PROGRAMMING ASSIGNMENT #2

SIGNALS & SYSTEMS

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CODE EXPLANATION
COMPLEX CLASS

```cpp
class Complex {
public:
    double a, b; //real part, imaginary part
    Complex(double _a, double _b): a(_a), b(_b) {}
    Complex operator+(const Complex &other) {
        Complex res(a, b);
        res.a += other.a;
        res.b += other.b;
        return res;
    }
    Complex operator-(const Complex &other) {
        Complex res(a, b);
        res.a -= other.a;
        res.b -= other.b;
        return res;
    }
    Complex operator* (const Complex &other) const {
        return Complex(a*other.a-b*other.b, a*other.b + b*other.a);
    }

    Complex& operator=(const Complex &other) {
        return (*this);
    }
    Complex& operator+=(const Complex &other) {
        a += other.a;
        b += other.b;
        return (*this);
    }

    double getSize() const {
        return sqrt(a*a+b*b);
    }
};
```
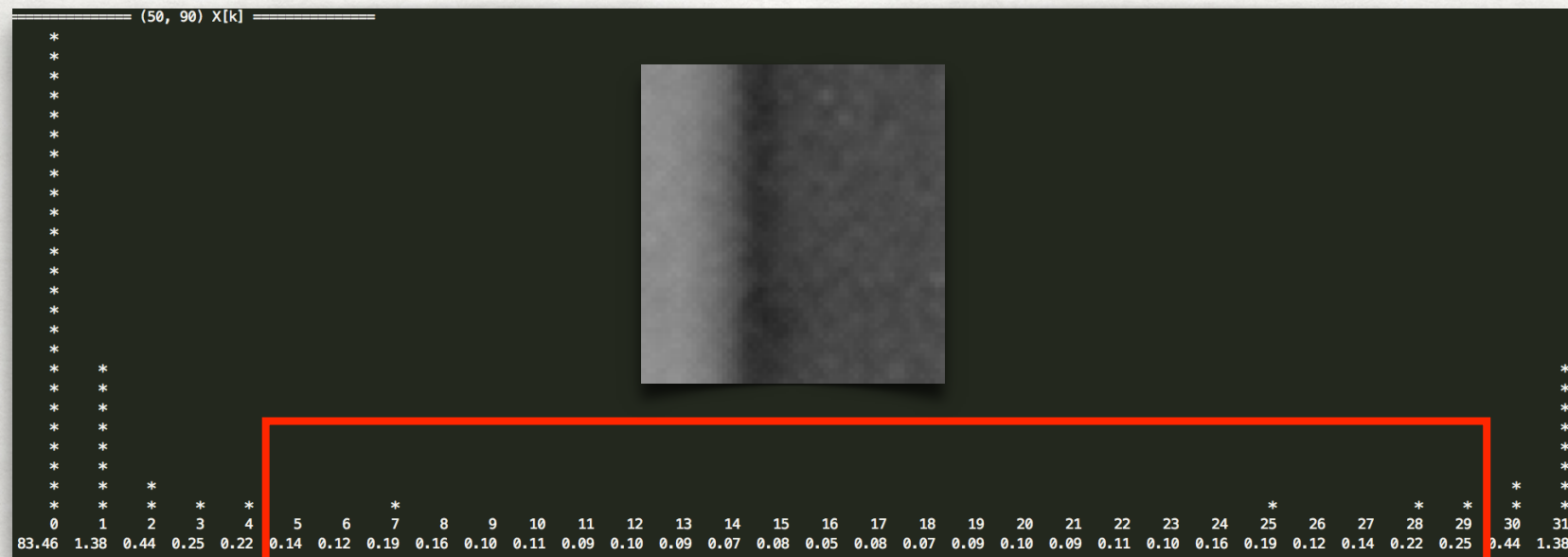
CODE EXPLANATION

