

Scale-Space Blob Detectors

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1 LoG filter kernel size

2 Speed comparison

Down-sampling the image was significantly faster than changing the filter size.

Input image	Time [ms] changing filter size	Time[ms] down-sampling the image
sunflowers.jpg	247.194	104.404
fruits.jpg	359.280	136.804
water_texture.jpg	302.661	139.446

Down-sampling the image takes some processing time. However, after it is done, all subsequent convolution operations are simplified and require less time to complete.

3 Scale-space selection

Our parameters are:

$$\sigma_0 = \frac{R_{min}}{\sqrt{2}} = \frac{2}{\sqrt{2}}$$
$$s = [1.2, 1.6] \quad \text{We tuned the parameter to obtain desired results.}$$
$$k = 0, 1, 2 \dots 20$$

4 Down-sampling image - scale

We selected σ_0 the same way $\sigma_0 = \frac{R_{min}}{\sqrt{2}}$. The image is then scaled down with factor s^k , while keeping σ constant $\sigma = \sigma_0$.

In the first iteration, the scale is not changed s^0 .

5 Down-sampling image - normalization

As σ increases, derivatives are attenuated. We need to normalize the filter response by multiplying it by σ^2 .

However, when down-sampling the image, we keep σ constant. Therefore, it is not necessary to normalize the filter response.

6 Non-maximum suppression function

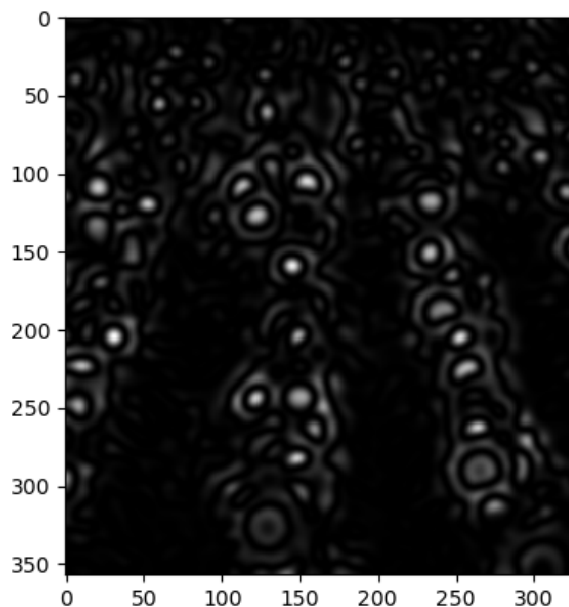


Figure 1: Filter response

Figure 1 shows the filter response. The goal of the non-maximum suppression function is to find the local maxima of the filter response. Some blobs are filtered using thresholds. Overlapping blobs are removed as well.

7 Other images

By default, the LoG filter looks for dark blobs.

For image *sunflowers.jpg* we squared the filter response. It is because we are looking for dark as well as light blobs. Therefore, squaring the filter response makes it positive everywhere and we can find dark/light blobs based on the amplitude.

```
filtered = ndimage.gaussian_laplace(image, sigma=s)**2
```

For image *water_texture.jpg* we kept the original filter (no changes in sign or squaring the response). It is because we are looking for dark blobs only.

```
filtered = ndimage.gaussian_laplace(image, sigma=s)
```

For image *fruits.jpg* we multiplied the filter response by -1. It is because we are looking for light blobs only.

```
filtered = -ndimage.gaussian_laplace(image, sigma=s)
```

