Fourier properties of the Shroud compared to drawings and paintings

By O.K.

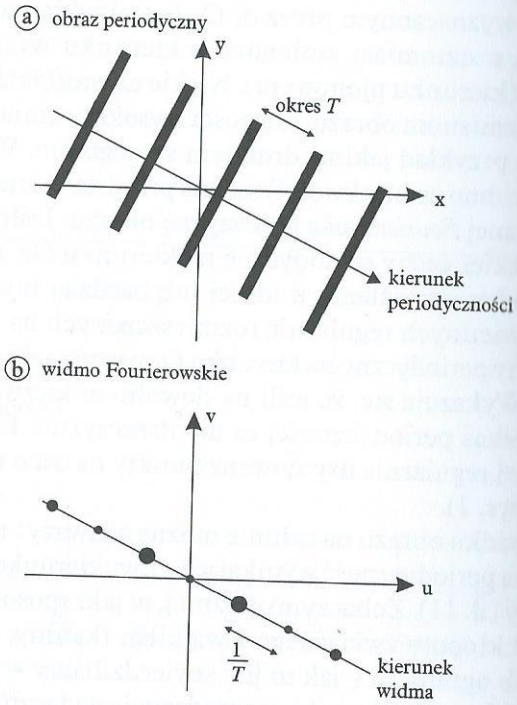
Introduction

One of the very important, yet rarely mentioned characteristics of the Shroud image is its lack of directionality, that is (to avoid confusion with light directionality, which is also absent) an isotropic FFT spectrum. In layman terms this mean that under high scope, there are no preferred directions in which image intensity modulates. For example , when painter paints a painting he moves his brush in regular way in some (consciously or subconsciously) preffered directions, thus modulating the intensity of the painted area. It can be detected via Fourier transform, or similar (for example wavelet) analysis. It is frequently used in painting analysis –for detection of forgeries for example (each painter has his or her characteristic frequency „signature", just like handwriting style).

Or in other words, according to Wikipedia:

The non-paint origin has been further examined by Fourier transform of the image: common paintings show a directionality that is absent from the Turin Shroud (citing J. J. Lorre – D. J. Lynn, "Digital enhancement of images of the Shroud of Turin", in: Proceedings of the 1977 United States Conference of research on the Shroud of Turin, Albuquerque 1977, Holy Shroud Guild, New York 1977)

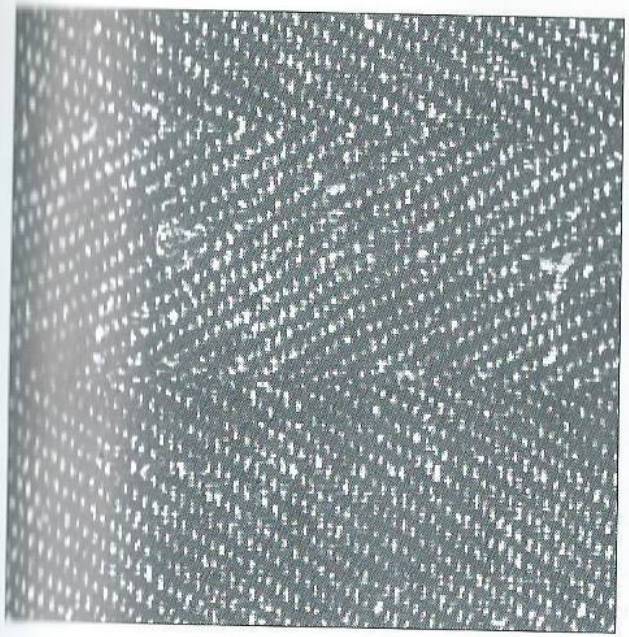
The best description of this property in the sources available to me is in the Andrè Marion, Anne-Laure Courage, *Całun Turyński Nowe Odkrycia Nauki* (the polish translation of *Nouvelles decouvertes sur le Suaire de Turin,* Editions Albin Michel, Paris 1997) , Znak, Kraków 2000, pg. 155-158. It is also briefly mentioned in Mark Antonacci's *The Resurrection of the Shroud,* M. Evans & Co., New York 2000, pg. 38.



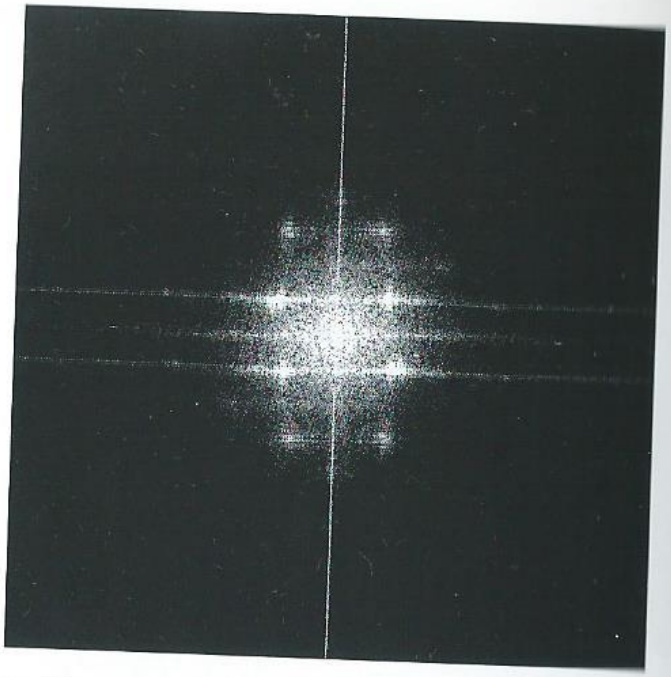
Rys. 2. a) Obraz periodyczny o okresie T w danym kierunku płaszczyzny
b) Widmo częstościowe, utworzone z punktów świetlnych, odległych od siebie o 1/T i znajdujących się na prostej, mającej na płaszczyźnie Fouriera ten sam kierunek co obraz periodyczny na osi *xy*.

On the left we have a figure from Marion –Courage book. As we can see for regular structures in the real domain (xy coordinates) there correspond points in Fourier domain (uv coordinates) showing the main frequencies of the structures in the real domain.

In case of the Shroud, the only regular structure in the microscale (say 1cmx1cm region) is the weave of the cloth.
Below we have two further illustrations from Marion-Courage book. On the left we have enlarged detail of the negative photograph of the Shroud. As we can see the weave is the only regular structure. On the right we see Fast Fourier Transform (FFT) spectrum of the Shroud image. Besides several dots, corresponding to the weave (and a cross, which is simply artifact of the limited size of the box), we see that the spectrum is quite isotropic, with no preffered directions.

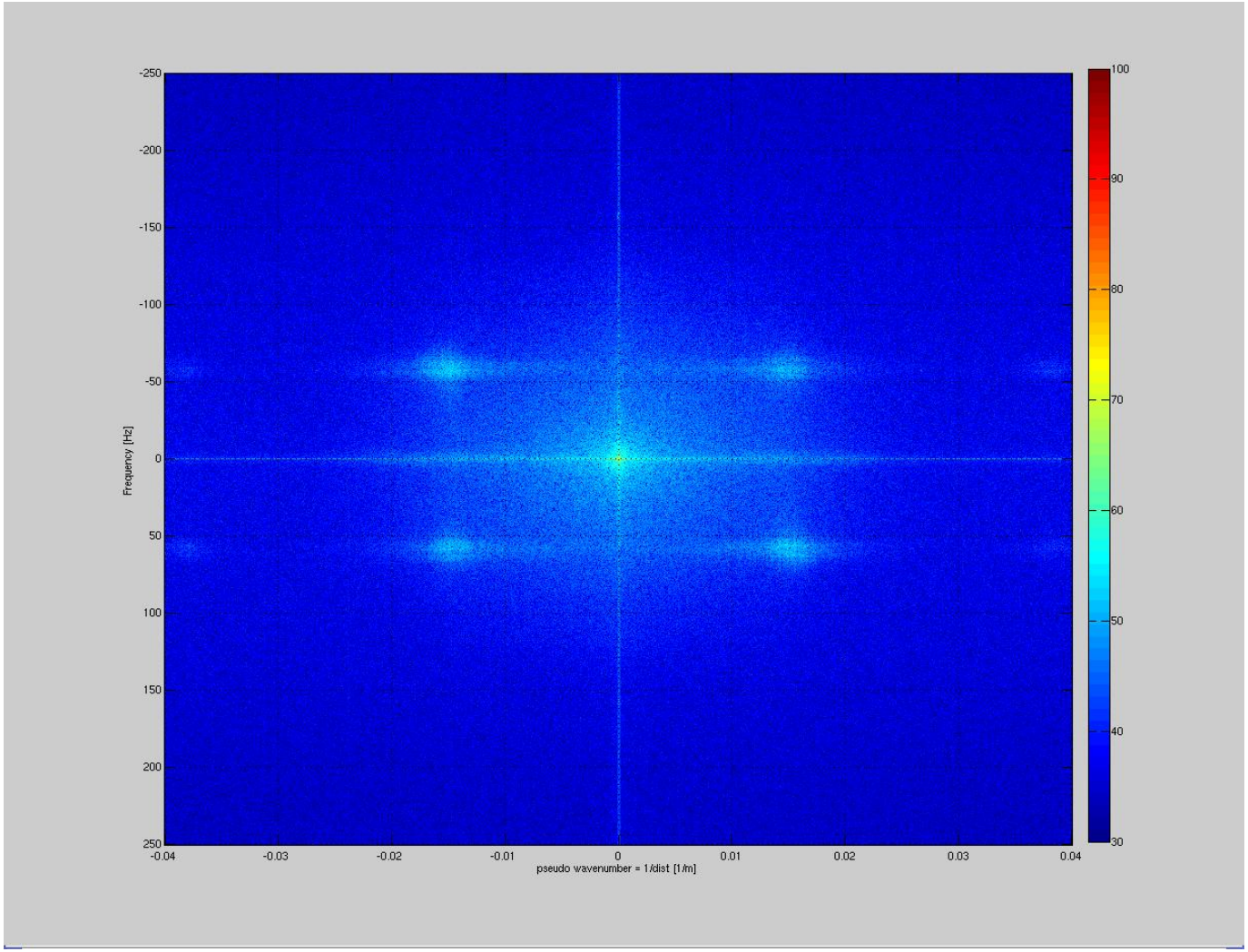


10. Makrofotografia w negatywie, ukazująca strukturę tkaniny, tkanej splotem ukośnym, jak również mikroskopijne jasne pałeczki, znajdujące się na wierzchołkach włókien i tworzące formę drukową obrazu ciała.



11. Widmo częstości tkaniny całunu: widoczne są m.in. punkty odpowiadające splotom tkaniny.

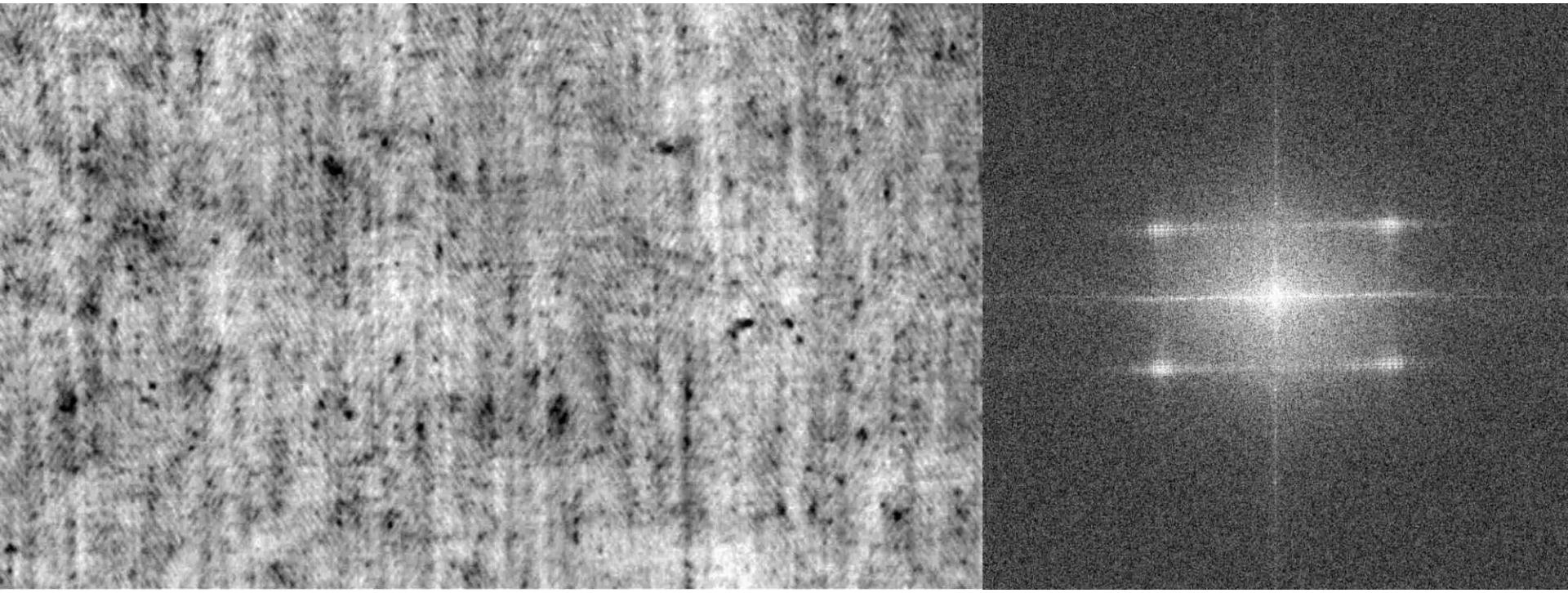
Here we have similar graph from Thierry Castex site:



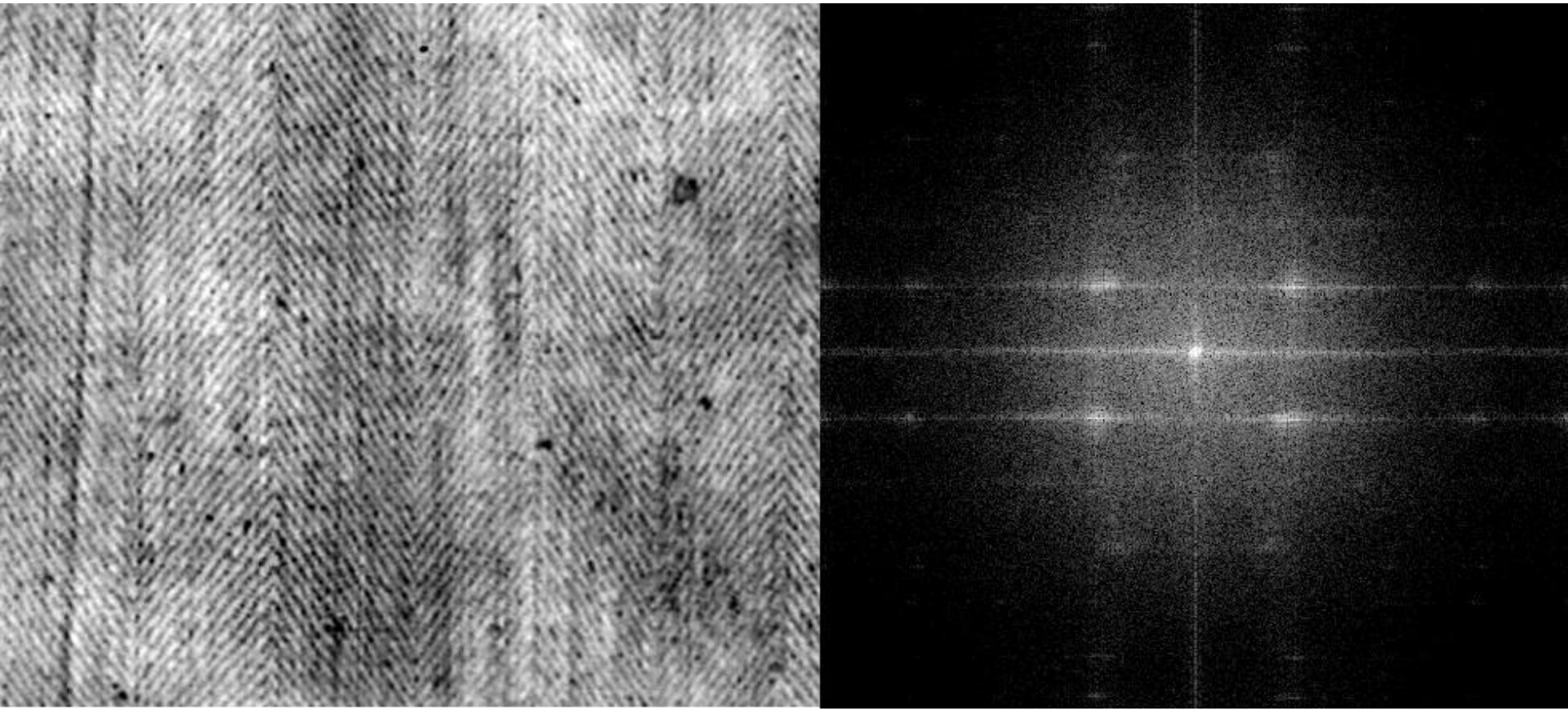
Now it's time to play ourselves. However, it should be stressed that not every image is suitable for that. We need high magnification photo, able to reveal to us very subtle structures of the cloth –we need area a few cm^2 as our goal is to discredit subtle brushstrokes of a size of milimeter or so.

