REPORT ASSIGNEMNT 3

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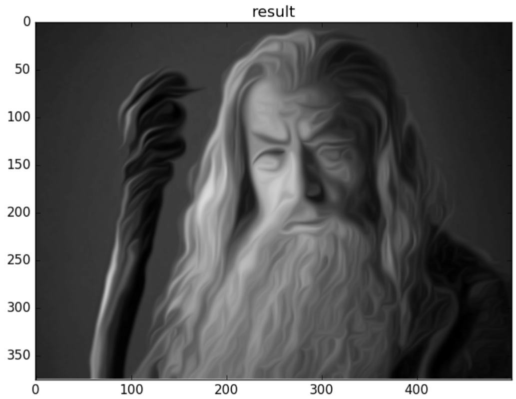
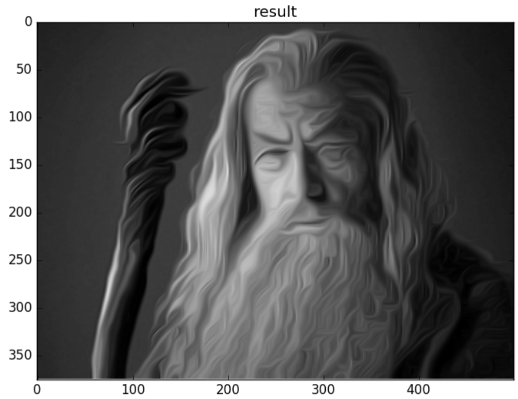
1. Use your own Images and experiment with the Parameters! Can you describe the Effects controlled by α and γ?

The standard values of $\alpha = 0.0005$ and $\gamma = 0.0001$. Let's take a look to change them:

- Change α: The bigger alpha, the bigger is the line width. If alpha is 1, then it ignores the edges completely.

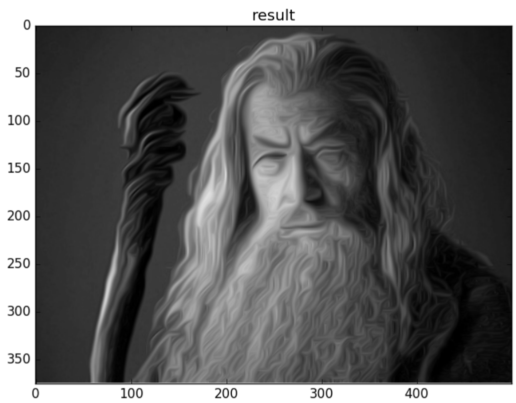


(A) $\alpha = 0.005$

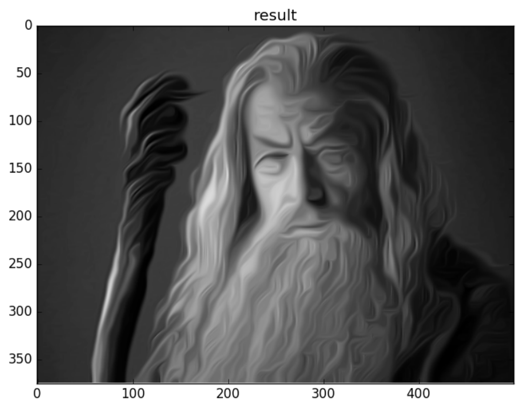


(B) $\alpha = 0.00005$

- Change γ: If the $\gamma = \infty$ is very big $\lambda_2 = \lambda_1 = \alpha$. If the γ is a big number, then the exponent in e is getting bigger because of the negative sign, this means the λ_2 is getting smaller.