DTFS

- To get the average values of X[k] among the each row/column, the value added is divided by *rect.height*

```cpp
//X[k] = 1/N sigma n=0 to 31 x[n]e^(-jk(2pi/N)n)
vector<Complex> getXaxisCoeiff(const cv::Mat &img, const cv::Rect &rect) {
    vector<Complex> X(rect.height, {0, 0});
    const int N = rect.width;
    for (int i=0; i<rect.height; i++) {
        int cy = rect.y + i;
        for (int k=0; k<N; k++) {
            for (int n=0; n<N; n++) {
                int cx = rect.x + n;
                X[k] += double(img.at<unsigned char>(cx, cy)) * ej(-k * 2* PI / double(N) * n)
                                                / double(N*rect.height);
            }
        }
    }

    return X;
}
```
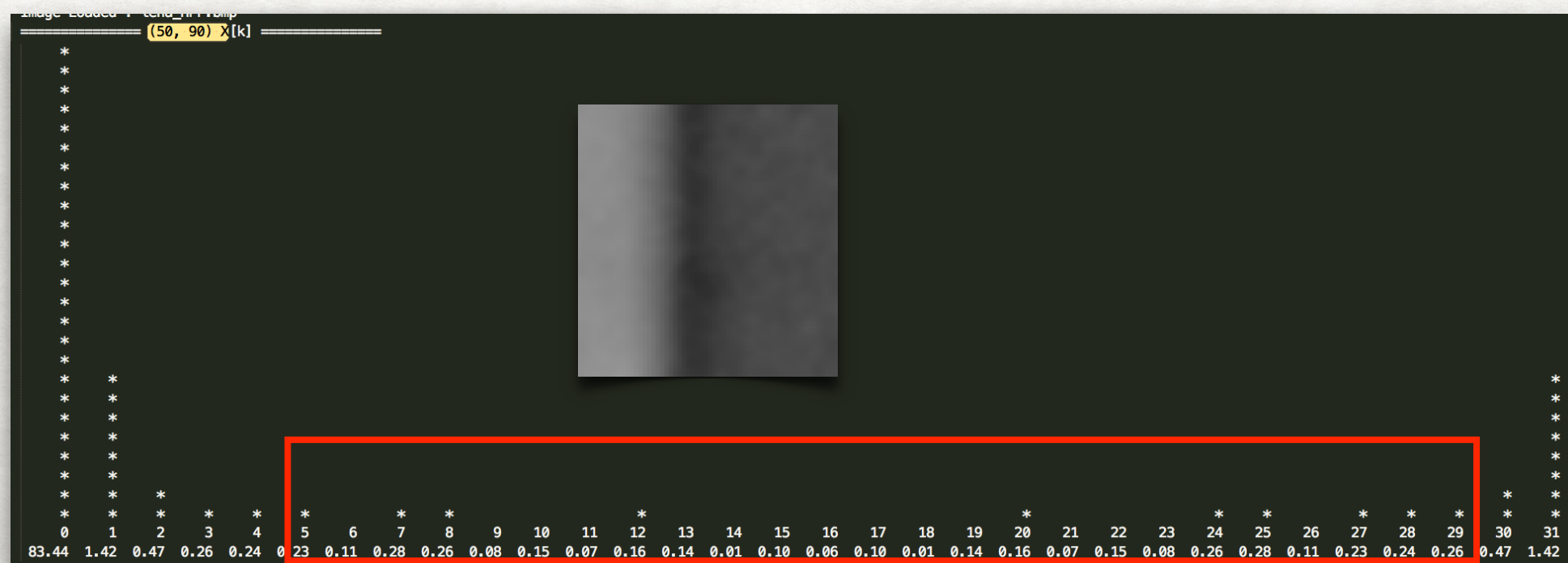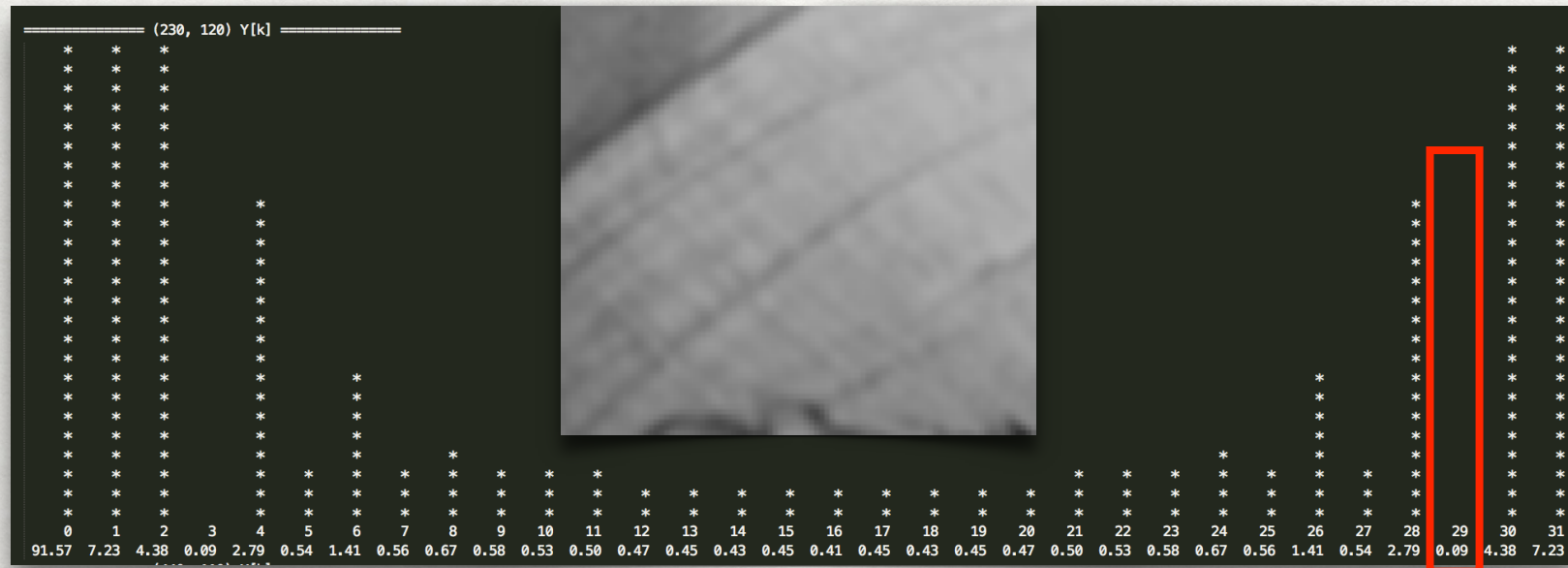
RESULT
ORIGINAL VS HPF

