

# Moiré

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## Abstract

As a digital artist I became interested in the optical phenomenon 'Moiré'. At first I tried desperately to remove the phenomenon when it occurred but after a while I began to see the fascinating beauty of it. In the following I will show 'traditional Moiré patterns I have designed but also 'new' ones of my own design. I will try to give some insight in how I design Moiré patterns and how small changes in the input files have a big effect on the results.

## Moiré; how does it work and why do we avoid it

The optical phenomenon Moiré is an interference pattern created, for example, when two grids are overlaid at an angle, or when they have slightly different mesh sizes. Anyone who uses a camera for instance will try to avoid Moiré patterns because they disrupt the image. (Figure 1) By adjusting the camera to a higher resolution the Moiré effect will often disappear. The Moiré pattern on image 1 appears because the jacket is woven in the fishbone style. If the photographer is solely interested in an image of the jacket than this picture would not be published because of the Moiré pattern. If the photographer is, like me, fascinated by the phenomenon, he most likely will print it.

### In search of examples

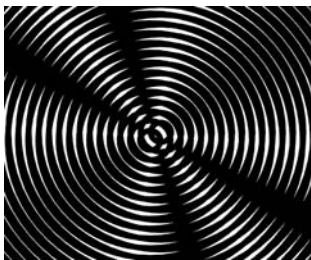


Figure 2: *Concentric circles*

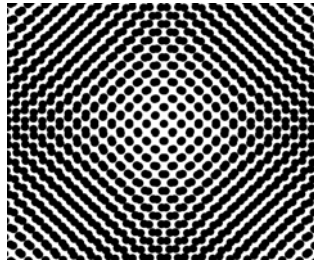


Figure 2: *Disks*

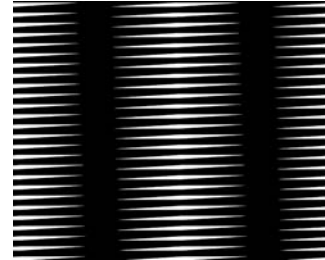
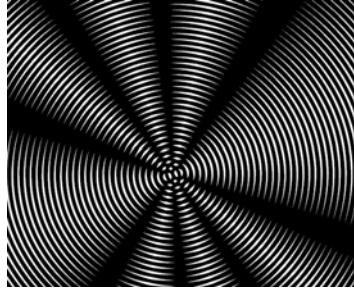


Figure 3: *Lines*

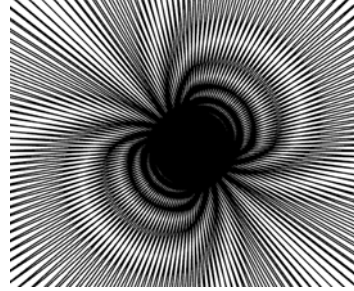
When one tries to find how examples of the optical phenomenon Moiré are made in order to illustrate some forms of it, the literature on the subject and the internet provide three examples most of the time: two layers of concentric circles (Figure 1); two layers of disks (Figure 2); and two layers of lines (Figure 3). All three of these methods can produce beautiful Moiré patterns.

## Creating Moiré patterns with concentric circles and spokes

Before designing my own Moiré patterns I wanted to experiment with concentric circles and spokes first. Because the whole concept of drawing Moiré patterns was new to me I wanted to make sure I got to the bottom of their look and feel. By 'feel' I mean the entire process of creating various shapes of lines (to make circles or spokes) which, in turn create different Moiré patterns. It was at that time not my sole intention to create Moiré patterns but also to find out if lines that differ in thickness create different patterns.