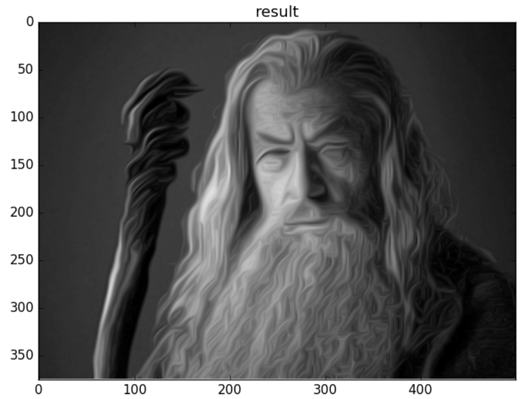


(C) $\gamma = 0.001$



(D) $\gamma = 0.000001$

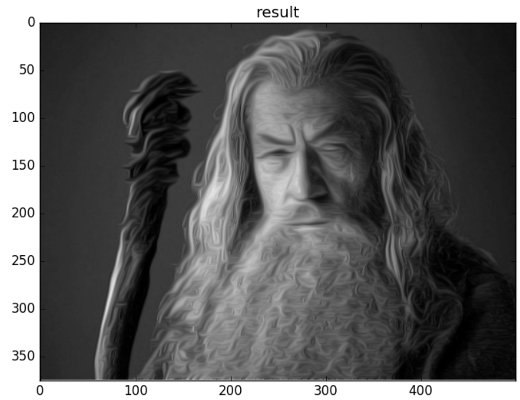
- Change α, γ



(E) $\gamma = 0.001$, $\alpha = 0.005$

(F) $\gamma = 0.000001$, $\alpha = 0.000005$

(G) $\gamma = 0.001$, $\alpha = 0.000005$



(H) $\gamma = 0.000001$, $\alpha = 0.005$

Conclusio: α effects the diffusion to orthogonal direction to the edge and γ into the direction of the edge.

2. Try a different discretization of the nabla Operator (make_Derivatives_hp_sym_2D). What is the corresponding filter kernel that is implemented by this Discretization? How does it change the result?

First, I feed the function with a shape of 3x3 matrix:

$$\begin{bmatrix} 0 & 1 & 2 \\ 3 & 4 & 5 \\ 6 & 7 & 8 \end{bmatrix} \tag{2.1}$$

OK, the function returns two arrays [9x9] with following values and the 2 middle diagonals of K_x and K_y have the opposite signs.

K_x :

```
[[-0.5  0.5  0.  -0.5  0.5  0.   0.   0.   0. ]
 [ 0.  -0.5  0.5  0.  -0.5  0.5  0.   0.   0. ]
 [ 0.   0.   0.   0.   0.   0.   0.   0.   0. ]
 [ 0.   0.   0.  -0.5  0.5  0.  -0.5  0.5  0. ]
 [ 0.   0.   0.   0.  -0.5  0.5  0.  -0.5  0.5]
 [ 0.   0.   0.   0.   0.   0.   0.   0.   0. ]
 [ 0.   0.   0.   0.   0.   0.   0.   0.   0. ]
 [ 0.   0.   0.   0.   0.   0.   0.   0.   0. ]
 [ 0.   0.   0.   0.   0.   0.   0.   0.   0. ]]
```

K_y:

```
[[-0.5 -0.5  0.   0.5  0.5  0.   0.   0.   0. ]
 [ 0.  -0.5 -0.5  0.   0.5  0.5  0.   0.   0. ]
 [ 0.   0.   0.   0.   0.   0.   0.   0.   0. ]
 [ 0.   0.   0.  -0.5 -0.5  0.   0.5  0.5  0. ]
 [ 0.   0.   0.   0.  -0.5 -0.5  0.   0.5  0.5]
 [ 0.   0.   0.   0.   0.   0.   0.   0.   0. ]
 [ 0.   0.   0.   0.   0.   0.   0.   0.   0. ]
 [ 0.   0.   0.   0.   0.   0.   0.   0.   0. ]
 [ 0.   0.   0.   0.   0.   0.   0.   0.   0. ]]
```

How come? I just try it for K_x. Parts of the matrix (formua 2.1) are taken and sticked together. Afterwards, they are flatten row by row.

```
i :          j :
0 1          0 1
3 4          3 4
———          ———
0 1          1 2
3 4          4 5
———          ———
0 1          3 4
3 4          6 7
———          ———
0 1          3 4
3 4          6 7
```

In the end, you can read out the following values at index (i,j). Those values are multiplied with the image itself. This values are calculated only for K_x. The same is done with the K_y direction, just some $(-)0.5$ are different.

```
i:  [[0][1][3][4][0][1][3][4][0][1][3][4][0][1][3][4]]
j:  [[0][1][3][4][1][2][4][5][3][4][6][7][3][4][6][7]]
v: [[-0.5][-0.5][-0.5][-0.5][ 0.5][ 0.5][ 0.5][ 0.5]
    [-0.5][-0.5][-0.5][-0.5][ 0.5][ 0.5][ 0.5][ 0.5]]
```

As ∇ operator we vstack K_x and K_y. As you can see the submatrix, is never used:

$$\begin{bmatrix} 4 & 5 \\ 7 & 8 \end{bmatrix} \tag{2.2}$$

Because of that the gradient is not fair in all directions and you can see as an example that the left eyelid (our point of view) in the image. If you look to the image 2.3 the eyelid starts horizontal and then it follows the round form of the eye ball. In image 2.4 it does not start with a horizontal line. The shape is flexed from the beginning.