There is more considerable changes
with X[k] than Y[k]
because of the direction of stripes.
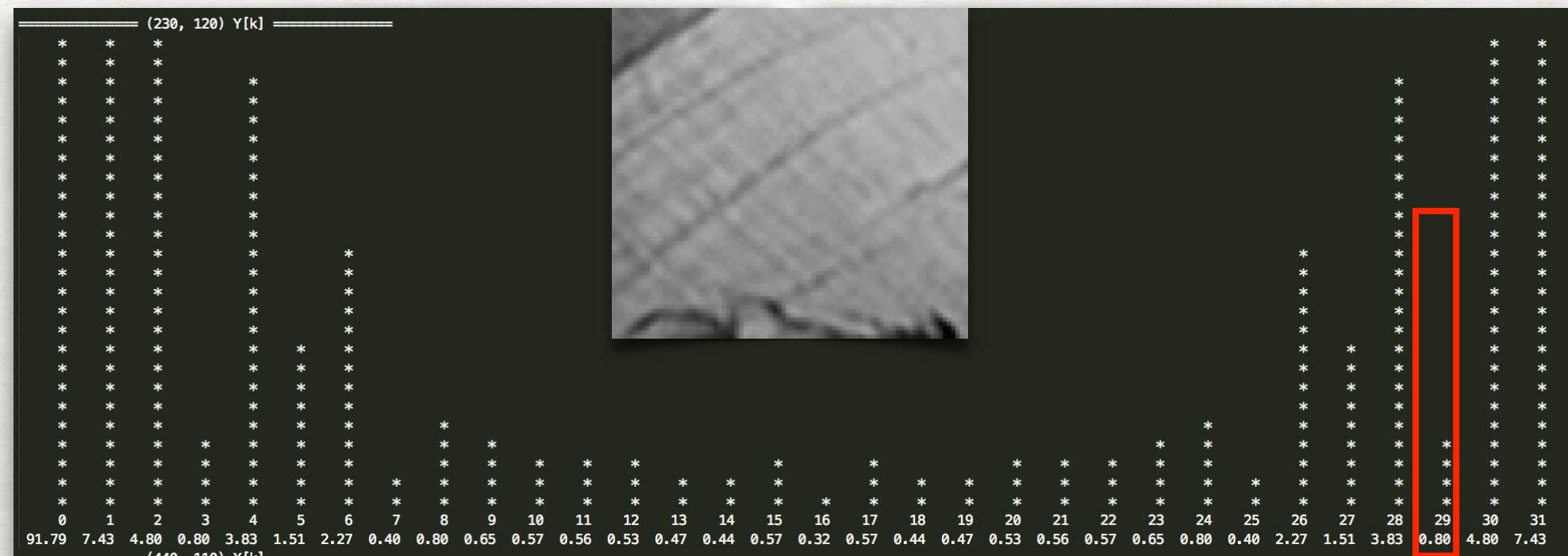
It makes the borders distinct between areas
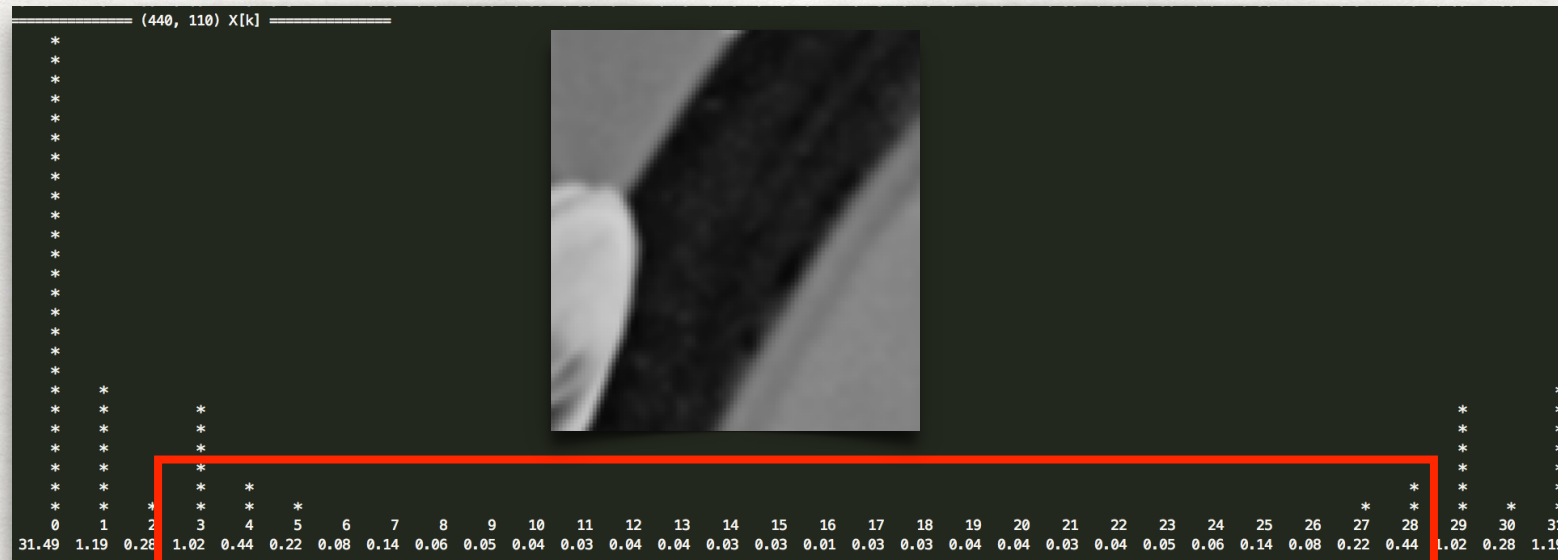
RESULT
ORIGINAL VS HPF

There is more considerable changes
with Y[k] than X[k]
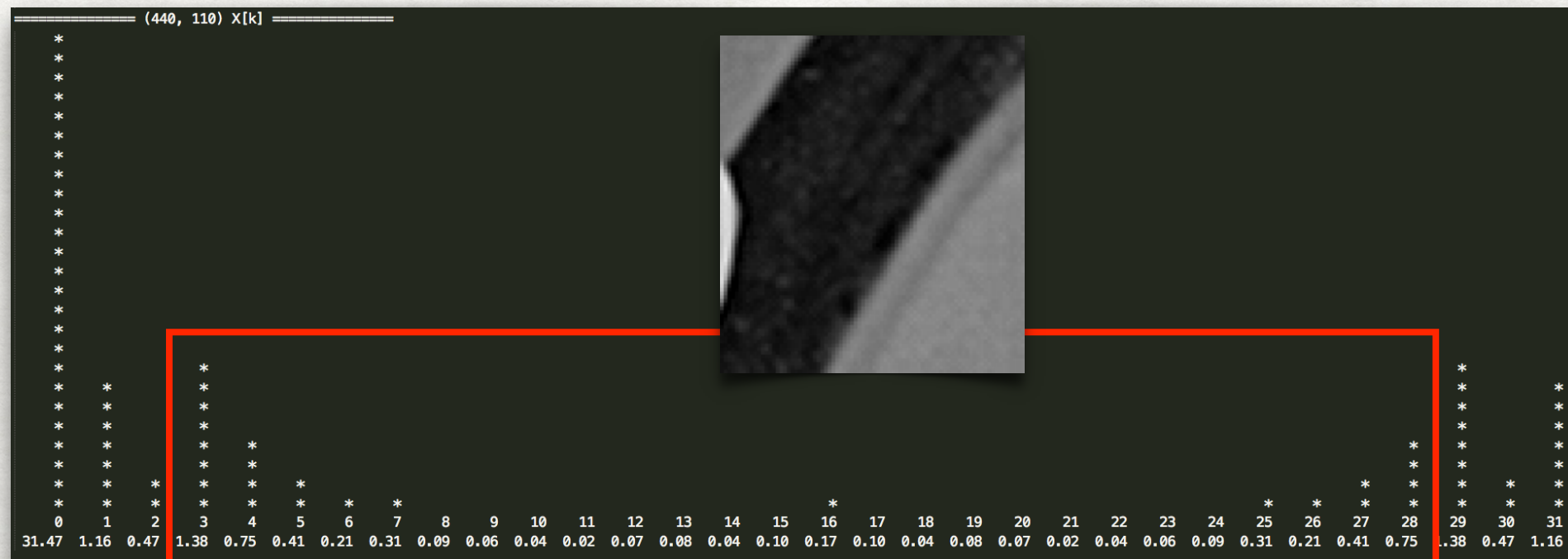because of the direction of stripes.