8 Sample images

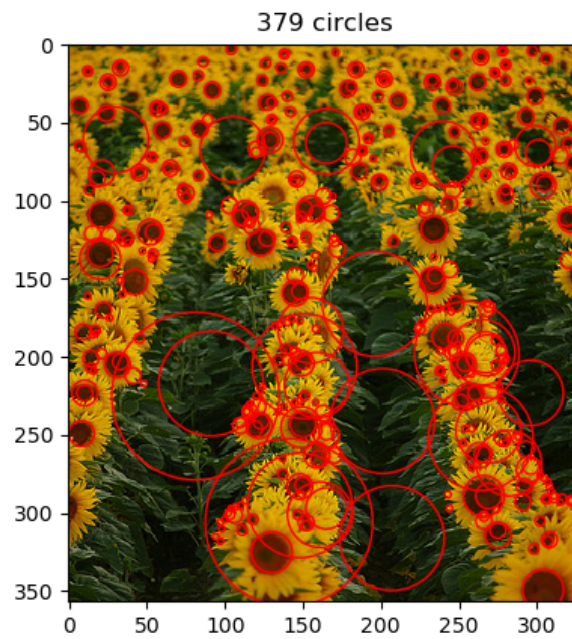


Figure 2: *sunflowers.jpg* processed by changing filter size

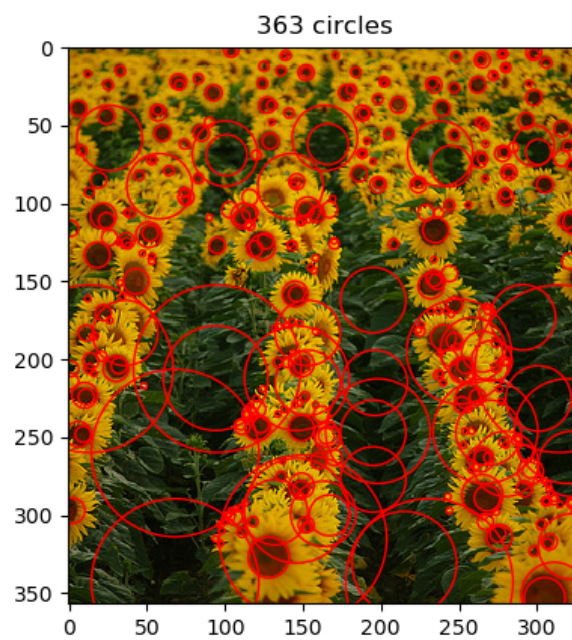


Figure 3: *sunflowers.jpg* processed by changing image size

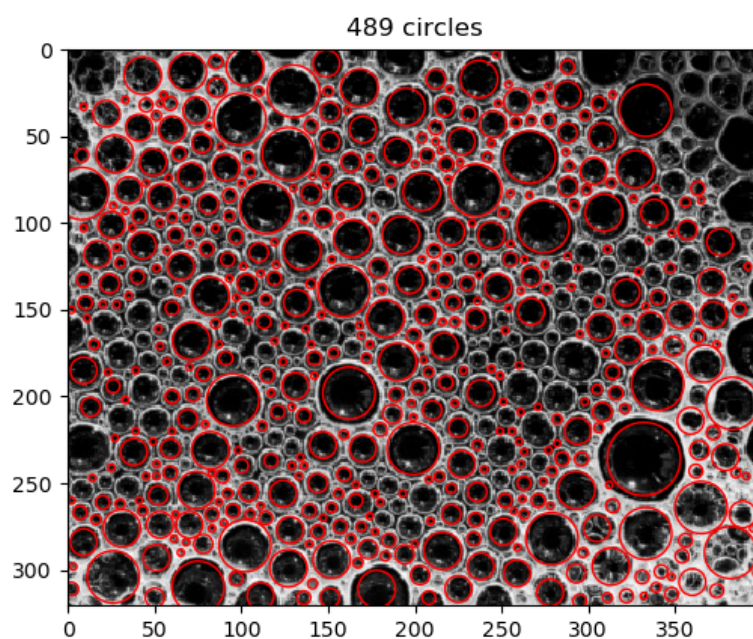


Figure 4: *water_texture.jpg* processed by changing filter size