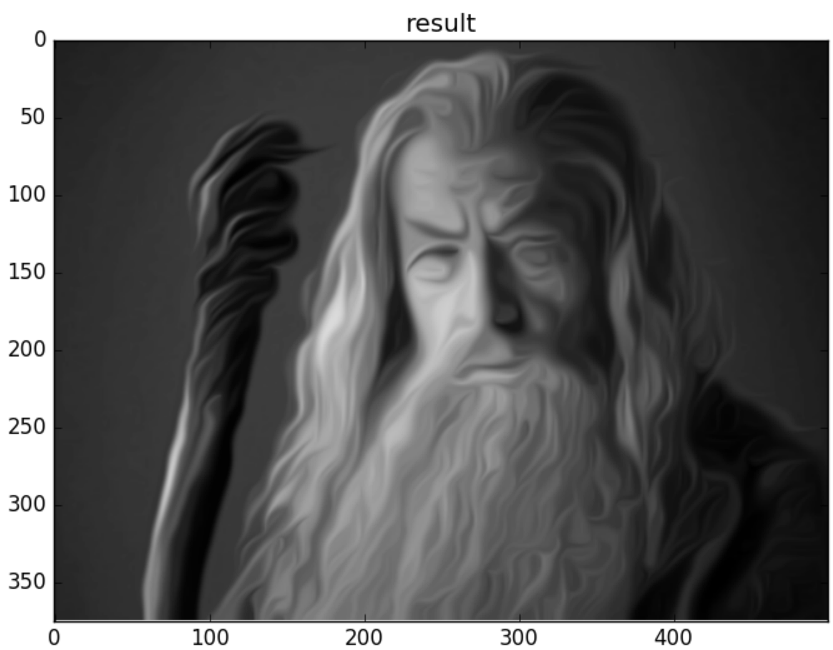


FIGURE 2.1. make_derivatives_2D (375 x 500)

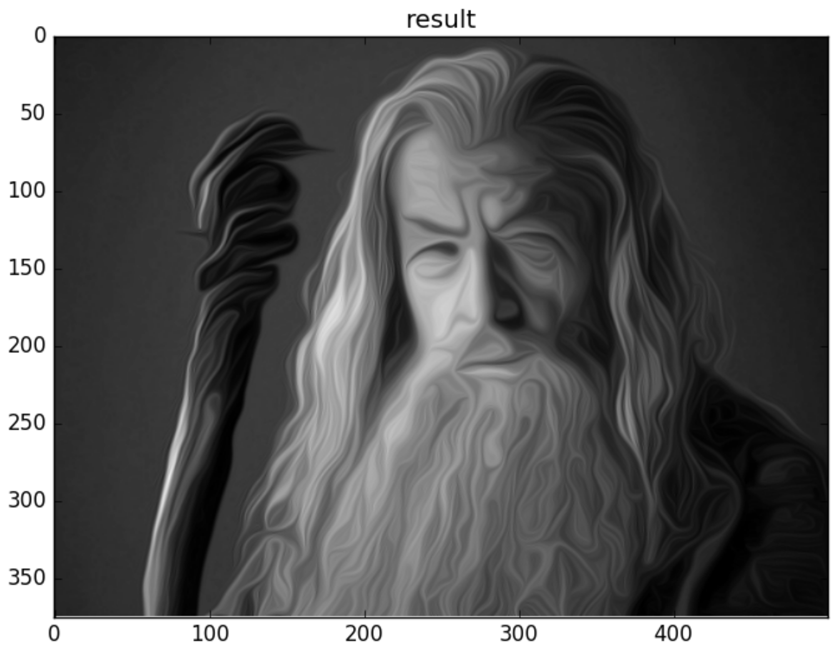


FIGURE 2.2. make_derivatives_hp_sym_2D (375 x 500)

FIGURE 2.3. make_derivatives_2D (758 x 1024)

FIGURE 2.4. make_derivatives_hp_sym_2D (758 x 1024)

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