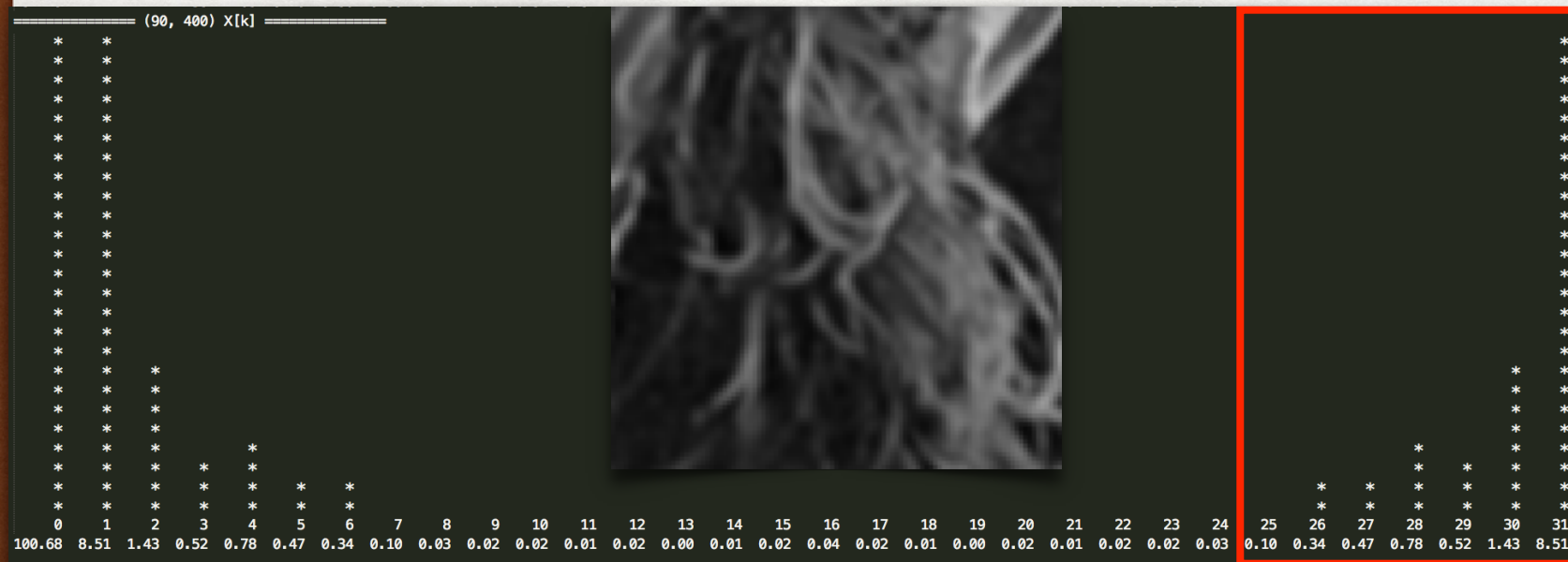**High-frequency component appears**

RESULT
ORIGINAL VS HPF

There is more considerable changes
with X[k] than Y[k]
because of the direction of arc.
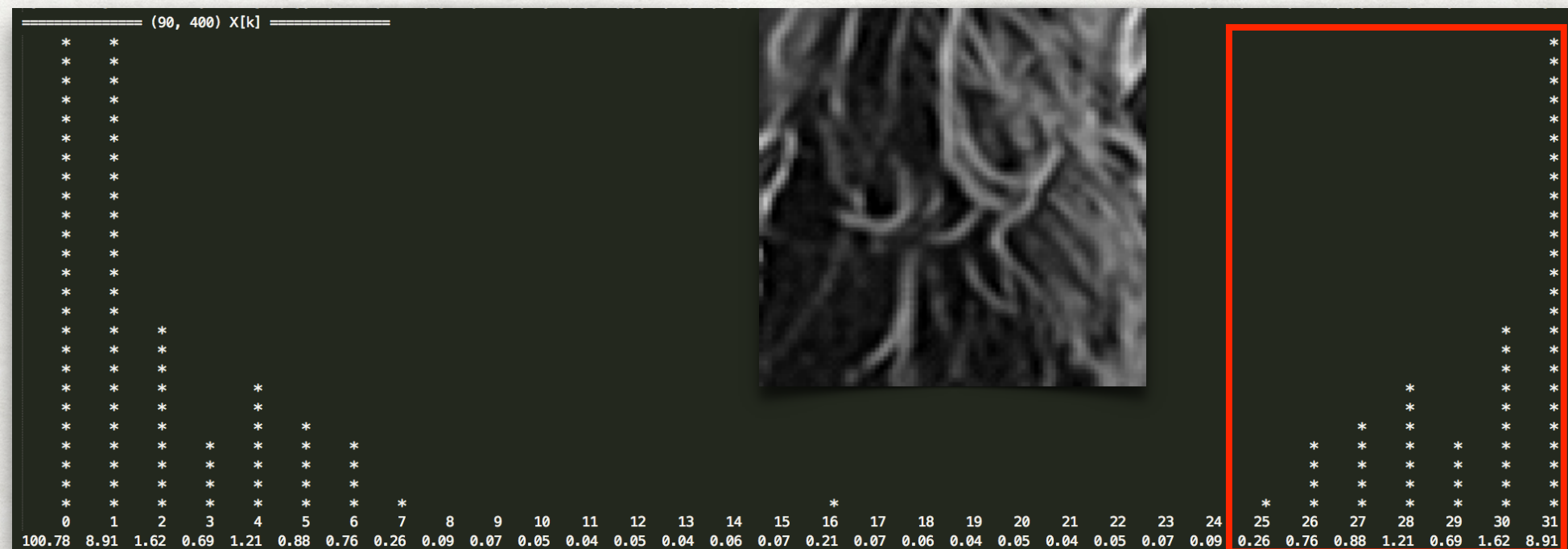
It makes the borders distinct between areas slightly
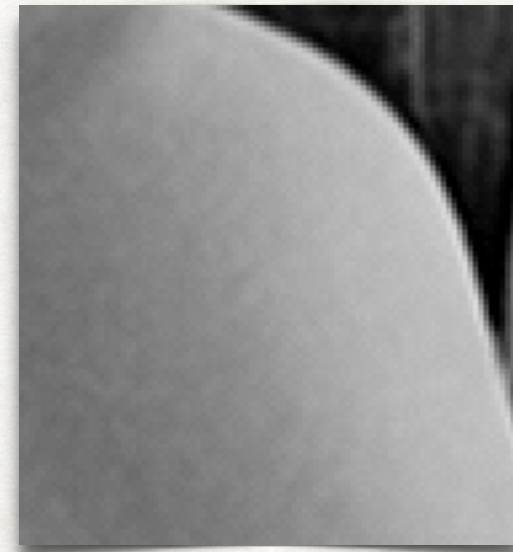
RESULT
ORIGINAL VS HPF

There is more considerable changes
with X[k] than Y[k]
because of the direction of hair grown.