And one crucial thing –**AVOID JPEGs!!!** They use some form of Fourier transform during conversion of the images, and eliminate certain frequencies to compress files.-thus eliminating informations that are crucial for our purpose (see Wikipedia article). For our purpose, BMP or similar format is preferred.

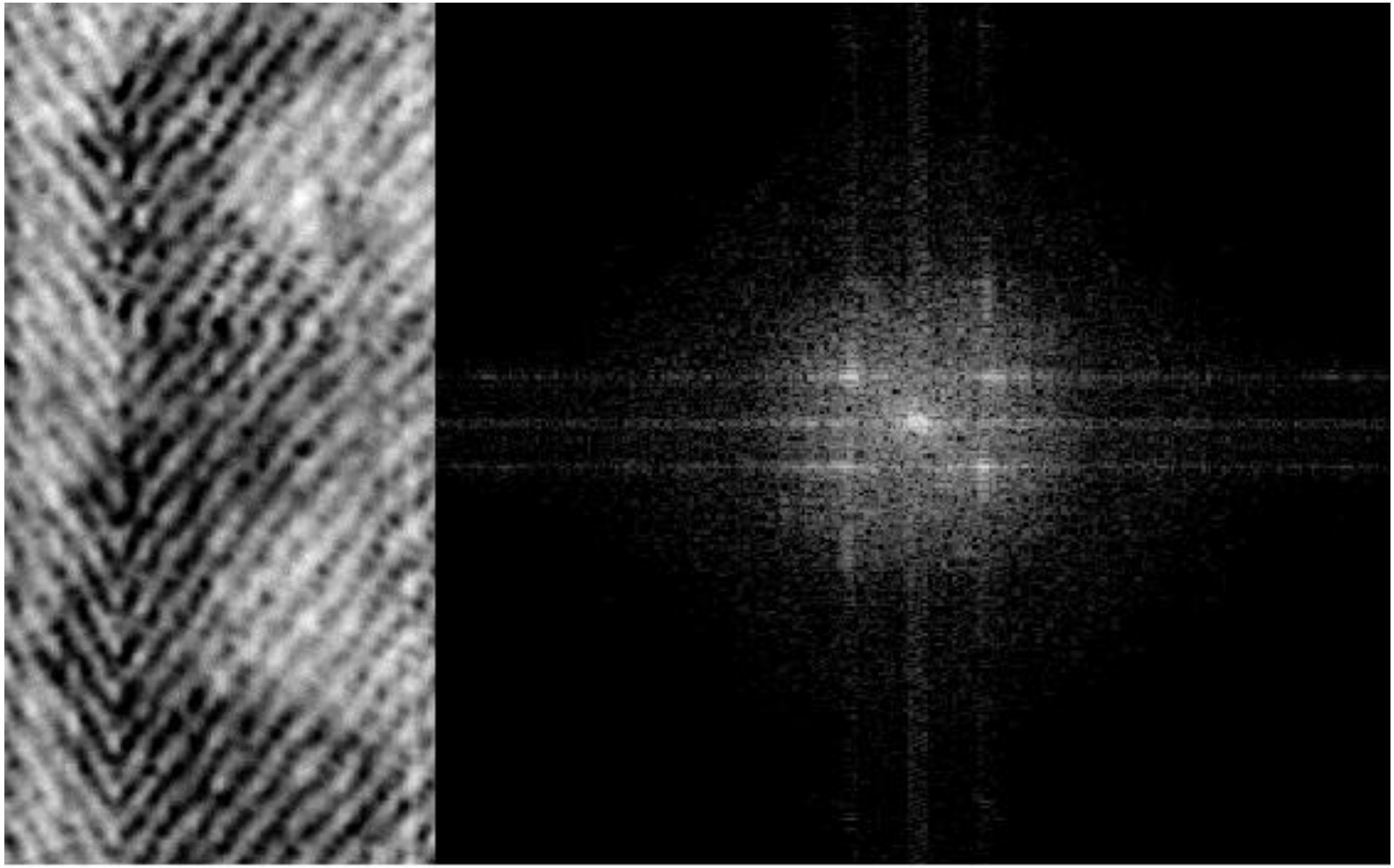
Here we have similar graph (right) made (using ImageJ: Process->FFT->FFT function) from Durante's non-image area near the face on the Shroud (left). As we might have expected, the only distinguished frequencies are those associated with the weave –besides of this the structure is fairly isotropic. This can be used as control check.



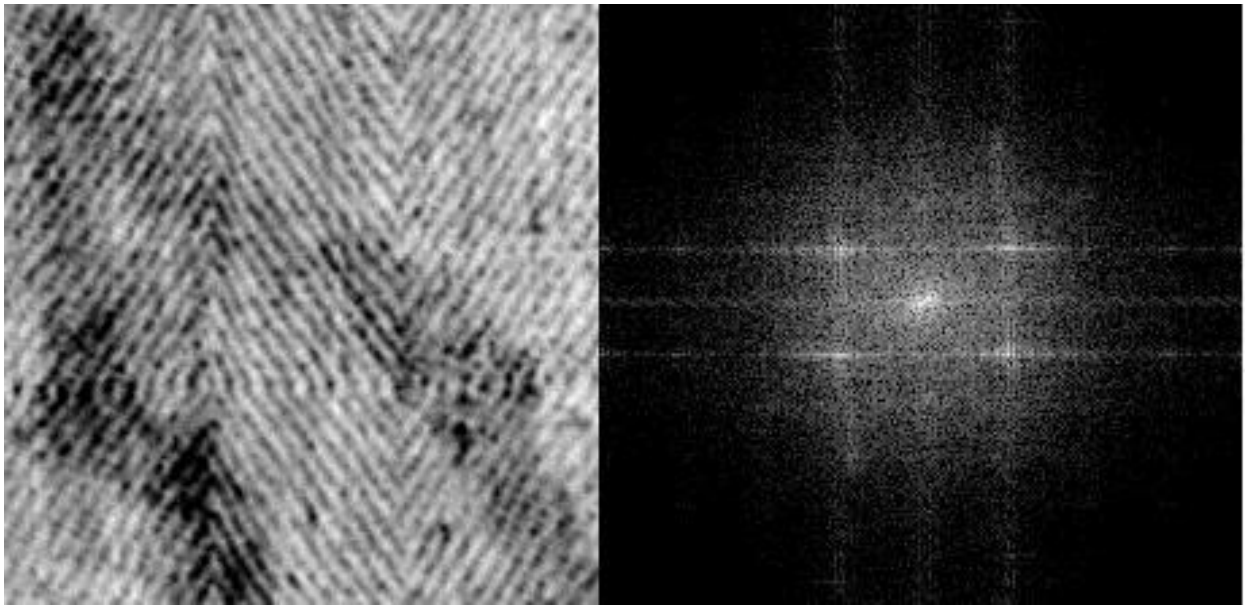
Here is nose area on durante's photo and FFT of it. As we still, excluding weave, the image in Fourier (frequency) domain is still isotropic.

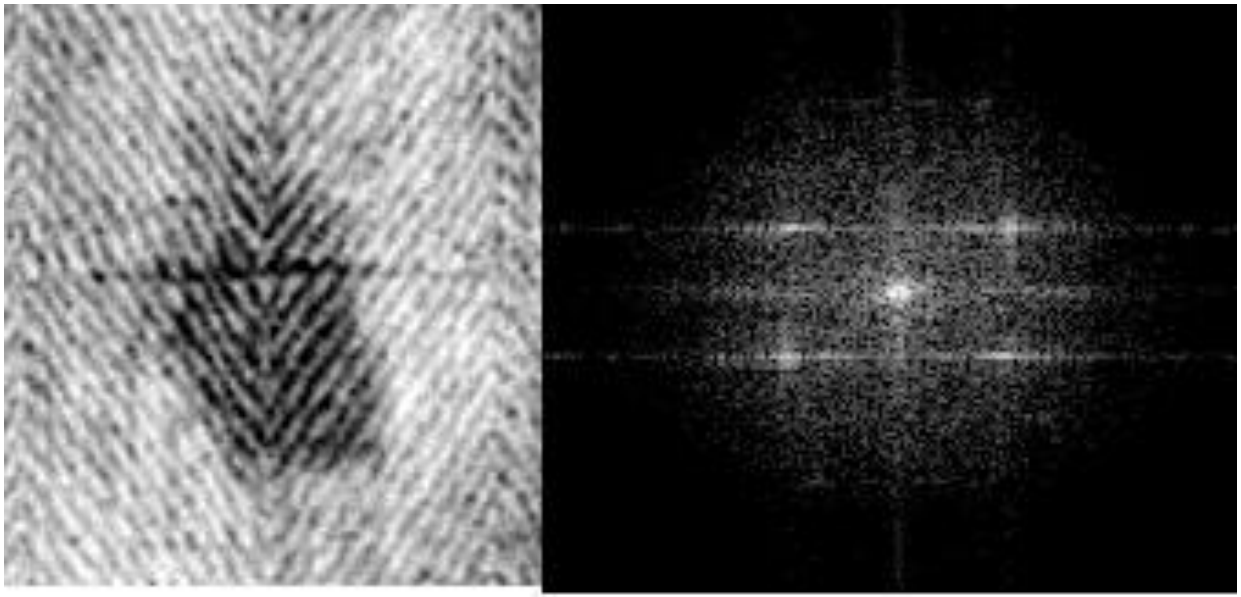


Similar property applies to blood images. Here the famous epsilon and its frequency representation:

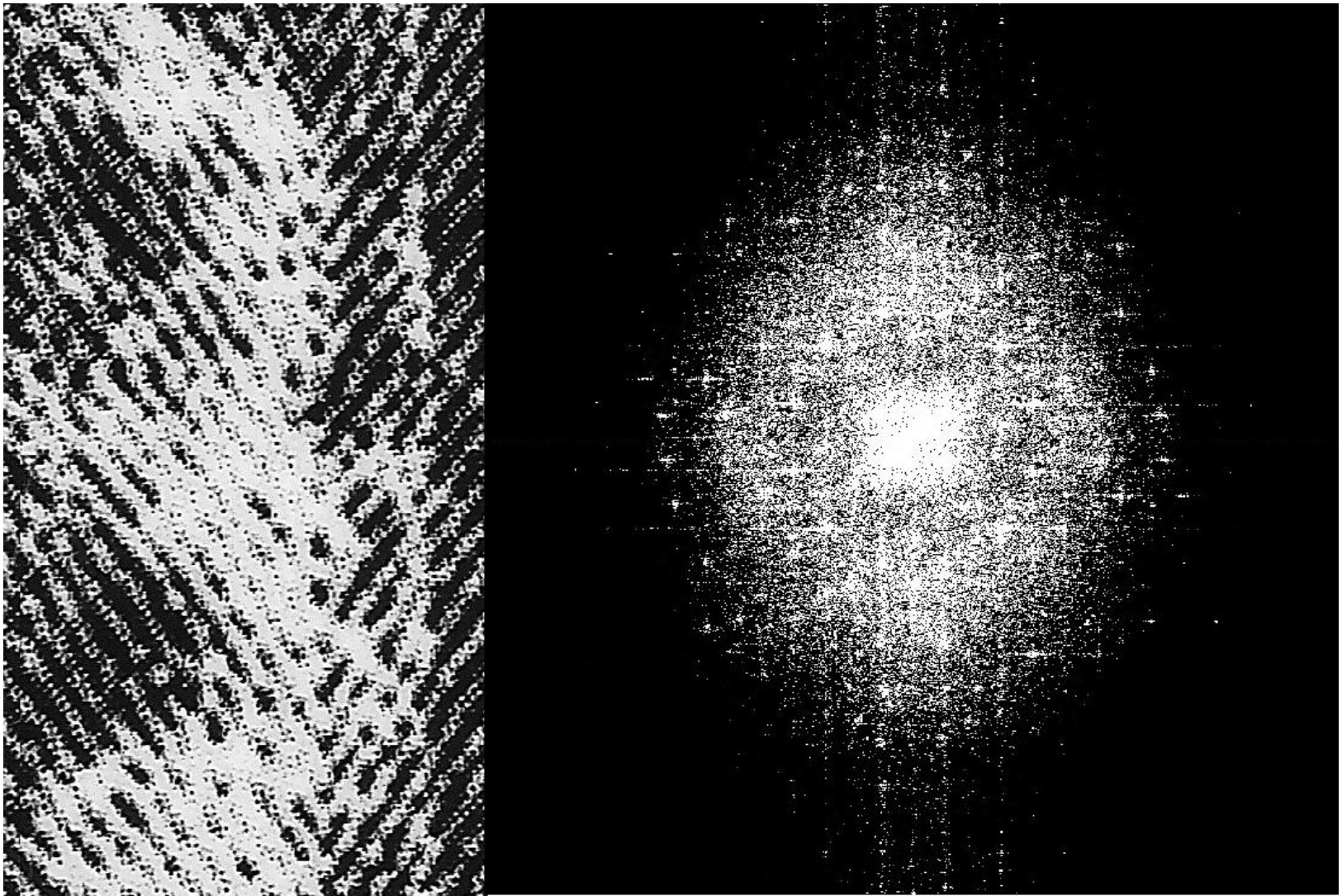


A couple examples more

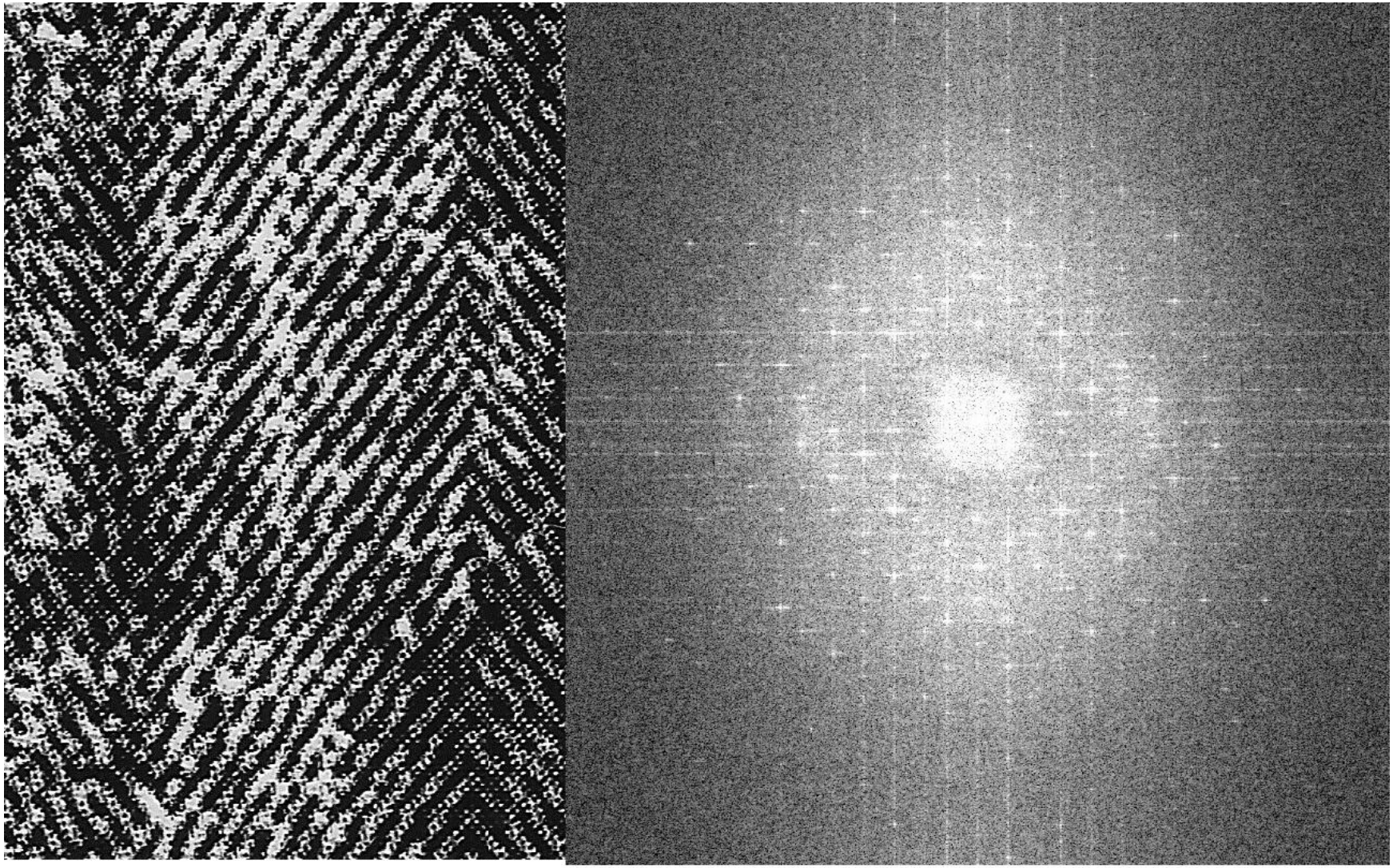




If someone needs bigger magnificaction, I can present it, as I have high resolution Enrie face image, scanned from the cover of Paul Badde's book. Here we have once again epsilon bloodstain –and a nice diffraction ring in frequency domain.



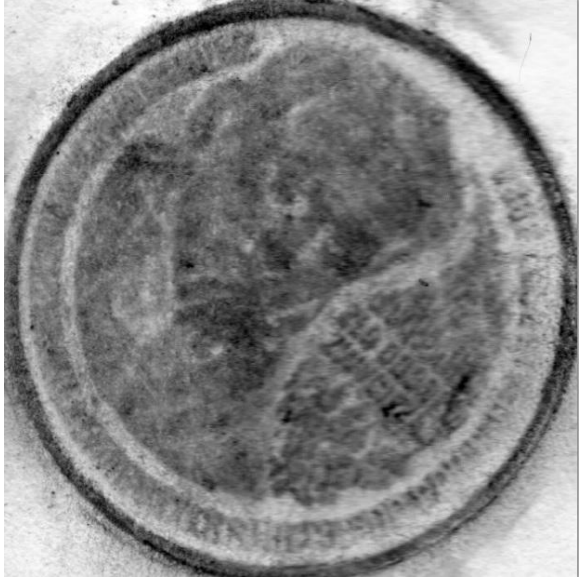
And here is nose area:

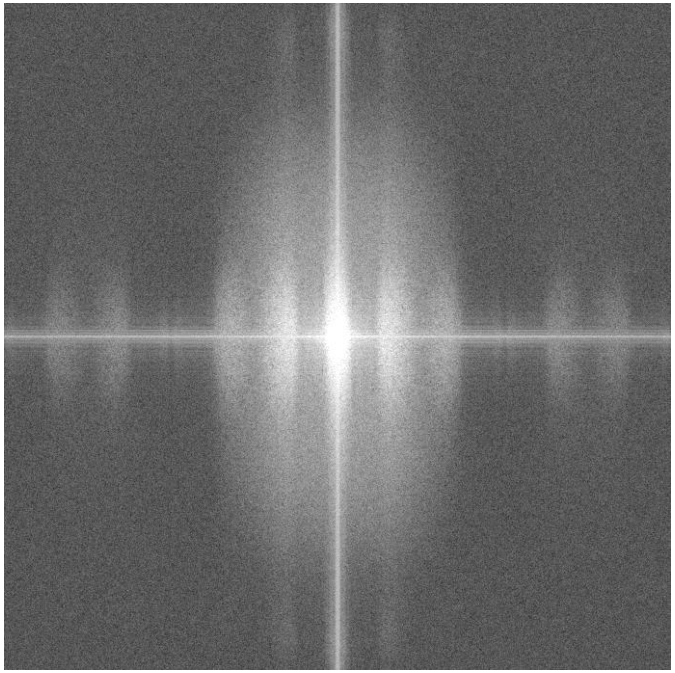


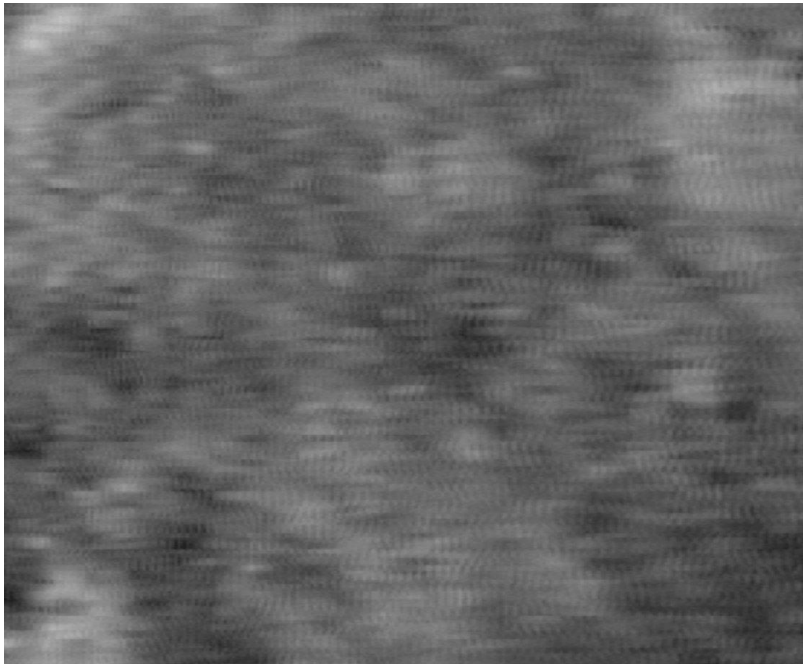
The coin trick rebutted

How many times have you heard that: „it is so easy to make a negative image" (sometimes they add „with 3D properties")? Like David Mo, who recently boasted on Dan's blog : *Everybody has done sometime a negative image. It suffices to rub a paper on a coin with a pencil. Furthermore, I have done a negative image with a pencil and a finger in 5 min.* Encouraged by Colin Berry: *Good point DavidM. Yes of course one can take a reasonable image off a bas-relief like a coin, despite the shallow relief. It will be a negative of course, but it's an easy matter to reverse it back to a positive. Here's one I did with the tail side of a UK 2p coin.* (below images posted by Colin):

The results of my experiment on the next slide, clockwise: a coin, a pencil-rubbed image of it, enlargment of the forehead area, FFT:







As FFT reveals, those talks about coins are not worth a penny.

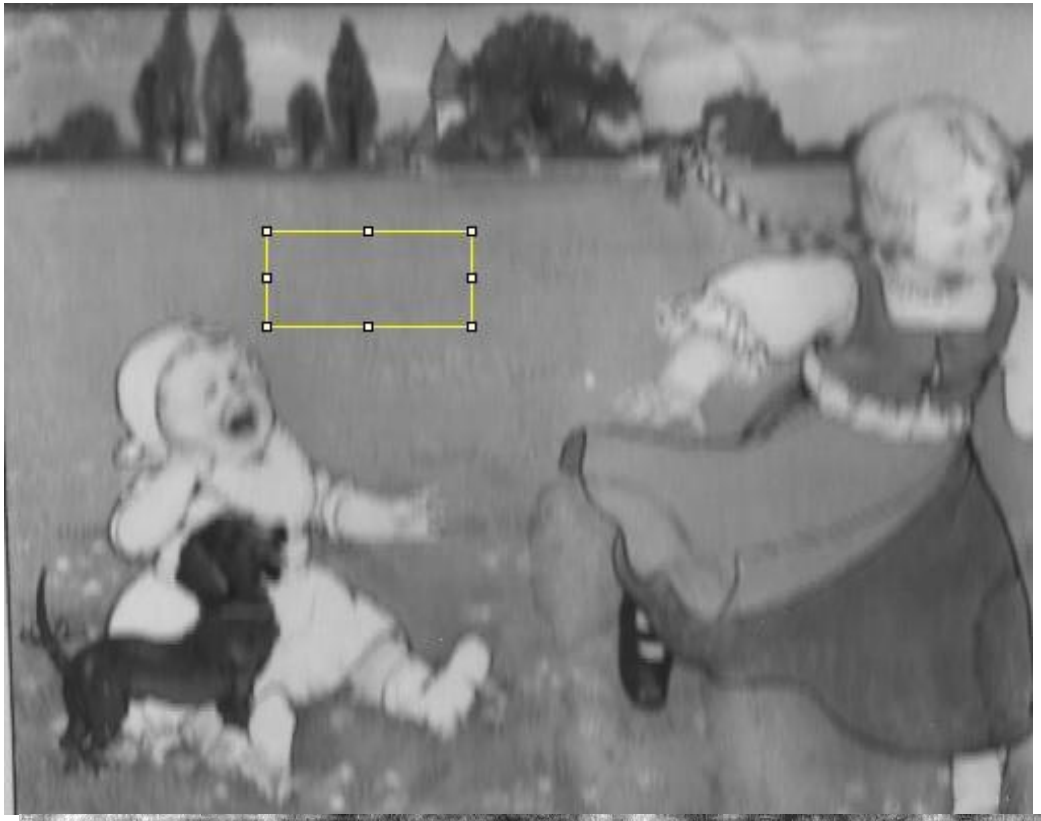
Controls -paintings

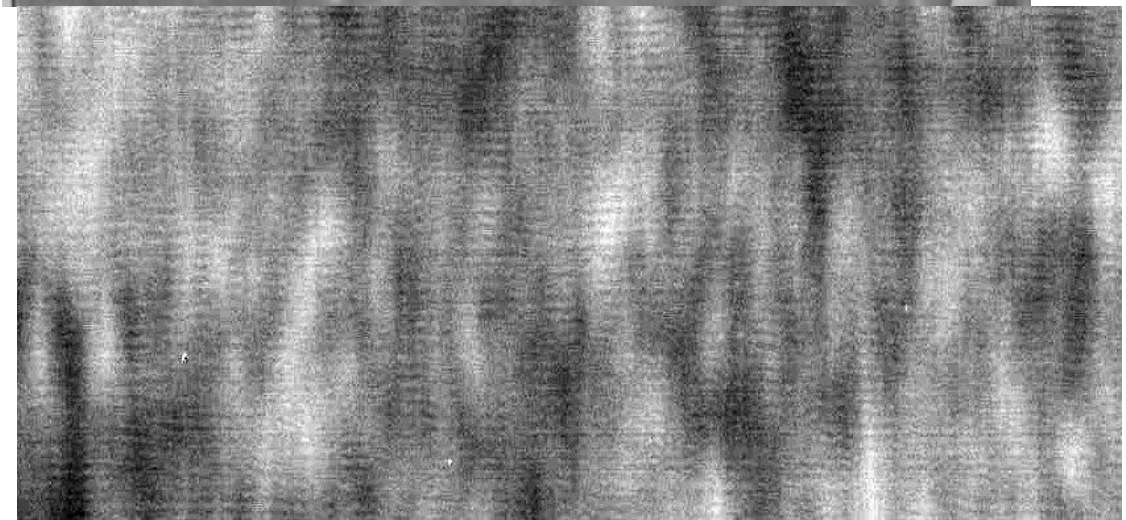
Obviously before we jump to the conclusions, we should compare our results with ordinary paintings –are the latter also isotropic, or perhaps one can find preffered frequencies encoded in them.

The problem is that it is not so easy to obtain suitable microphotographs for analysis in home laboratory -the widely available reproductions have far too low quality -but one can always find a way.

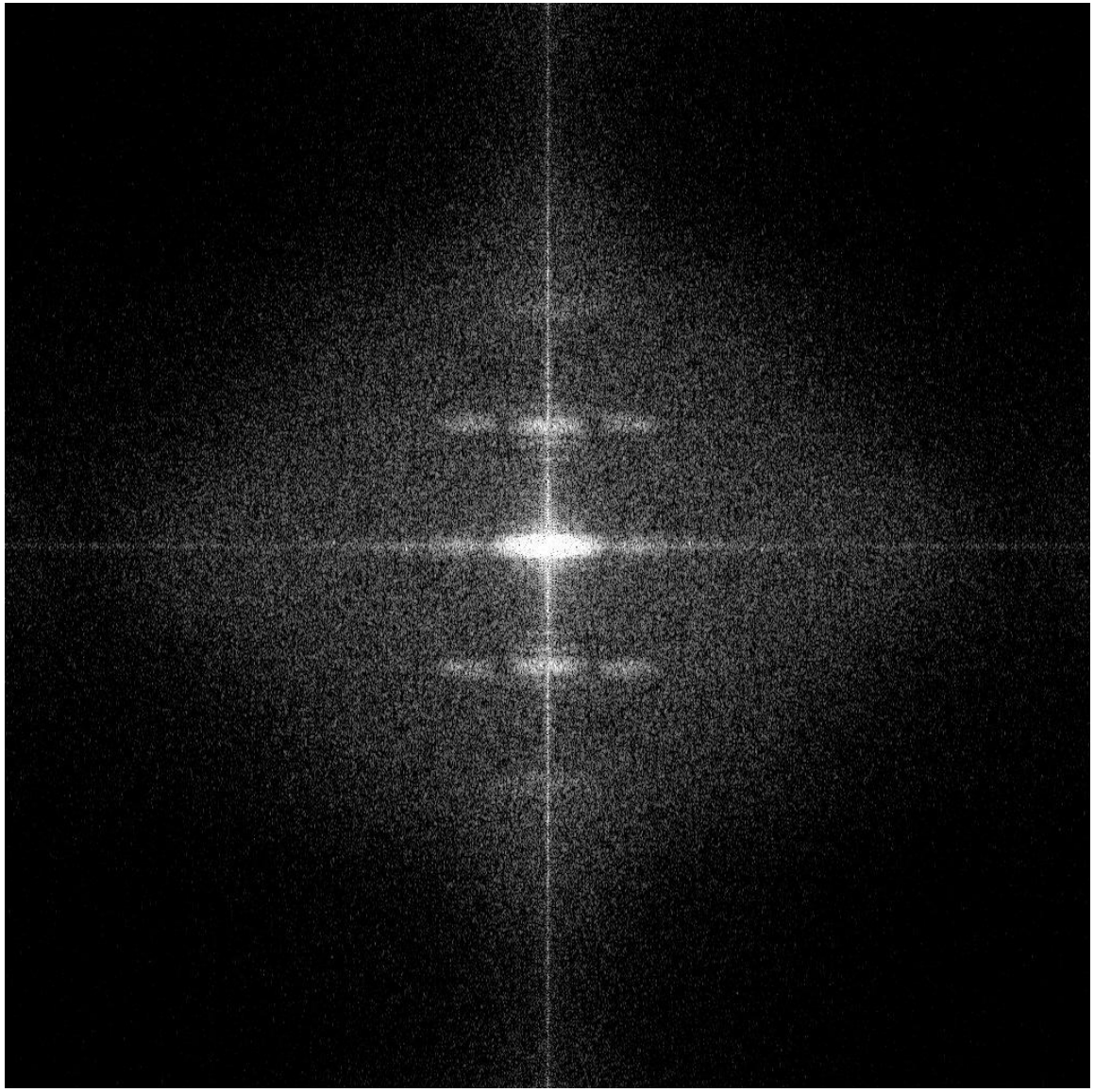
First let’s examine what hangs on the wall next to my desk…

