring elements shapes can be used, the most classical one being the disk. In order to suppress small objects, the function imreconstruct is used (see tutorial on morphological reconstruction).

```
% maximal radius size
N=35;

% array of areas and numbers
areas=zeros(N, 1);
number=zeros(N,1);
area0=sum(A(:));
nbre0=bweuler(A);
% loop over the different sizes
for i=0:N
    se = strel('disk', i, 0); % structuring element
    C = imopen(A, se);        %
    C = imreconstruct(C,A);   % suppress small objects
    areas(i) = sum(C(:))/area0*100;  % normalized area
    number(i)=bweuler(C)/nbre0*100;% Euler number
end
```

The results are displayed using the following commands, and reproduced in Fig. 1. The function diff is used to evaluate a discrete derivative.

```
% display the results
figure;
subplot(121);plot(0:N,areas,'-xr');title('Granulometry');
hold on; plot(0:N,number,'-xb');legend('area analysis','number analysis')
    ↪ ;
% finite difference analysis
```

```
diff_areas = -diff(areas);
diff_number = -diff(number);
subplot(122);
plot(0:N-1,diff_areas,'-xr');title('Finite differences');
hold on; plot(0:N-1,diff_number,'-xb');
legend('area analysis','number analysis');
```

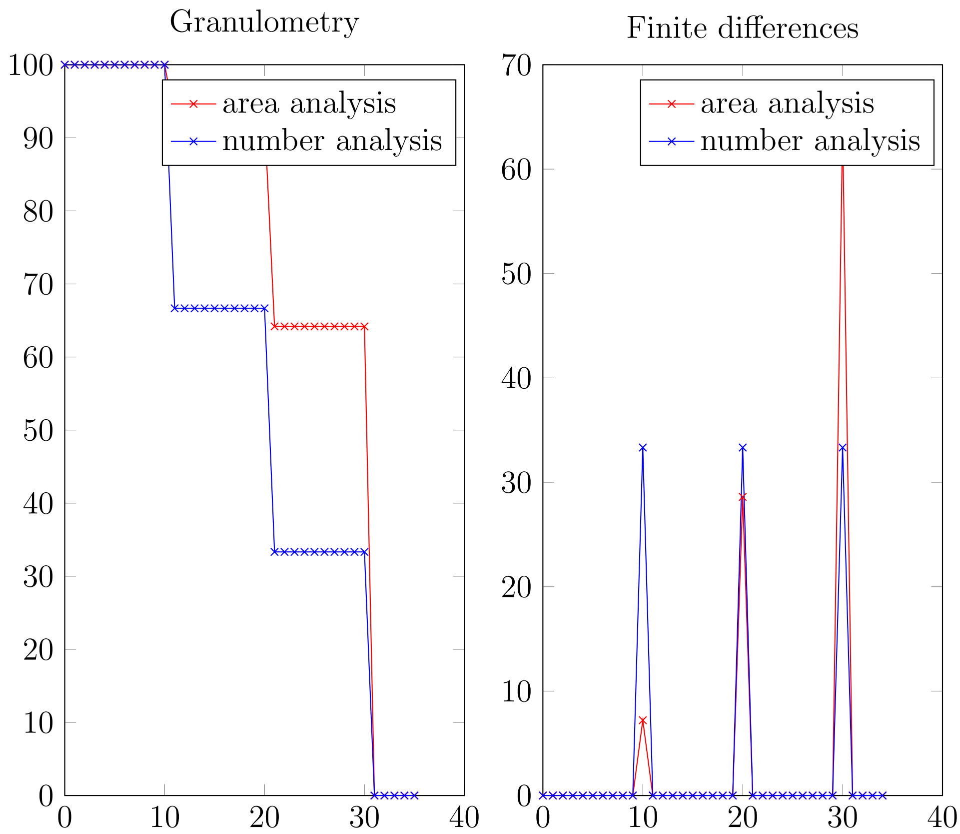


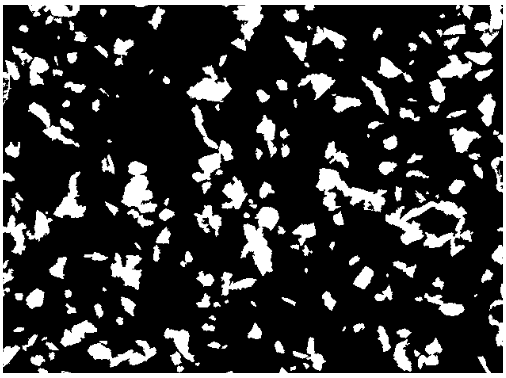
Figure 1: Granulometry and finite differences for the synthetic image of disks.