High-frequency component appears
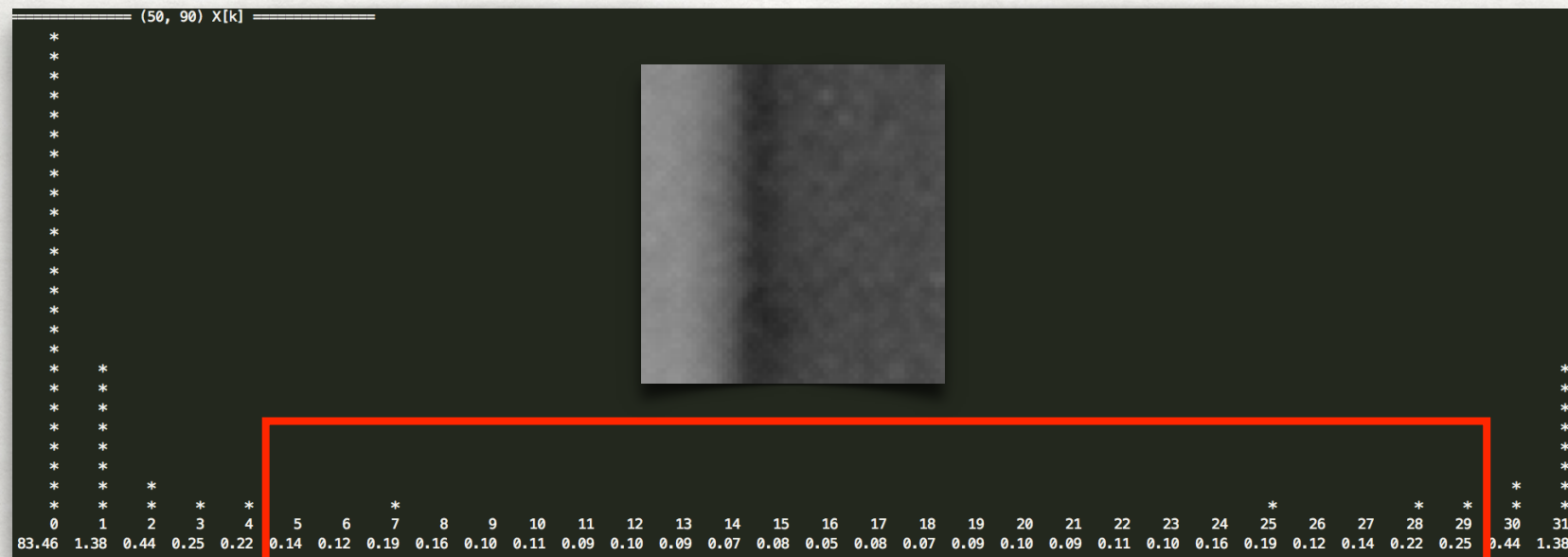
RESULT
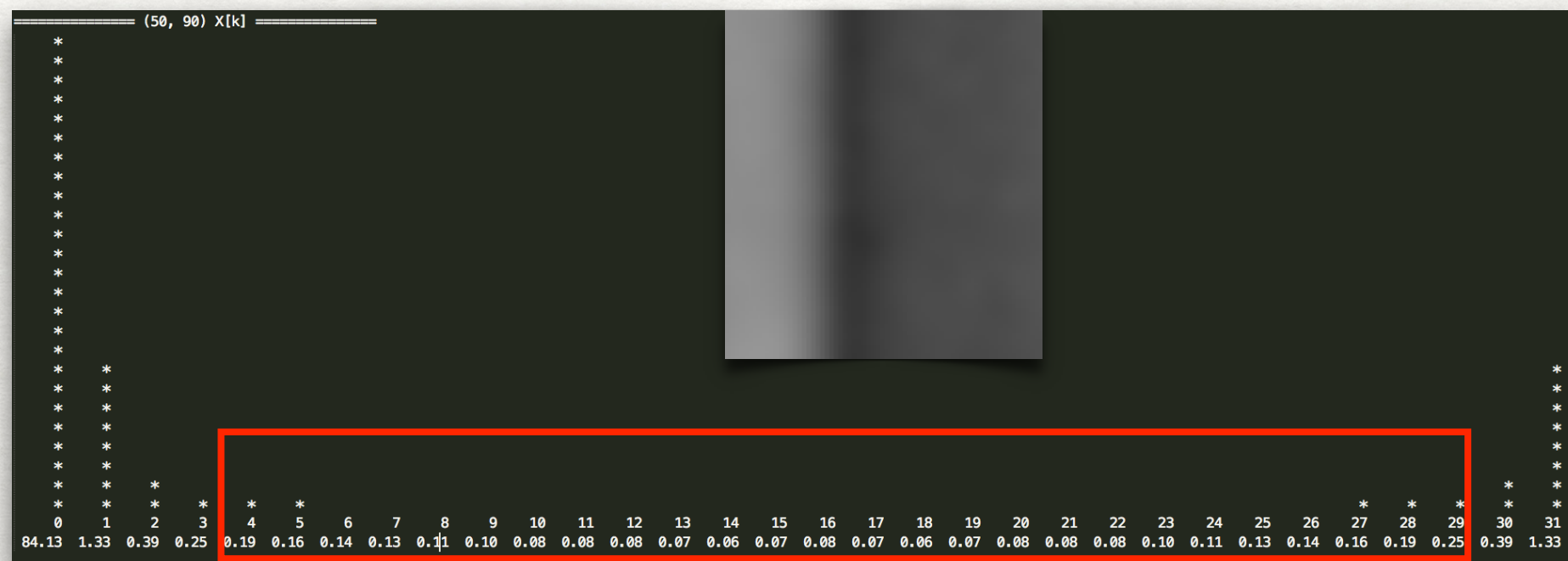## ORIGINAL VS HPF