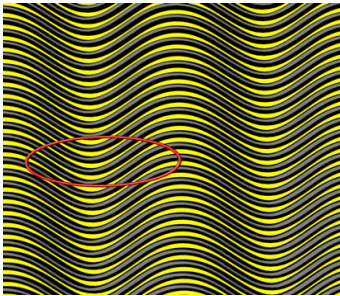
**Figure 4:** *Concentric circles*



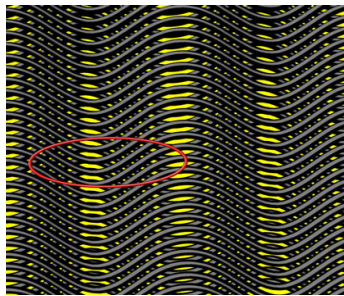
**Figure 5:** *Spokes*

### Creating my own Moiré patterns

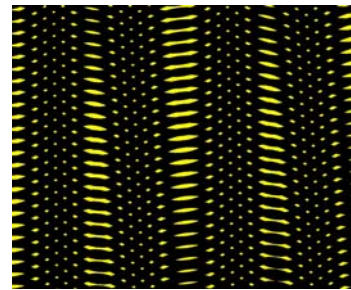
Soon it became clear that these two designs produced more or less the same patterns every time. Figure 4 shows a pattern created with concentric circles. Using concentric circles create patterns that are stripy. Figure 5 shows a pattern that is made with spokes. Using spokes create spider-like patterns. I experienced that to be a limitation. And what's more important I wasn't interested in seeing what caused the pattern to emerge. Concentric circles as well as spokes are too empathic in the drawing. I had to find a way to make the Moiré pattern come more to the foreground and the objects that caused it become more invisible.



**Figure 6:** *Line grid with path*

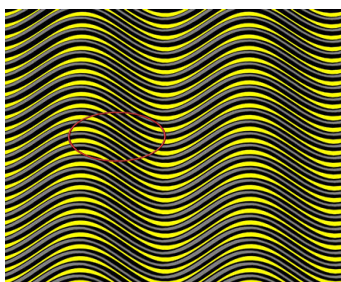


**Figure 7:** *Two line grids*

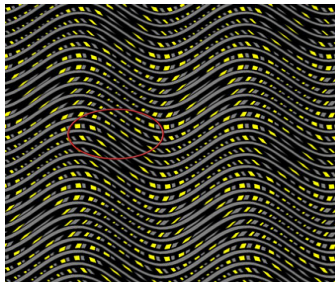


**Figure 8:** *Moiré pattern*

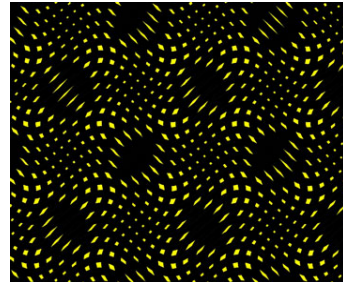
I created a grid of lines. Not straight lines but lines that had a slight wave in it. I then gave this grid the command to move along a path. This is the red oval in figures 6 and 7. After that I made a copy of the entire grid and turned that 90 degrees and placed that one top of the original. The Moiré pattern it created was clearer than the shape of the objects that were the cause of the pattern. (Figure 8 is the first and last frame of an animation I made of this pattern.) To be sure that it was the look of the grids that made it almost invisible and not another coincidental matter I decided to subject these grids to a little test.



**Figure 9** *one grid*



**Figure 10** *two grids*

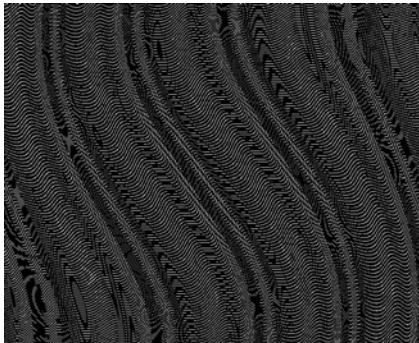


**Figure 11** *Moiré pattern*

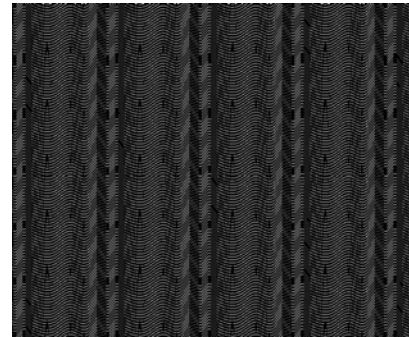
I created similar grids. I made the path a little less oval and turned the upper grid 45 degrees instead of 90. Remembering the concentric circles and the spokes, I expected to see a Moiré pattern that was almost the same as the one shown in figure 8. But the pattern that appeared was completely different! That meant that making relatively small changes to the grids and the path, produced a largely different Moiré (Figure 11)

### The last change

After having produced several Moiré patterns following the procedure as described above, I decided it was time to make a radical change to the grid instead of making small changes all of the time.