1.2 Real application

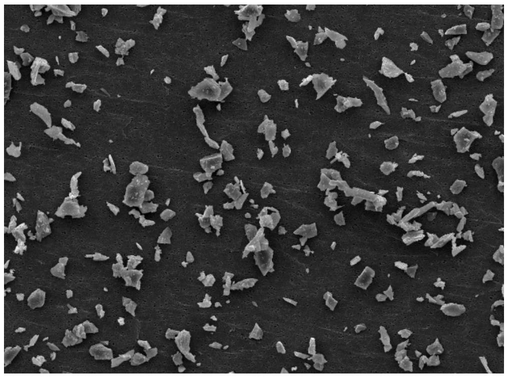
The code is exactly the same as the previous one, taking a binary image as input. The powder image is segmented using a threshold at value 74, and applying some filtering processes (see result in Fig. 2).

```
B=imread('poudre.bmp');
% threshold
imThresh=(B>74);
% fill holes
```

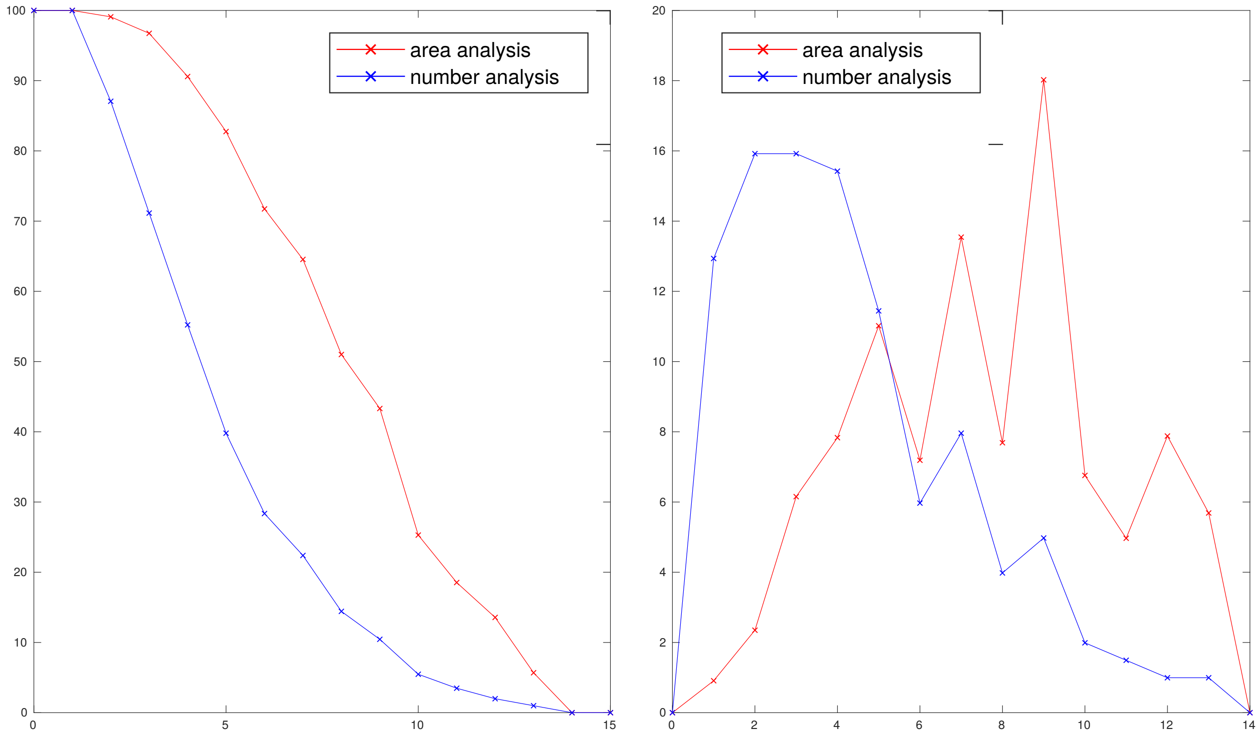
```
imHoles=imfill(imTresh,'holes');
% suppress small objects
se = strel('disk',1);
C = imopen(imHoles,se);
imSegmented=imreconstruct(C,imHoles);
% visualisation images
figure;
subplot(121);imshow(B,[]);colormap('gray');title('Original image of silicium');
subplot(122);imshow(imSegmented);colormap('gray');title('Segmented image');
```



(a) Segmented image.



(b) Original image.



(c) Granulometry evaluation on the powder image.

Figure 2: Illustration of grain analysis, in size and number, on a powder image.