I scanned it at 1200 DPI, turned B&W, adjusted B&C, and extracted a few areas:

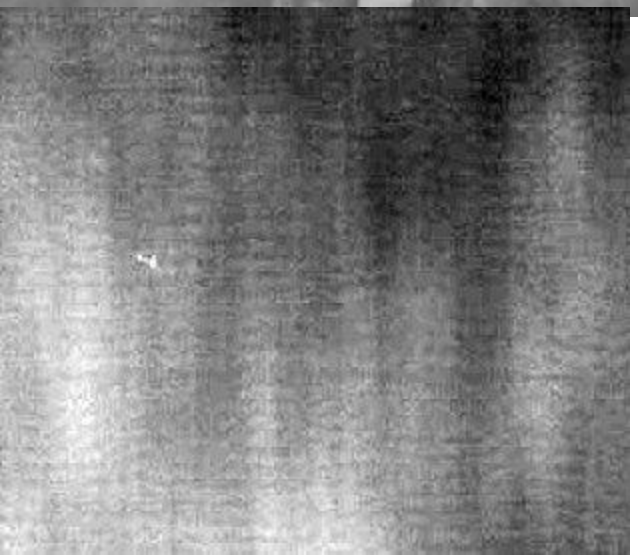


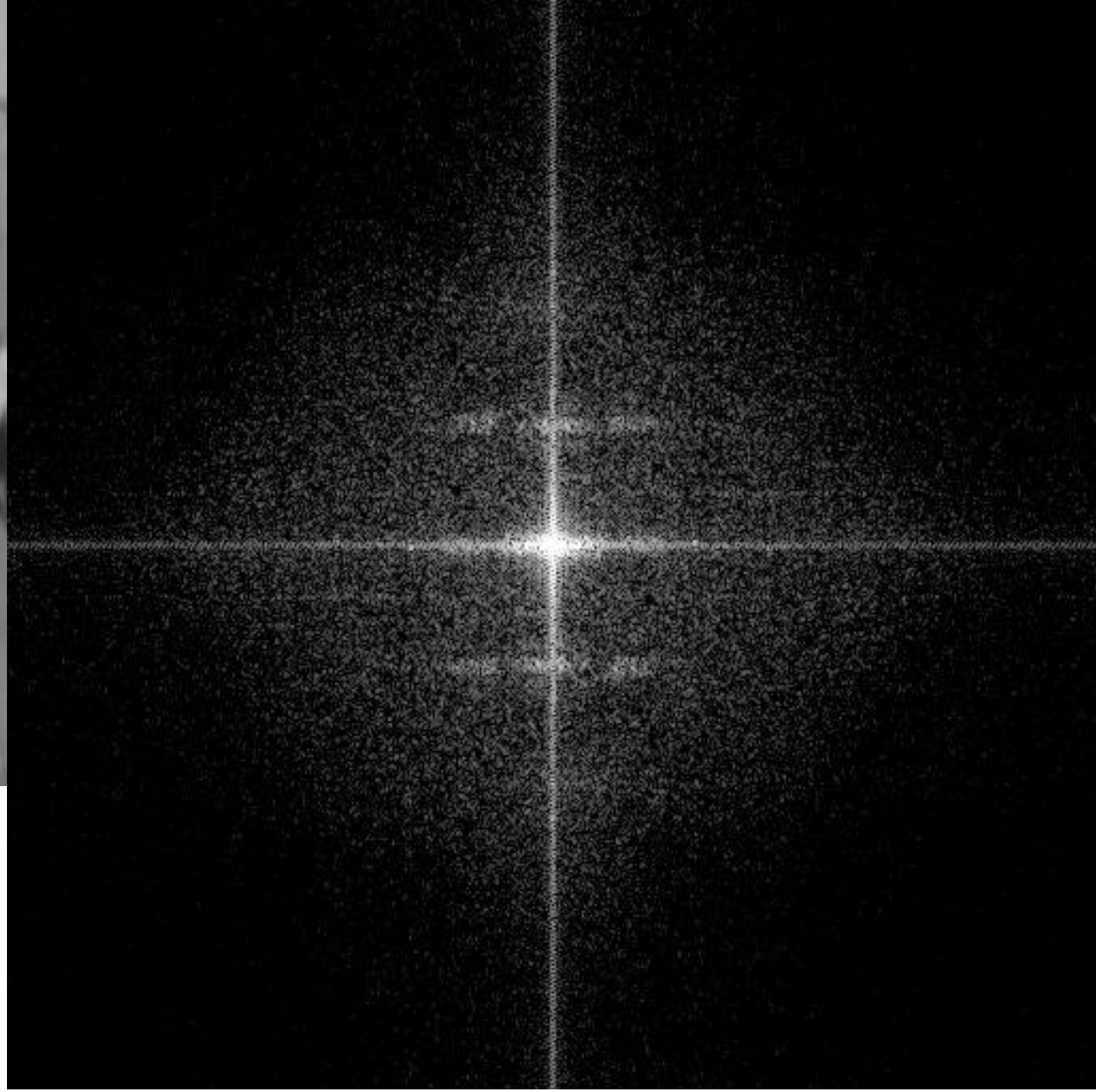


Here are the corresponding results:

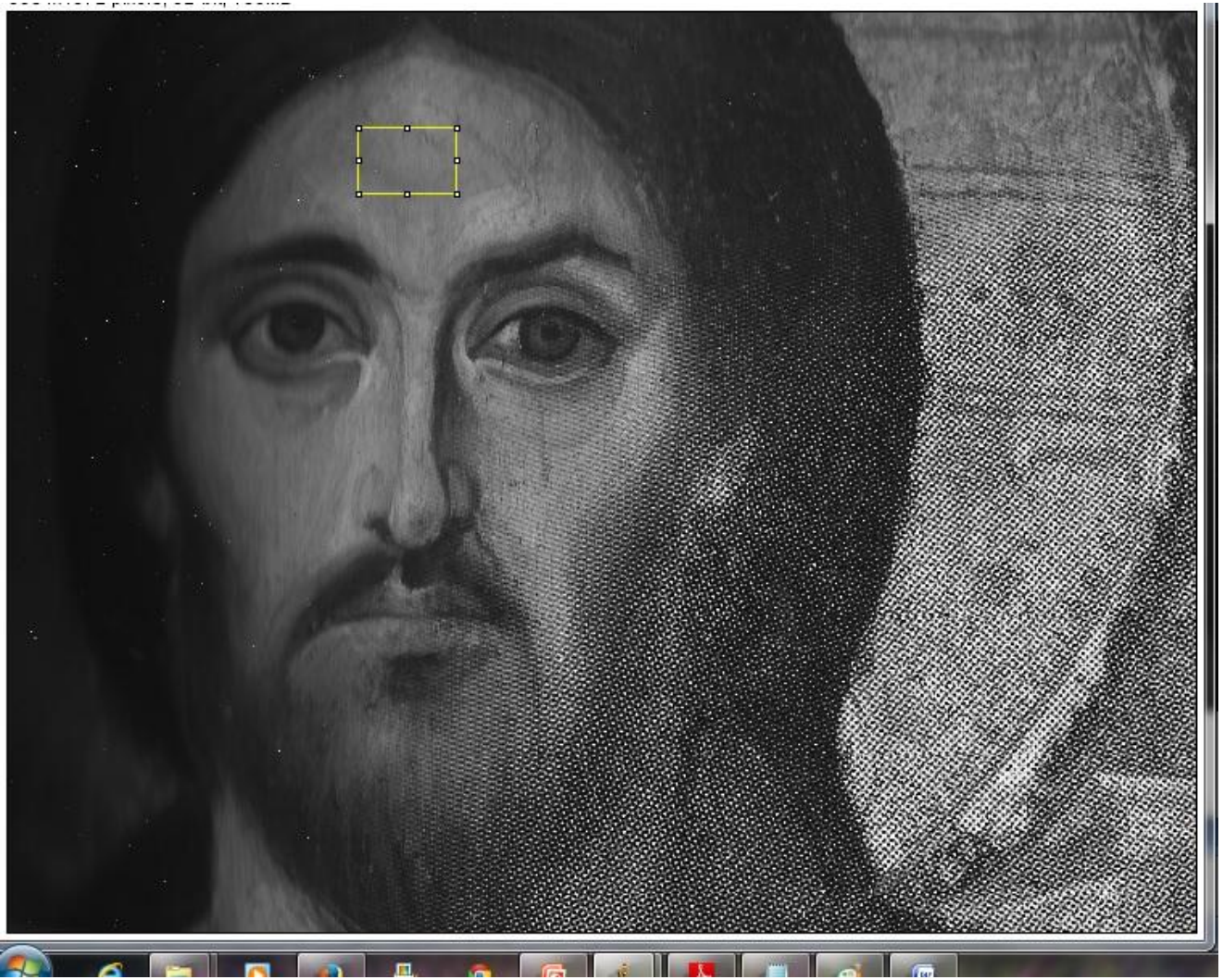


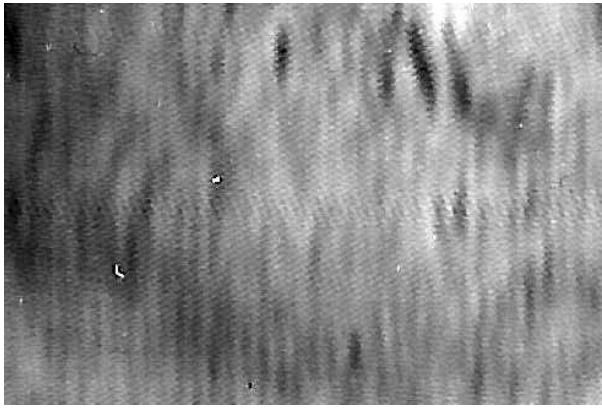
We see dominant frequency mods –the image is not isotropic.



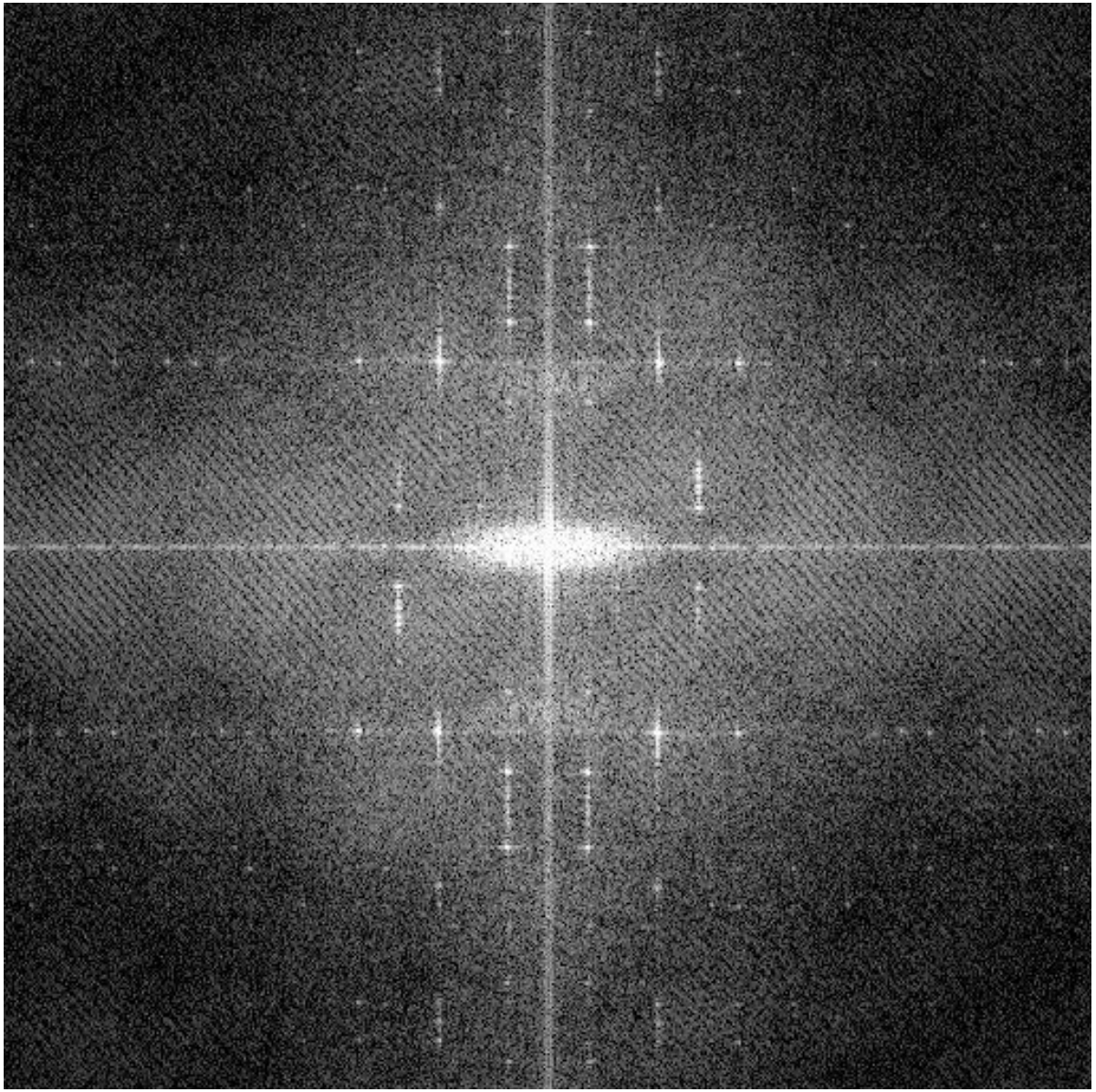


Next I checked famous Sinai Pantocrator, scanned from Judith Herrin's book *Bizancjum: Niezwykłe dziedzictwo średniowiecznego imperium* (original title *Byzantium: The Surprising Life of a Medieval Empire*). It was a good quality photo, but unfortunately, because it was a book, the right side of it had scanned badly. Nevertheless, left side remained useful. Here we will examine forehead area:

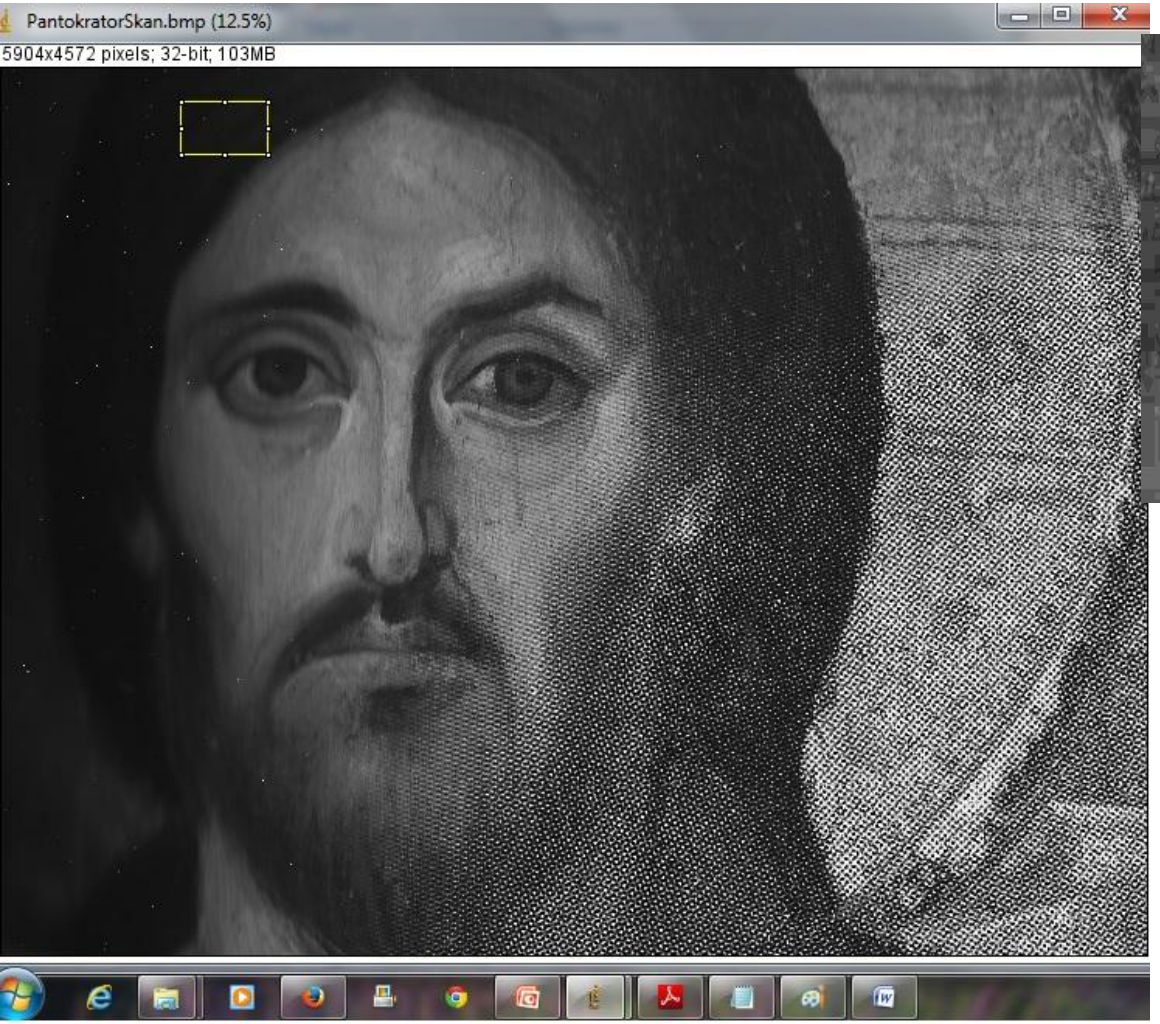


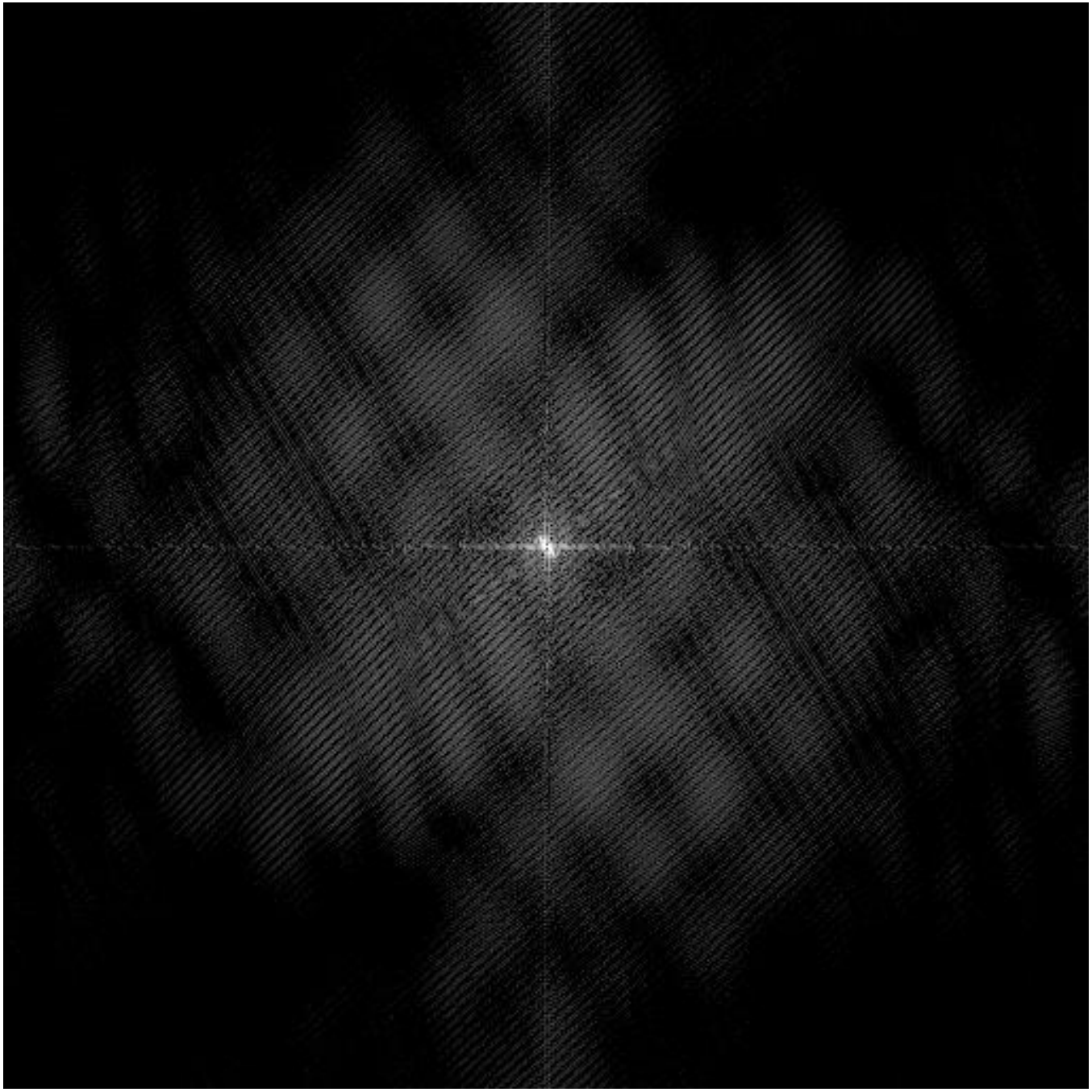


Here is the signature of monk who wrote this famous icon:

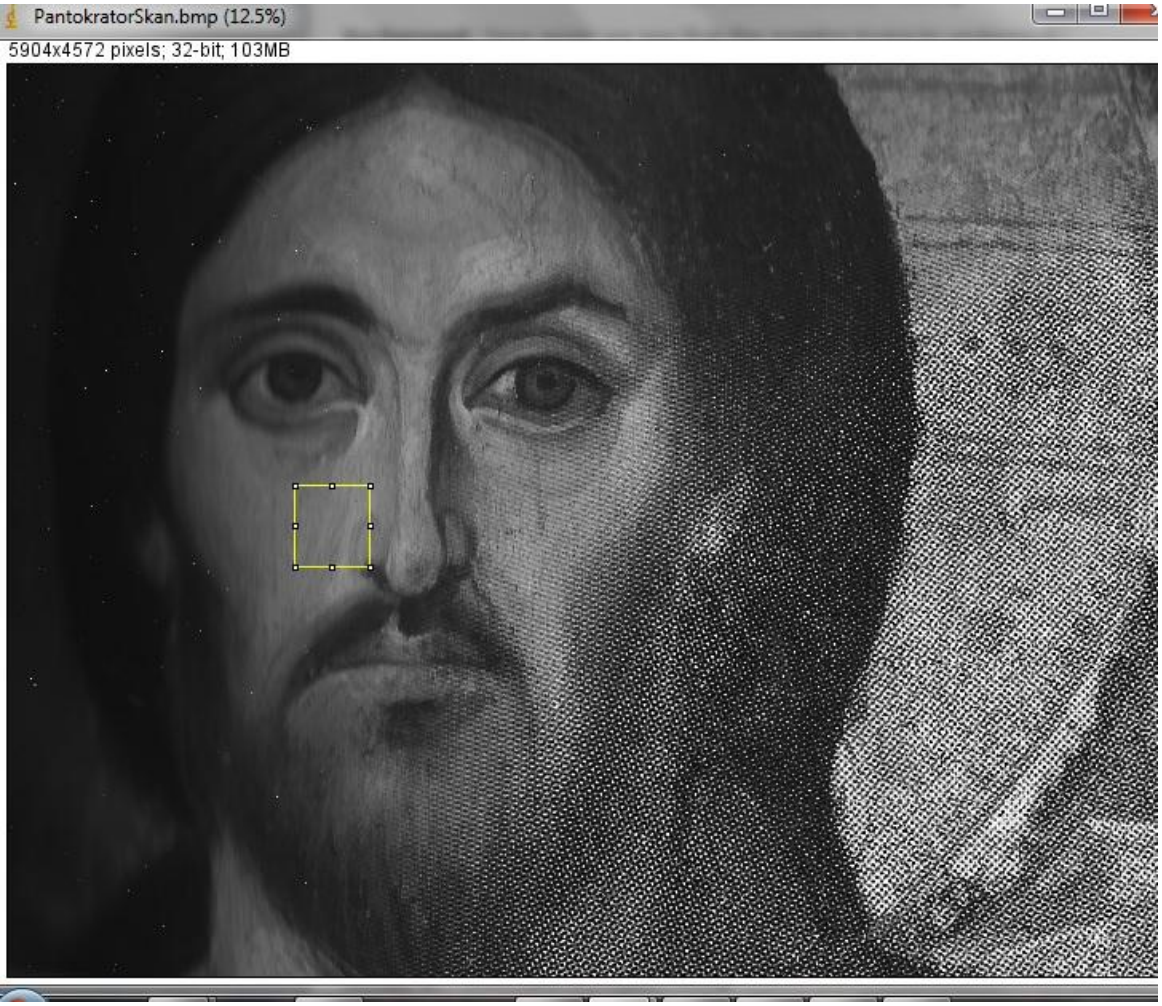


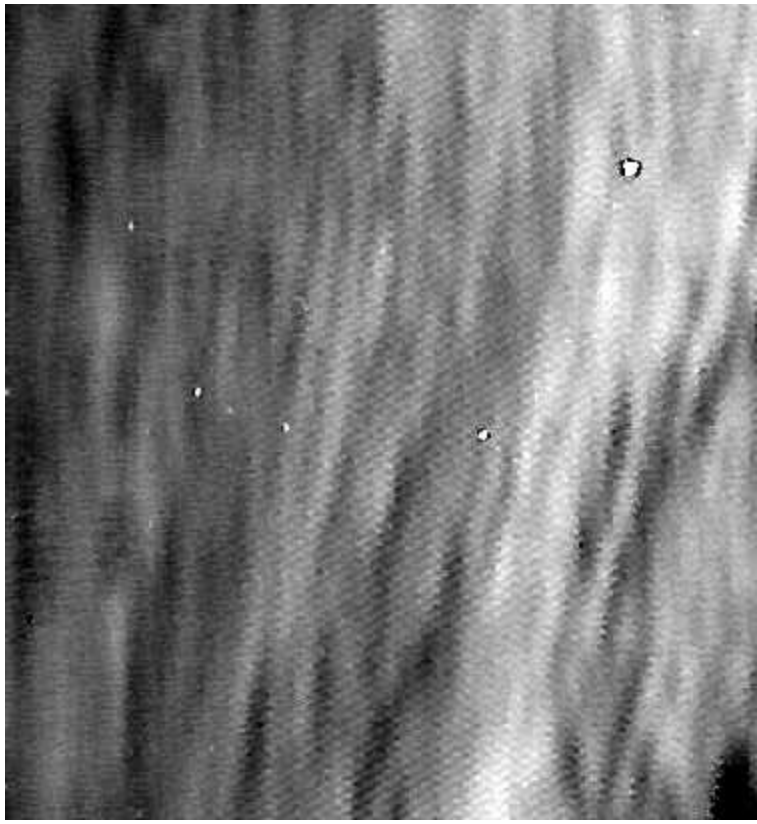
Let’s examine hair area:

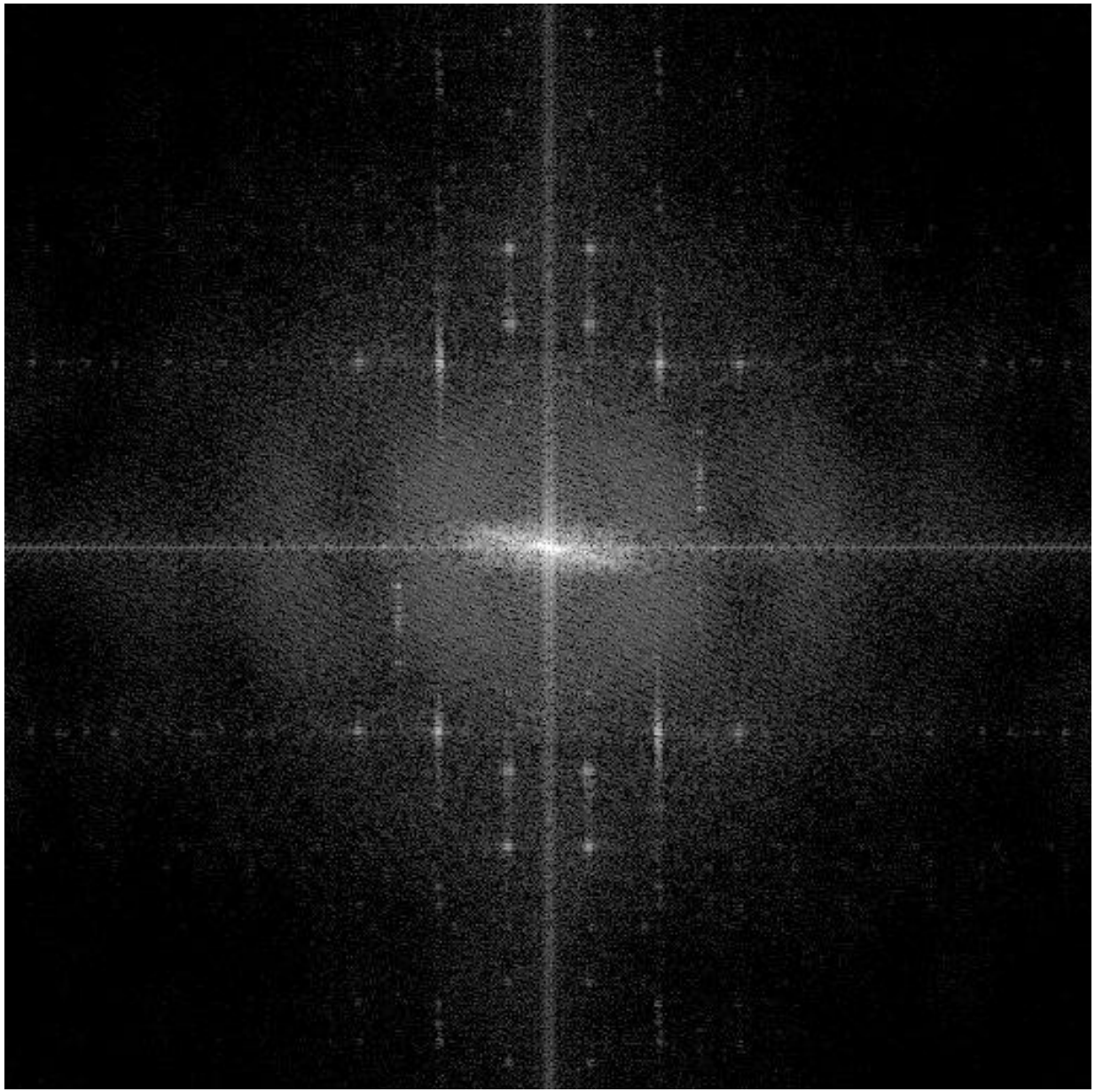




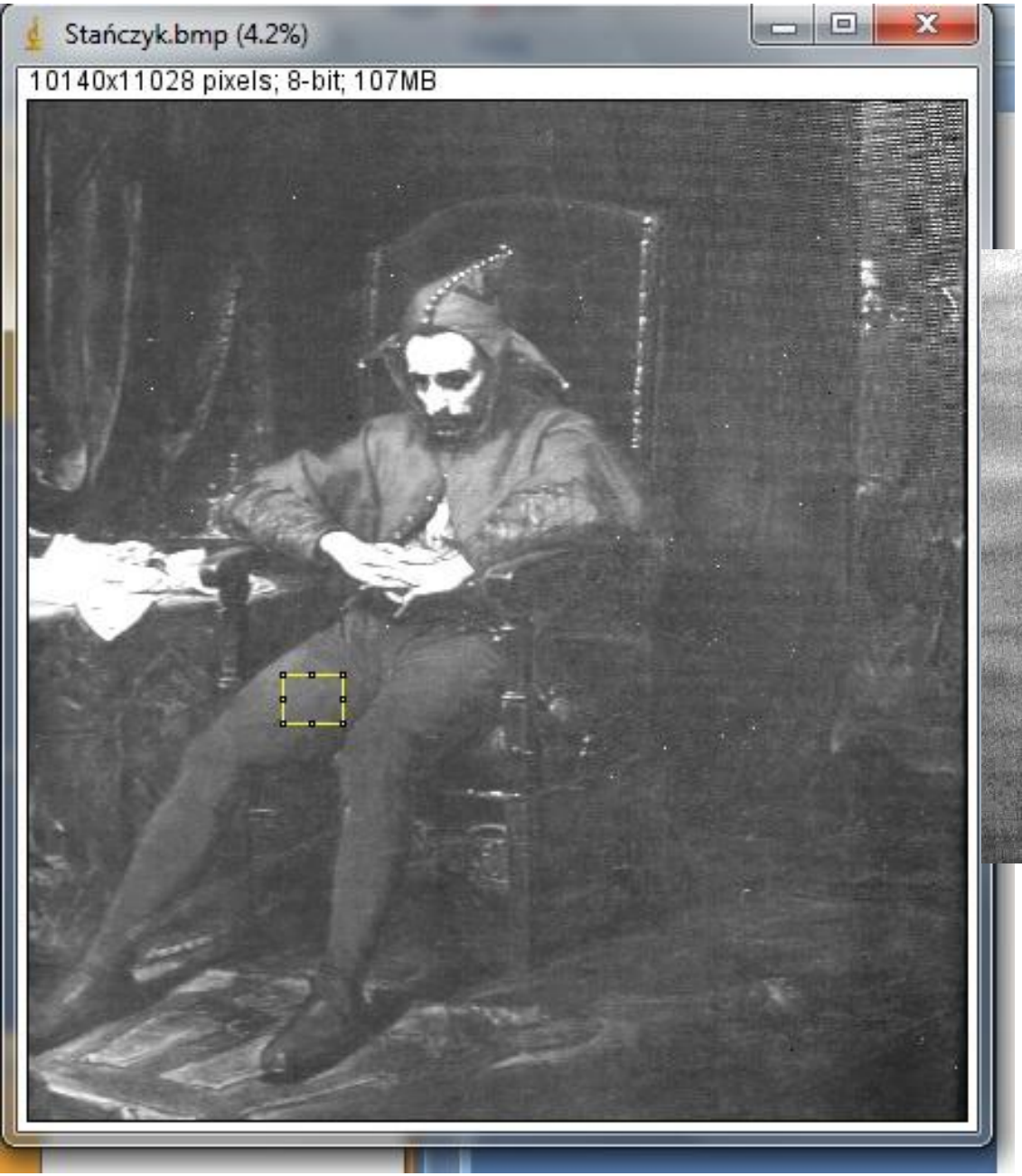
Cheek and nostril:

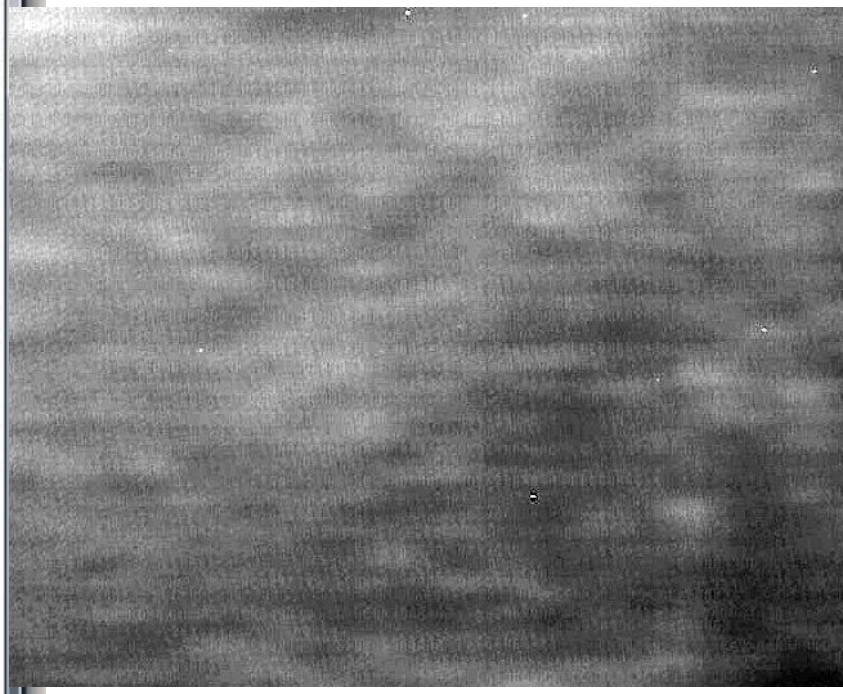




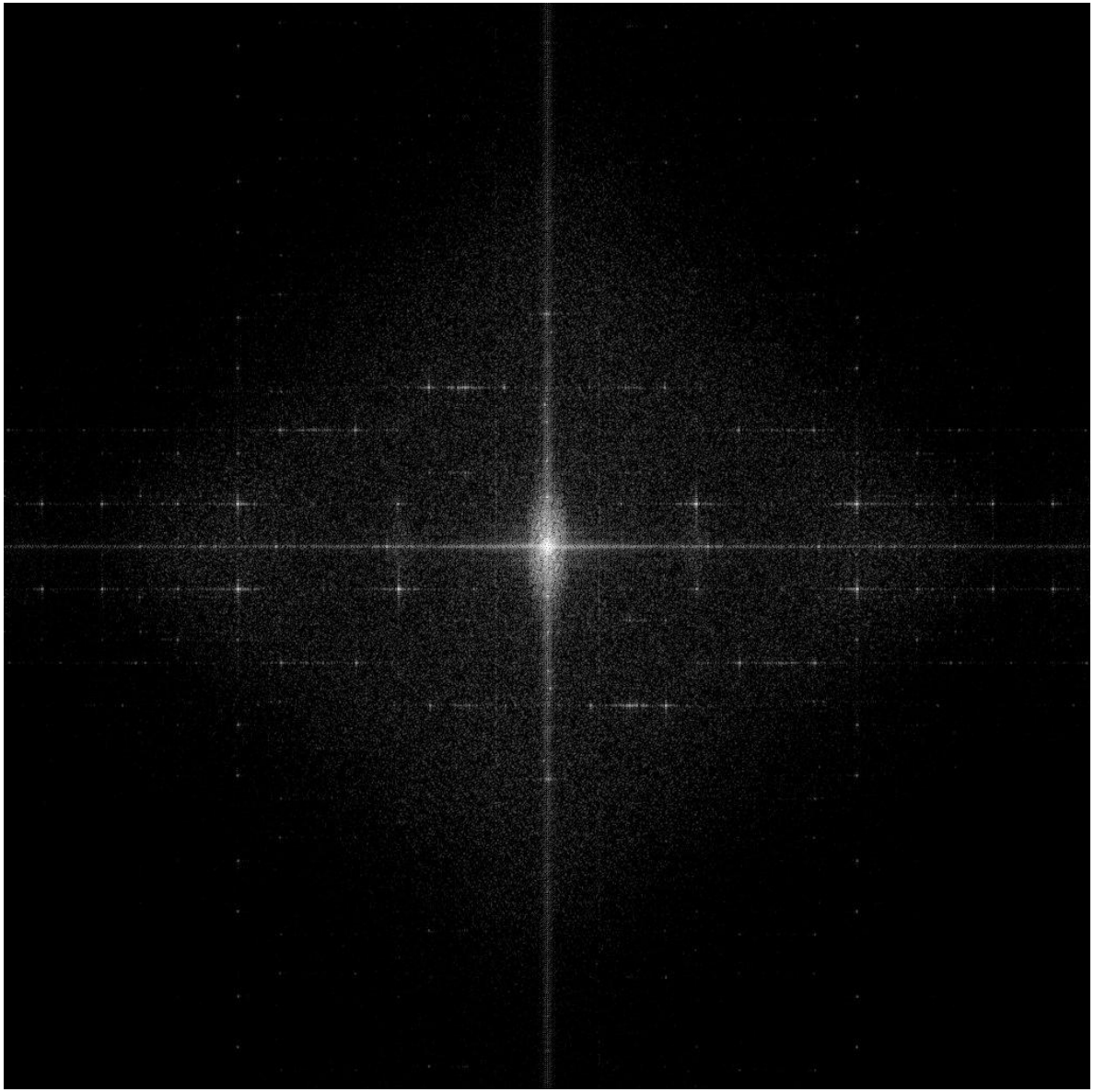


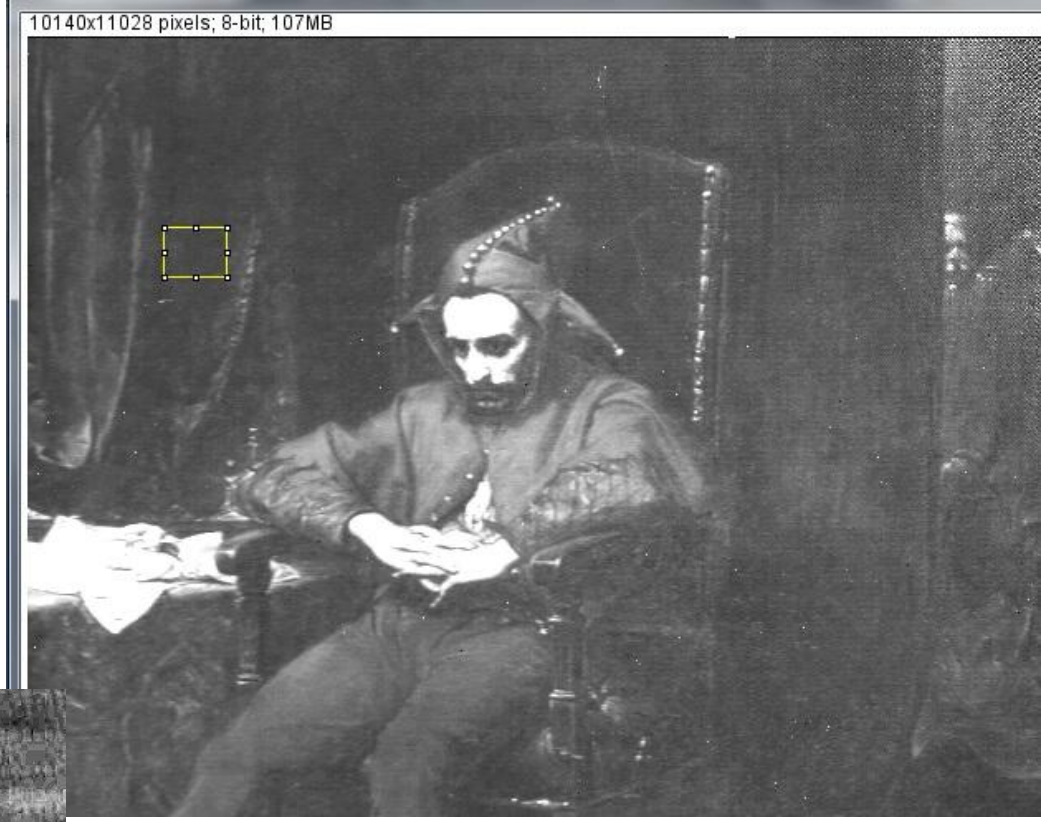
Next is the famous Stańczyk by Jan Matejko ([Wikipedia article about the painting]), scanned from the cover of album of paintings by this artists. The covers of similar albums are usually the best source of good quality images for FFT analysis

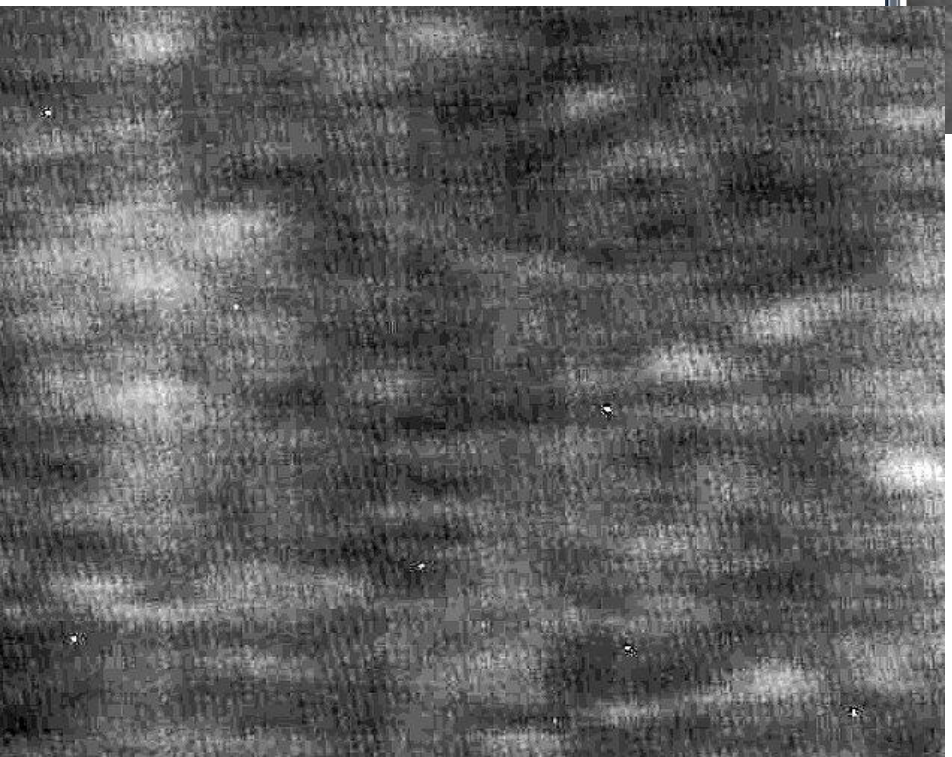

Stańczyk.bmp (4.2%)
10140x11028 pixels; 8-bit; 107MB

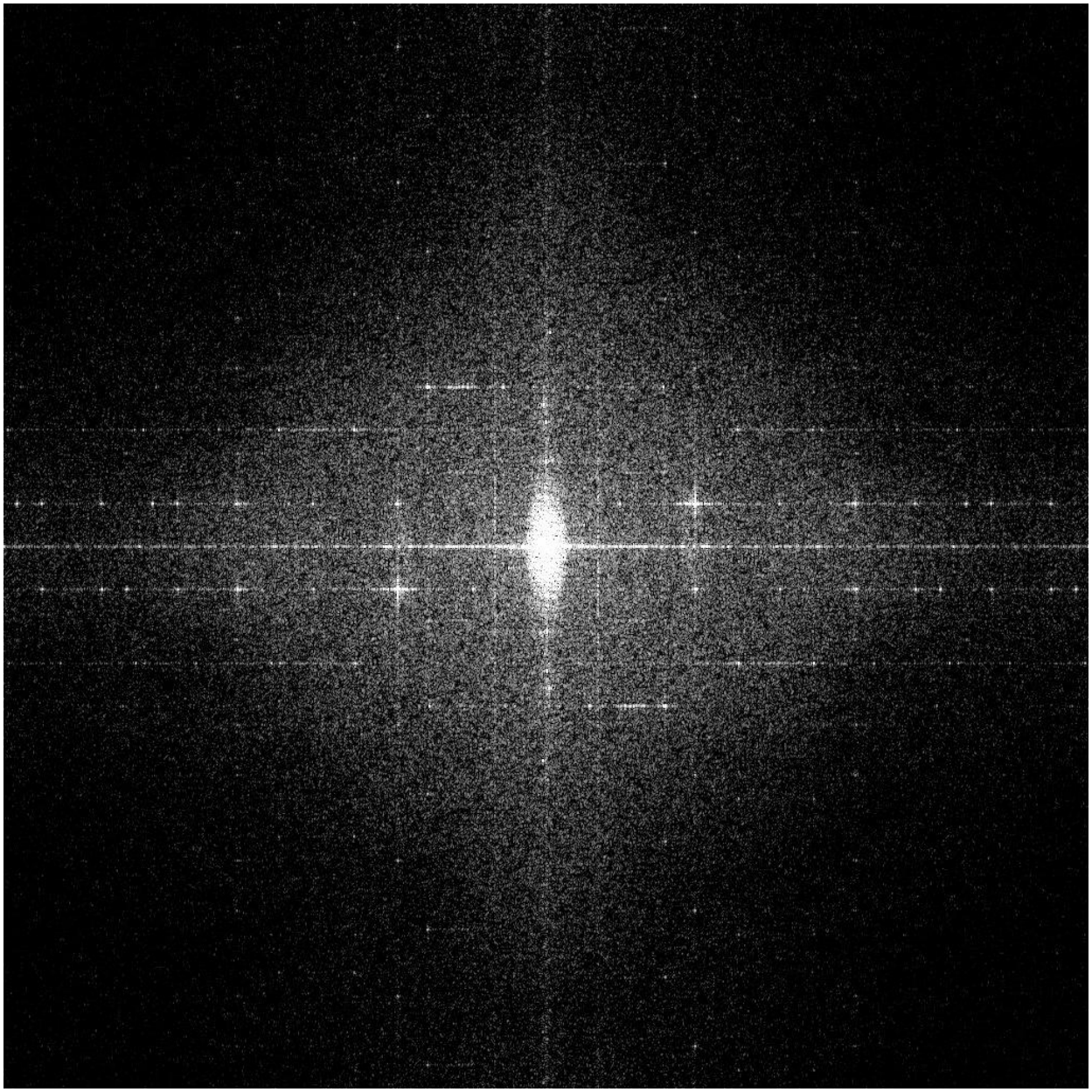


The Matejko's signature:



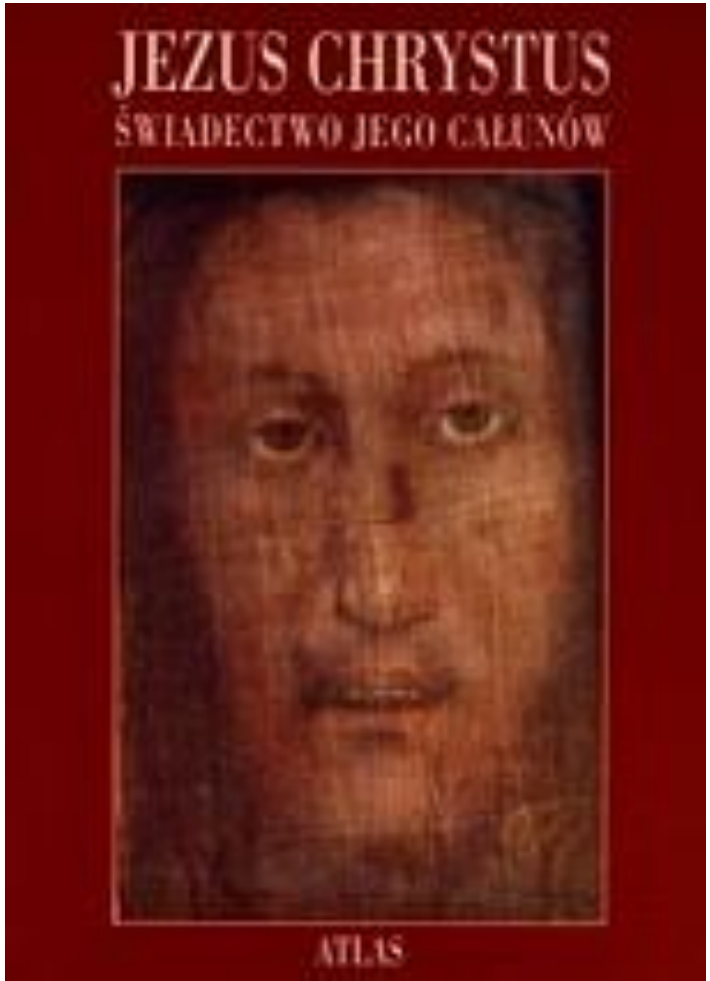

10140x11028 pixels; 8-bit; 107MB





The Manoppello Image

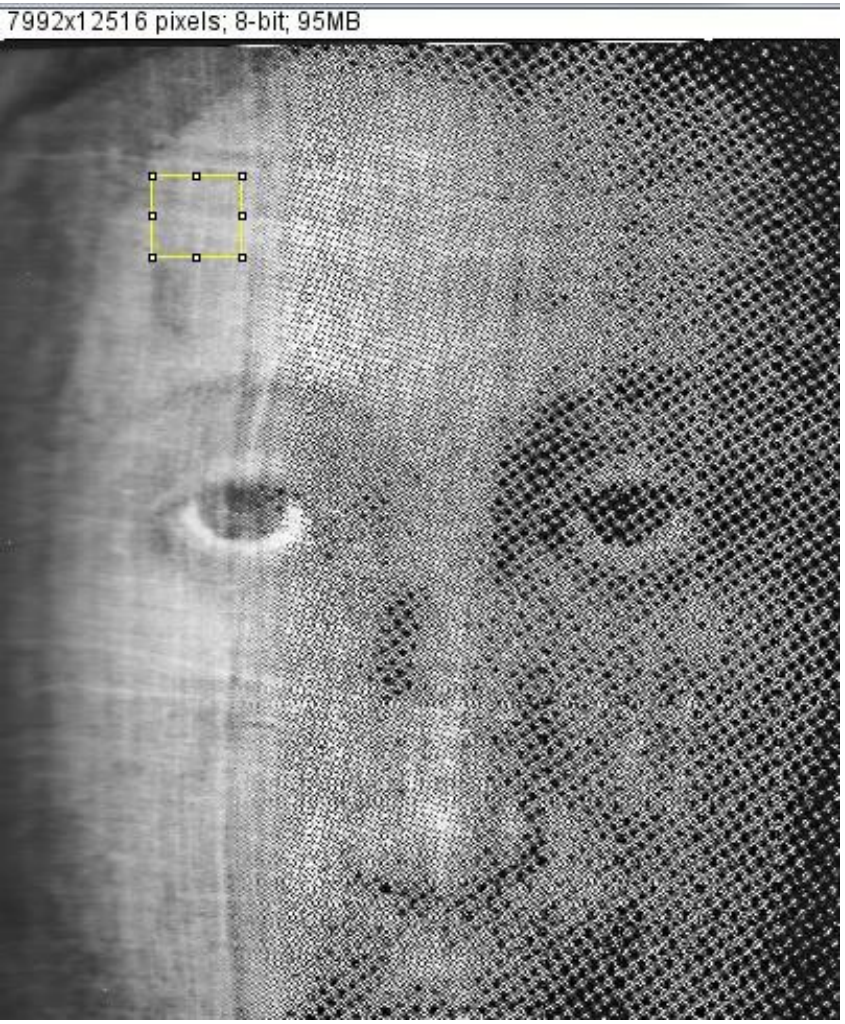
We could play this without the end. However, there is also another matter that I would like to check. The Manoppello Veil –considered by some as miraculous image, and as a manmade object by others. Does it show directionality of hand of its supposed painter?

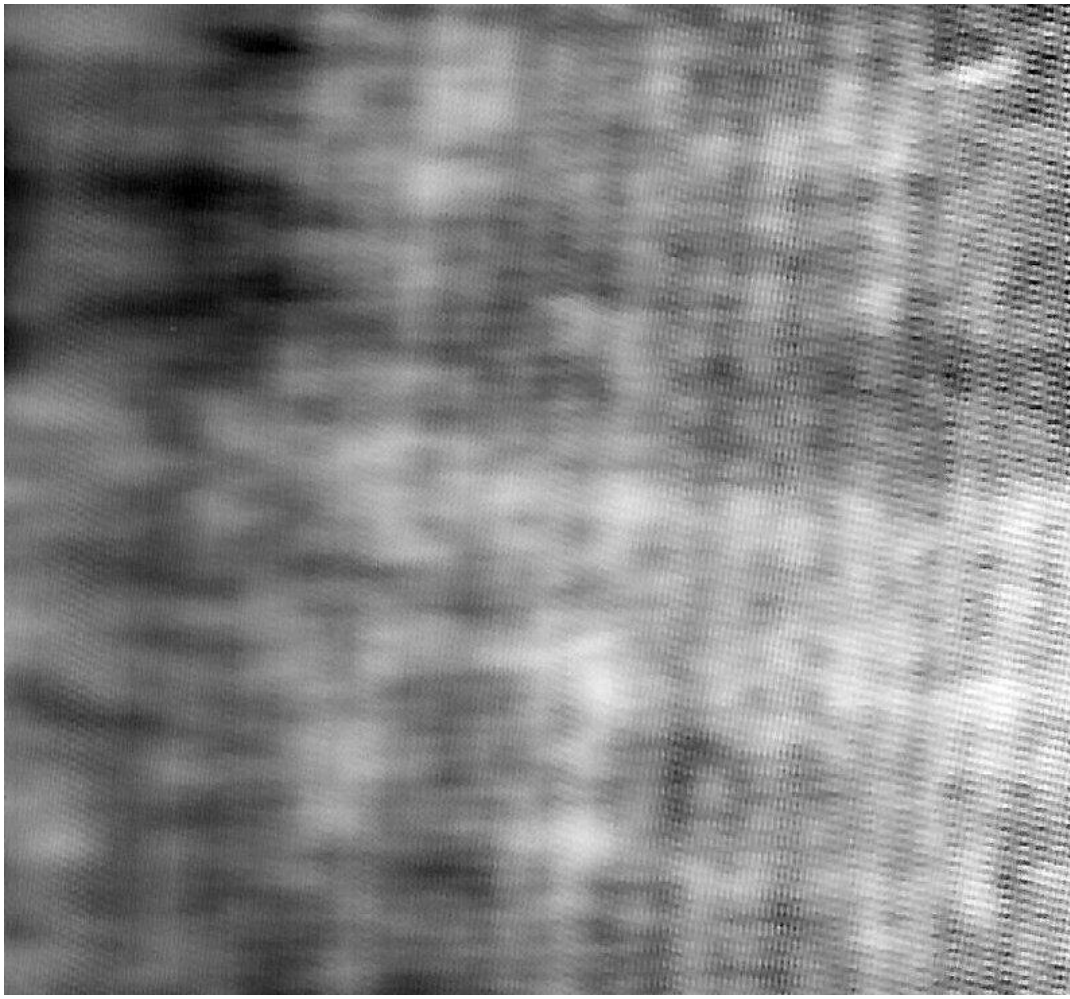


Unfortunately, although I have an atlas by sister Blandina Paschalis Schloemer with several high quality photographs, the matter turned out to be more complex…

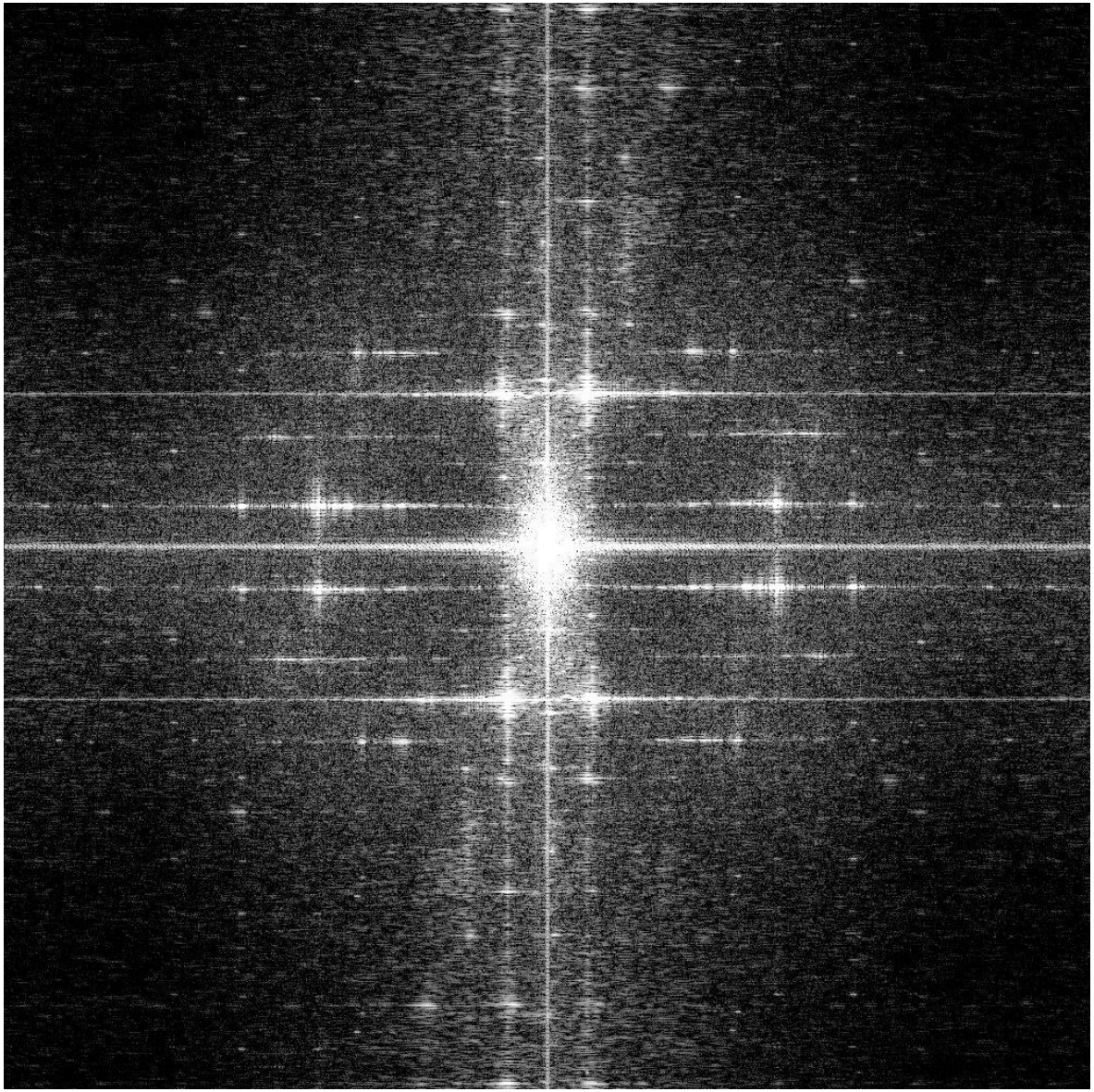
First , as atlas is A4 format book, and I have small area scanner, the result was quite bad scanning – the entire right side apparently got defocused. Had I cut the entire page from it, maybe it would have scanned better –but the atlas is not only high quality , but high price!