HPF does almost nothing

RESULT
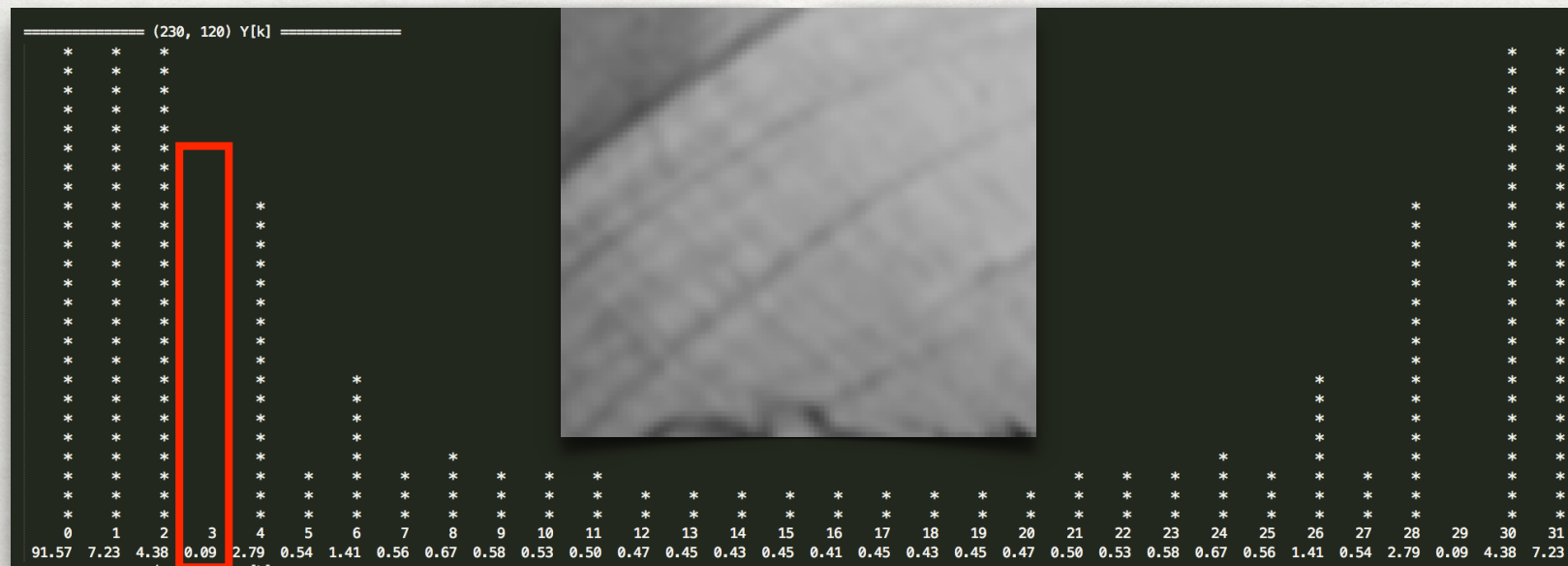## ORIGINAL VS GAUSSIAN LPF

There is more considerable changes
with X[k] than Y[k]
because of the direction of stripes.

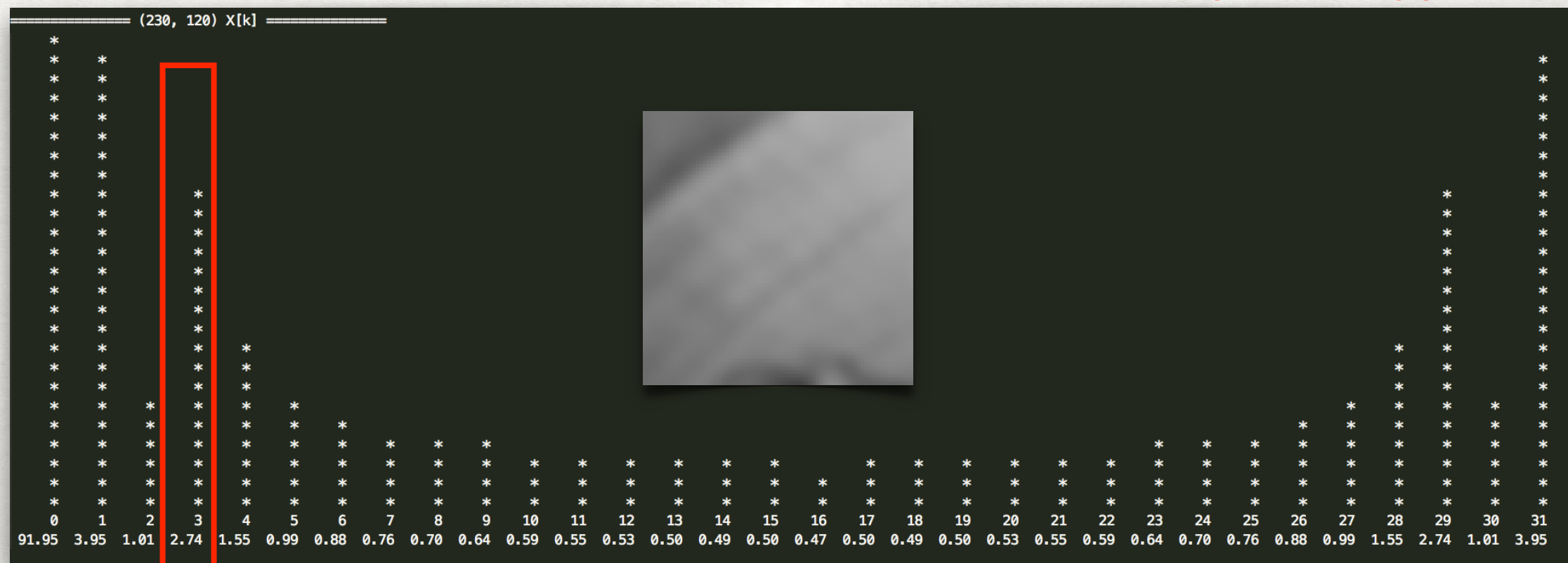It makes the borders blurred between areas
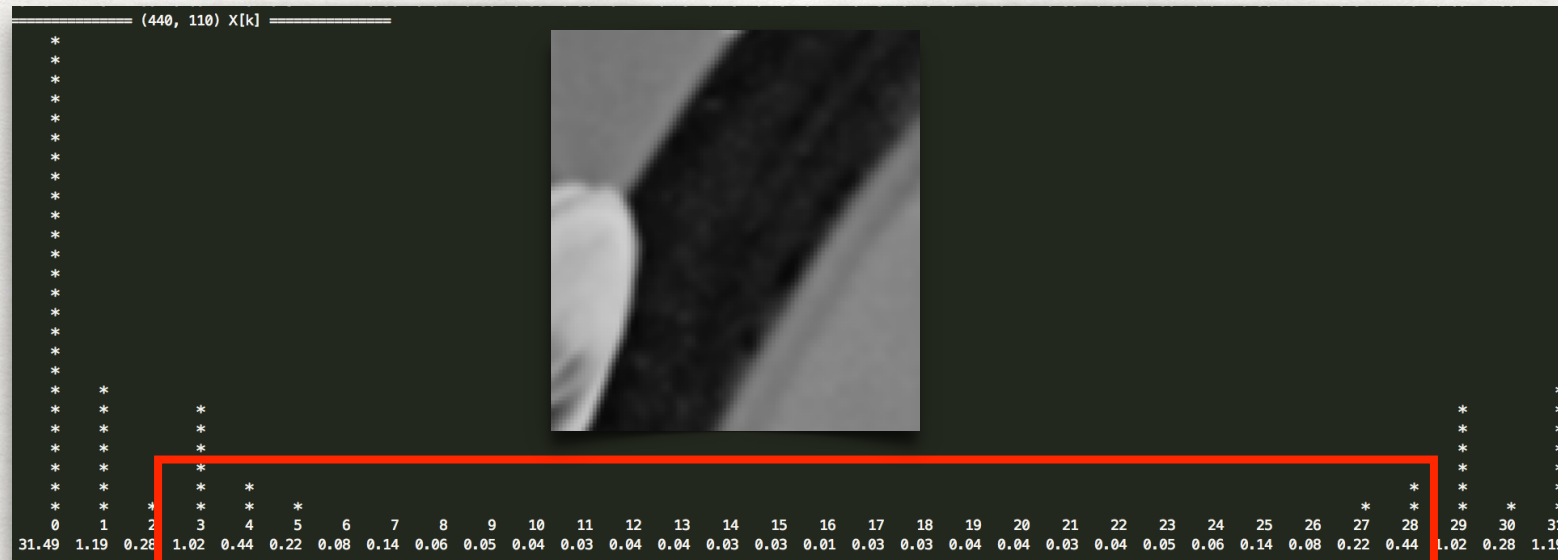
RESULT
ORIGINAL VS GAUSSIAN LPF