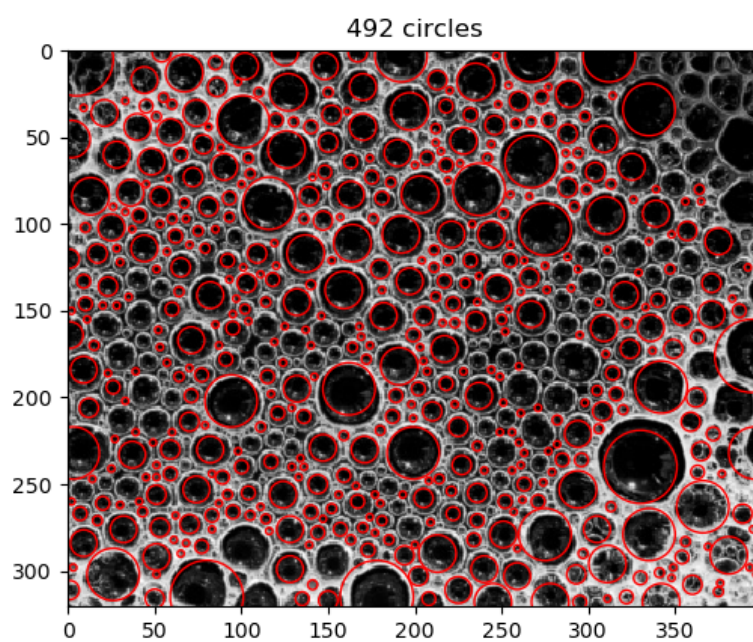


Figure 5: *water_texture.jpg* processed by changing image size

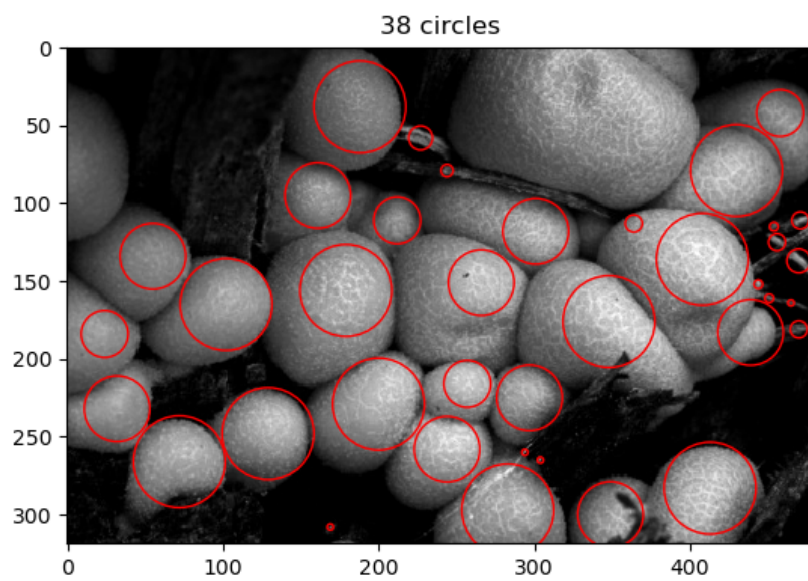


Figure 6: *fruits.jpg* processed by changing filter size

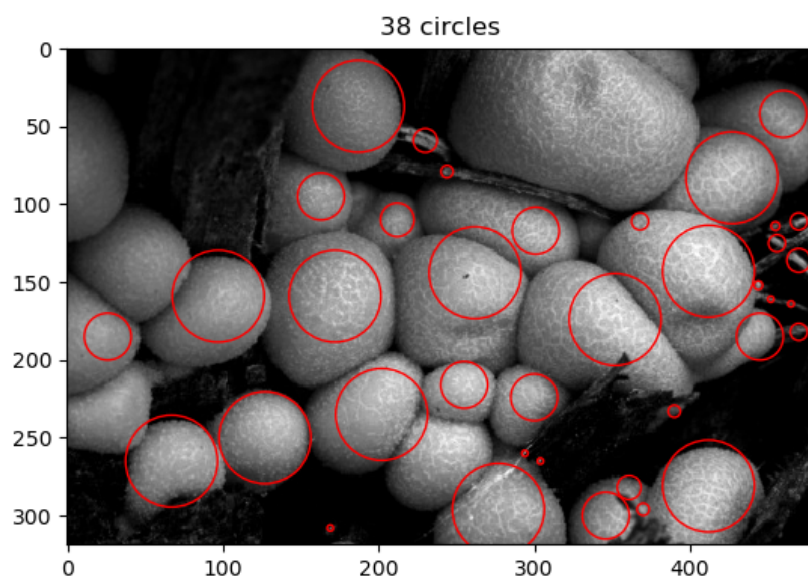


Figure 7: *fruits.jpg* processed by changing image size