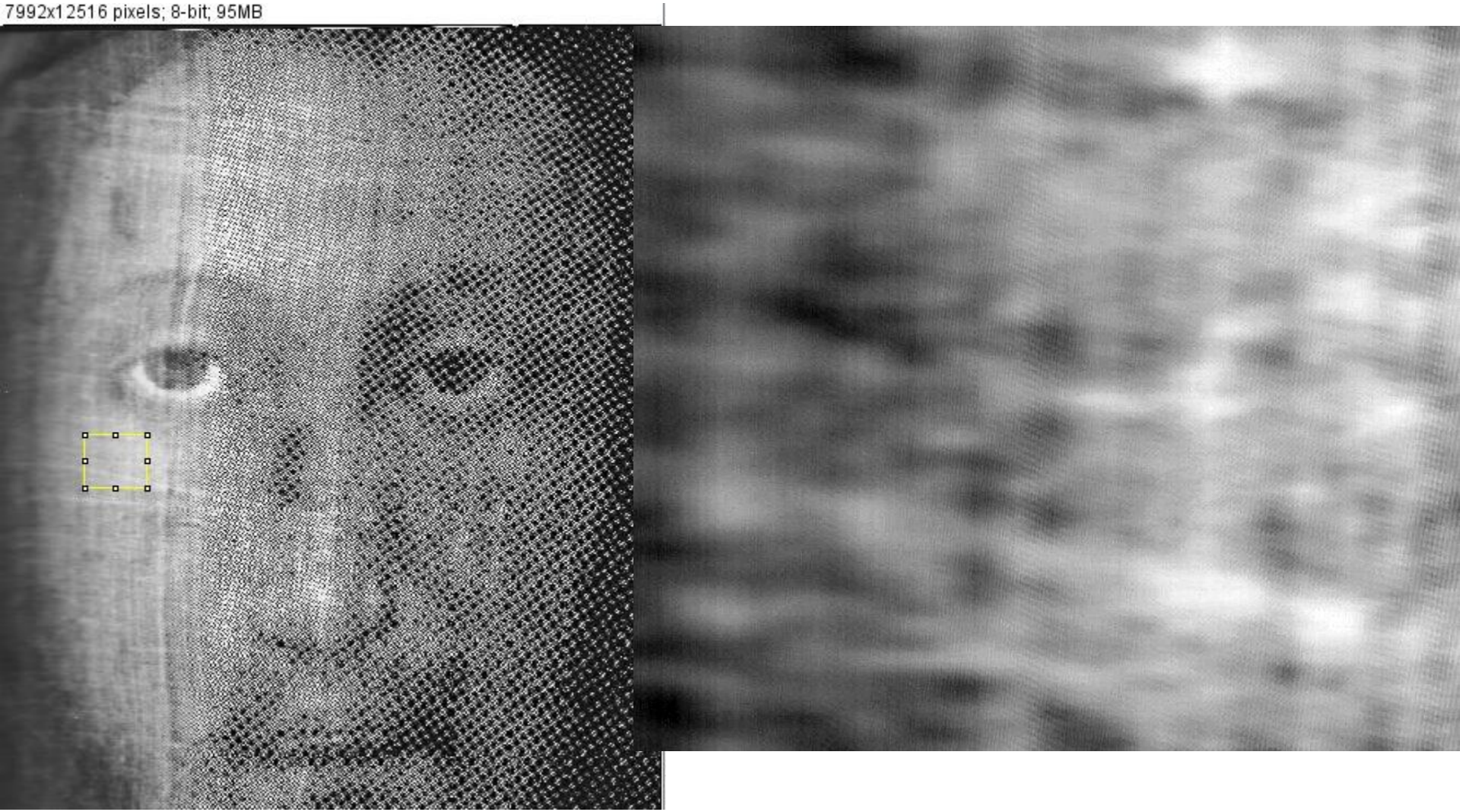
Nevertheless I tried, using left side of scanned image. But the results were far from conclusive…

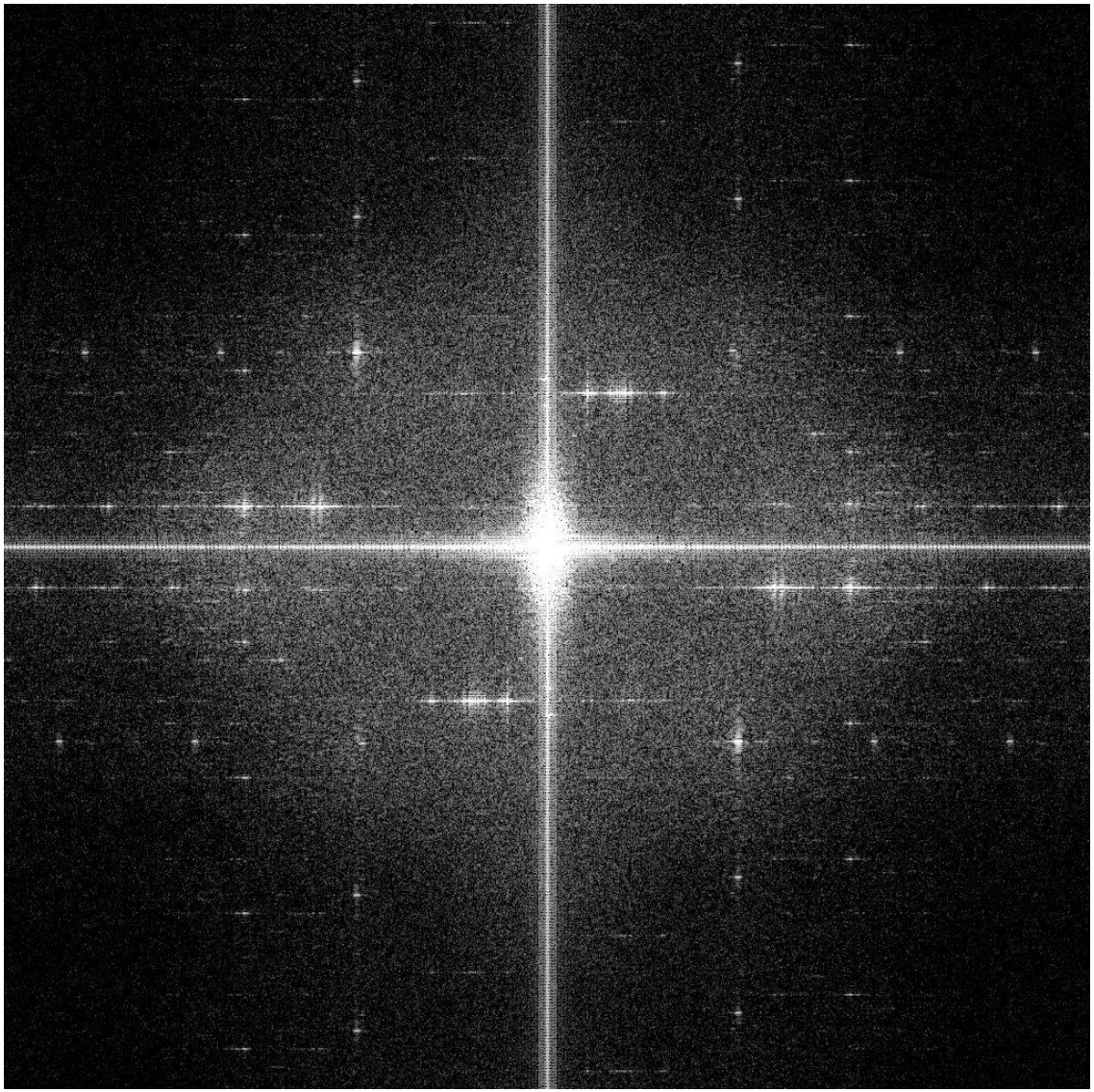




The FFT of the marked area on Manoppello:




7992x12516 pixels; 8-bit; 95MB

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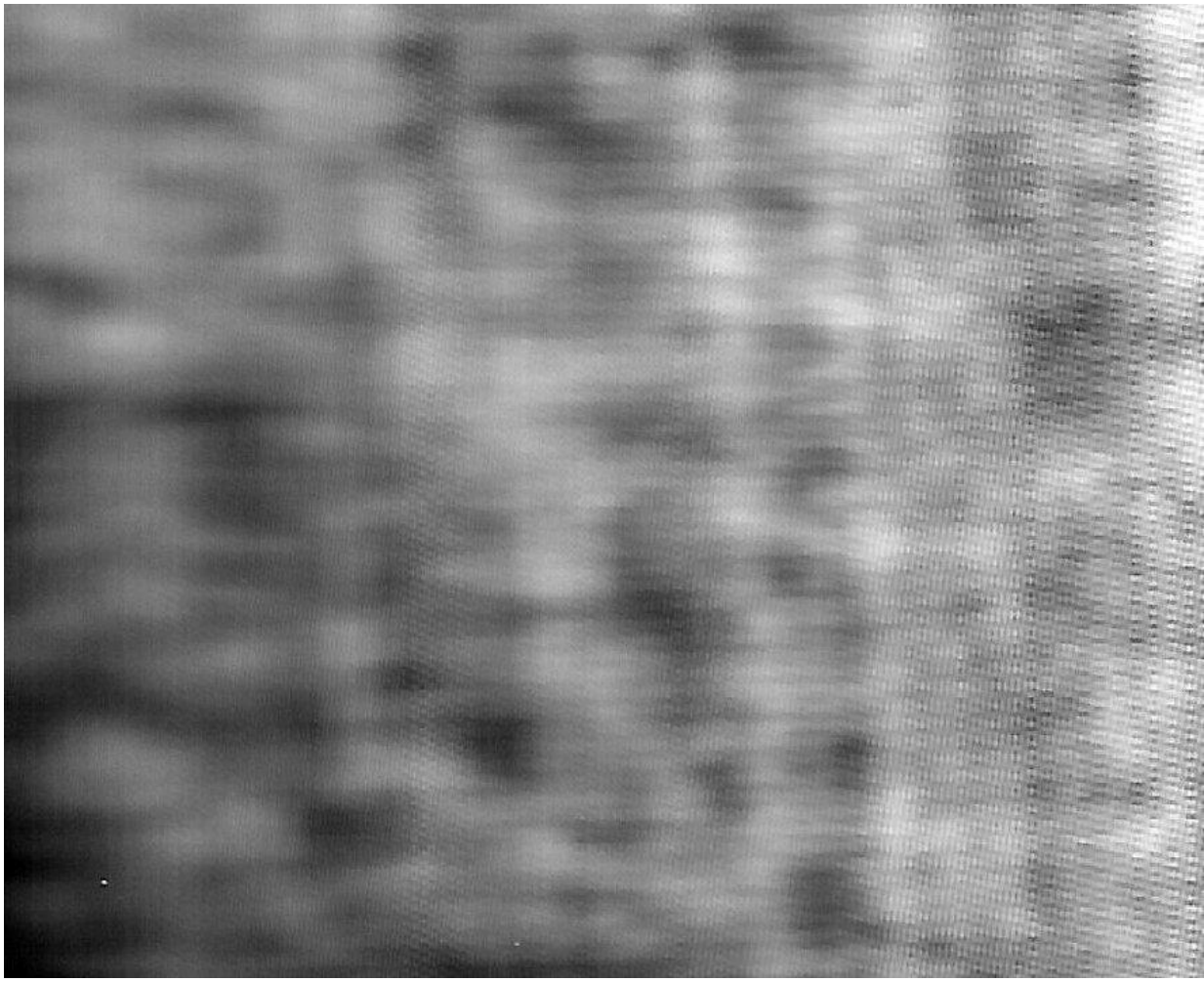

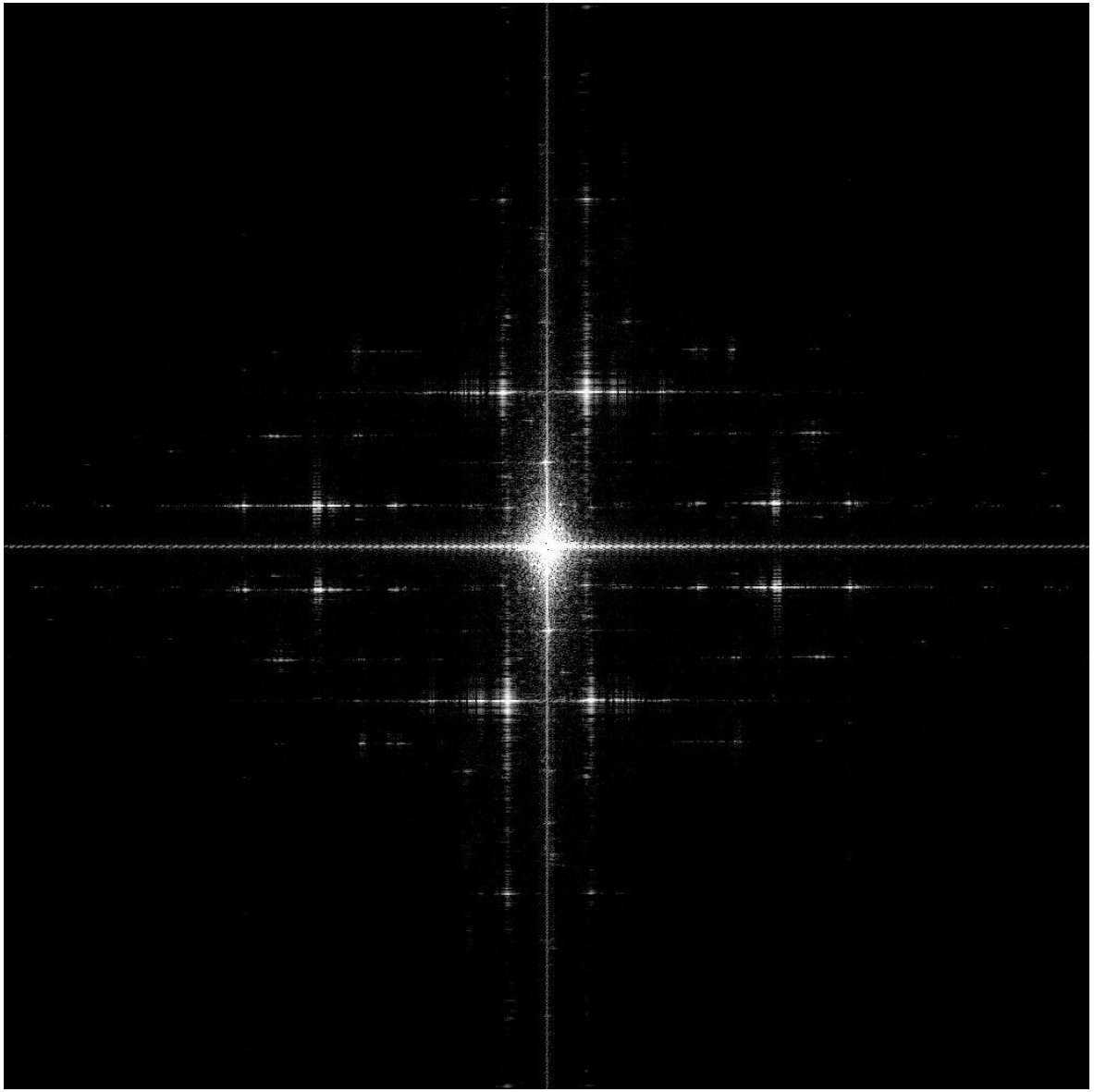

A few comments are necessary. Is the Fourier spectrum of Manoppello Image isotropic? Hard to say. I think rather ‘yes’ but , it isn’t so perfect isotropy like in the case of the Shroud (one should always have in mind that in reality there is no absolute isotropy), and the matter requires further research.

However, one should take into account an extremely complex nature of the Veil. As we can see on the left (the photo by Paul Badde, via Juliusz Maszloch site), when illuminated by small angle, the Veil reveals several , mainly vertical, but also horizontal bands, which may give impression of several brushstrokes. The nature of those bands remain unclear. So it is necessary to take care, when interpreting results of FFT analysis.

Conclusions

I could write in conclusion the very same what I have written in introduction: as both blood and body images on the Shroud show isotropic FFT spectrum, it practically excludes that they were painted. We can say that the Shroud is indeed in literal sense *acheiropoietos* –not made (directly) by human hands (Marion and Courage agree with me). It is practically impossible for humans to make images without some preffered directions –they are always established, no matter what human would do, simply our trained behaviour is much more regular, than random –we are unable to make fully random moves, that would erase Fourier traces of our hands moving. And of course such demand was far beyond thinking horizon of medieval forger.

This of course eliminates the so-often-raised-by-the-sceptics scenario that blood (or pseudo-blood) was later manually added by some clever forgers –or any potential touch ups. All McCrones or Freemans who think the body image, or bloodstains were manually applied to the surface of the cloth would have very easy task –just show us Fourier „signature" of the forger. So why haven't they done this so far, if they are so convinced that their case is right?