There is more considerable changes
with Y[k] than X[k]
because of the direction of stripes.
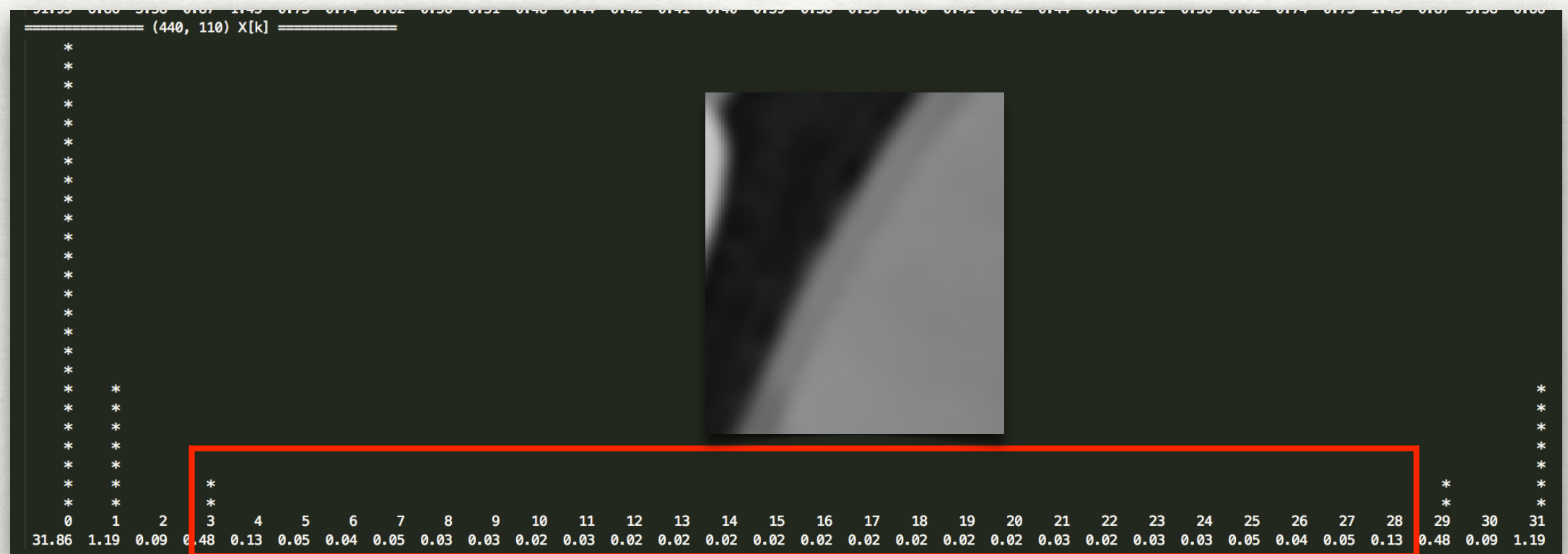
Low-frequency component appears
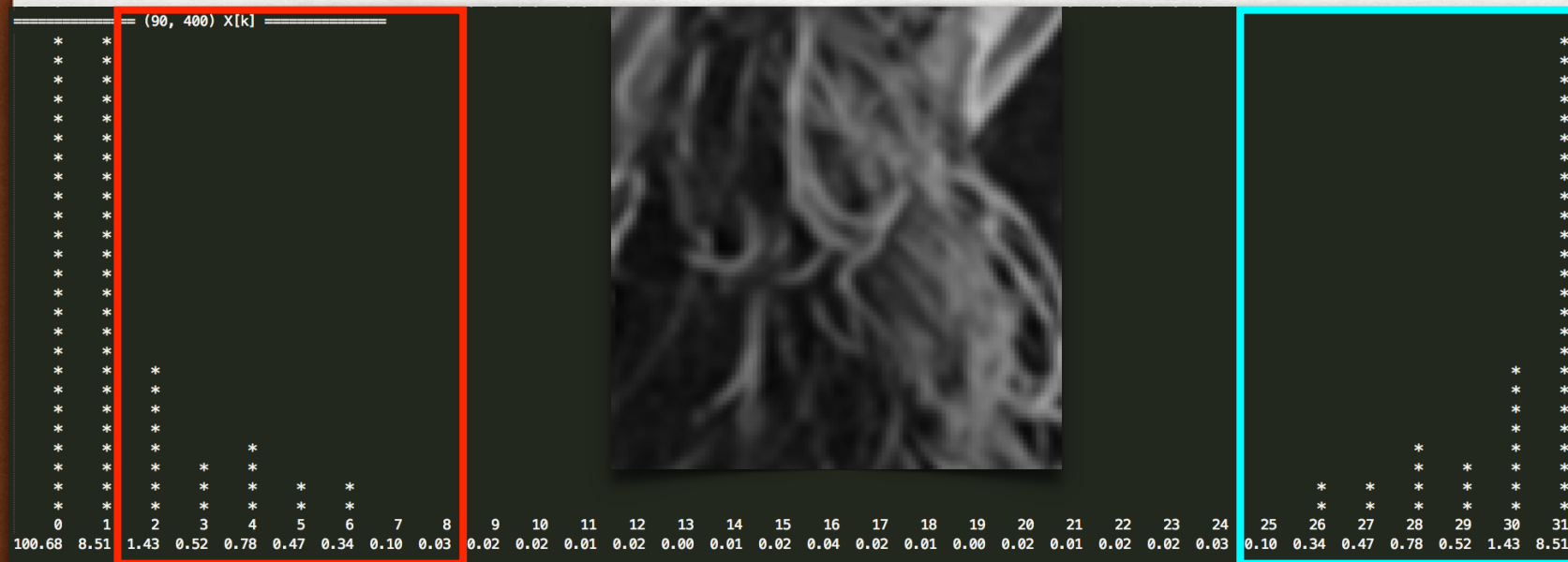
RESULT
ORIGINAL VS GAUSSIAN LPF