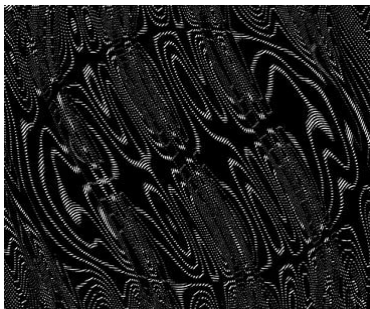


**Figure 12:** *Grid with wave-lines in wave form*

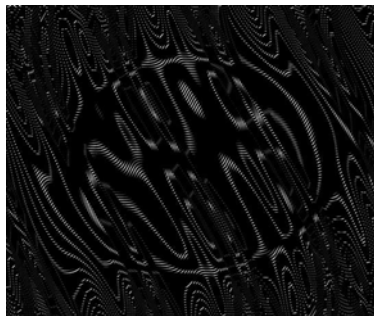


**Figure 13:** *Grid with wave-lines*

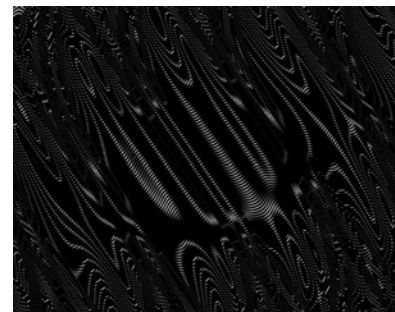
I designed a grid with wave-like lines that had it self a wave-like form. (Figure 12) The underlying grid had the same wave-like lines but not the wave-like form. (Figure 13) Contrary to the previous moiré patterns the upper grid didn't follow a path but turned 360 degrees over it's height axes. After having made an animation of this pattern I noticed that in three frames a strange circle-like pattern emerged. This phenomenon was unique compared to all the other Moiré patterns I had designed! I isolated these 4 frames and rendered them separately as stills. Forth came three, in my opinion, beautiful images of Moiré patterns. When placed in correct order next to each other, they show the circle like form change from big to small. (Figures 14, 15, 16)



**Figure 14** *Opening*



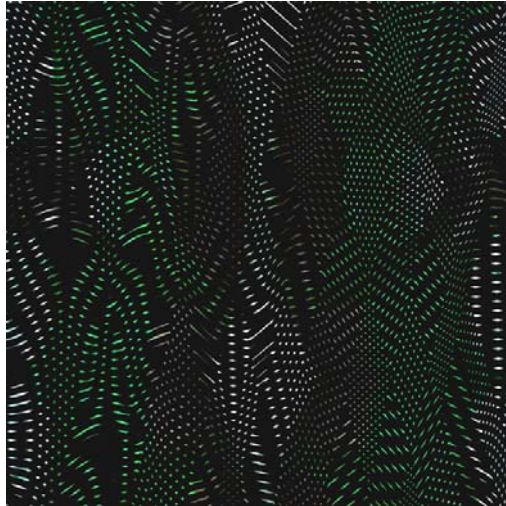
**Figure 15** *Open*



**Figure 16** *Closing*

## Moiré images from animation stills

I decided to add another layer to the moiré patterns, namely colour. I gave them colour in such a way that a strange sense of 3d could be seen. Along with that, I made these stills to be somewhat ominous.



**Figure 17:** *Unsettled depth #1*

In the near future I intend to make various objects on which a moiré pattern can be seen through glass or an other transparent material. These object can be; boxes, cases, tables, etcetera.

## References

- [1] A. M. F. Wegdam, O. Podzimek and S. Zijlstra, *Projecting moiré fringe pattern prediction using the optical transfer function*, Applied Optics **30**, Issue 13. 1991
- [2] I. Amidror, *The Theory of the Moiré Phenomenon*, Kluwer, Dordrecht, The Netherlands, 2000