There is more considerable changes
with X[k] than Y[k]
because of the direction of arc.

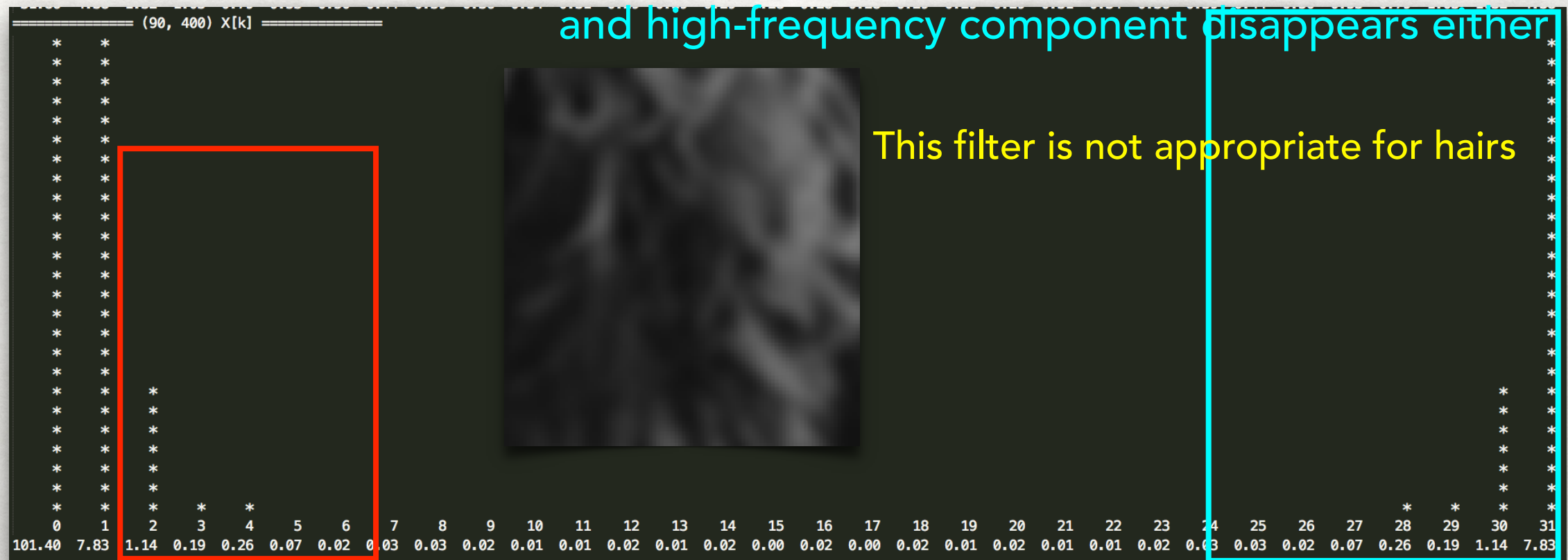**It makes the border blurred between areas slightly**

RESULT
ORIGINAL VS GAUSSIAN LPF
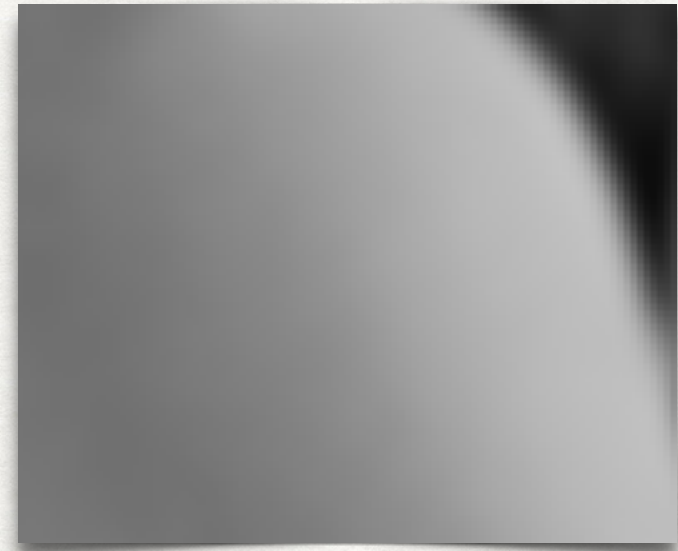

There is more considerable changes
with X[k] than Y[k]
because of the direction of hair grown.

Low-frequency component disappears
and high-frequency component disappears either

This filter is not appropriate for hairs

RESULT

ORIGINAL VS GAUSSIAN LPF

Gaussian LPF does almost nothing

CONCLUSION
HPF, LPF

- HPF makes the border distinct

- LPF makes the border blurred or smooth

- The Image signal has an extremely high DC component as compared to those of AC.

You could get the full result and source code at https://github.com/iriszero