

Write a program that prints out one-dimensional grating

Requirements:

- The grating should have 2 mm pitch.
- The white part should be 1 mm long.
- The black part should be 1 mm long.

Write a program that prints out two-dimensional grating like Picture .

Requirements:

- The grating should have 2 mm pitch.
- The grating pattern should not be clear-cut black and white.
- The grating pattern should have cosine waves of brightness horizontally and vertically.

Moiré patterns can be used for accurate displacement detections and 3D shape detections. Toward this goal, a person need a grating pattern which should be projected on the surface of the sample object. Then, an image from the object will be obtained while the image of the grating is projected on it. Finally, image processing techniques will be used to filter data and extract information including all type of special measurements.

In practice, as can be seen in the Figure 1, there are several parameters involved to project grating patterns (in pixels) on the surface of an object in a way that the pitch of the grating patterns are as predefined (2mm for the example here). If grating patterns are simulated using programming language like MATLAB or Python, as I did, the exchange rate of Pixels to millimeter would be depends on several experimental parameters such as:

- Enlargement Rate of the projector lenses
- Distance of the object from the projector
- Size of the Image in the software



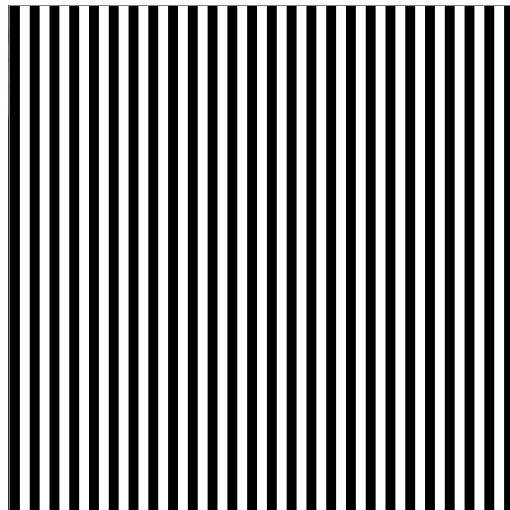
Figure 1 a simple moire setup

Therefore, the practical setup highly affects the size of each pixel in real life.

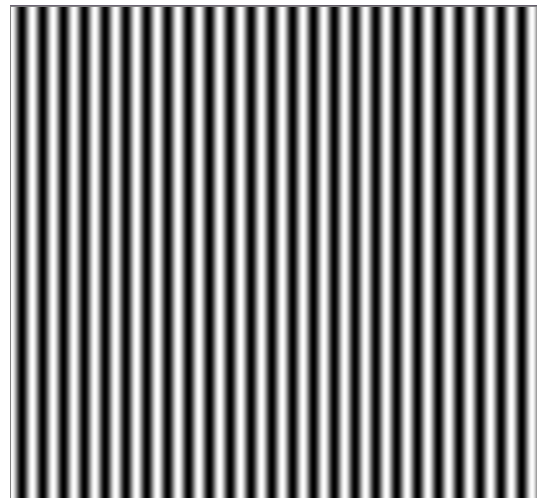
I created a 500*500 Pixel Image in Python (and MATLAB) programming language and I considered the pitch of grating equal to 20px.

Meanwhile, I used two different codes for drawing 1D and 2D gratings (with respects to two rules which I mentioned previously). In the first code, my images considered to have hard edges, and in second code, soft edge can be seen in grating patterns by using cosine wave (brightness changes in the scale of 0 to 255).

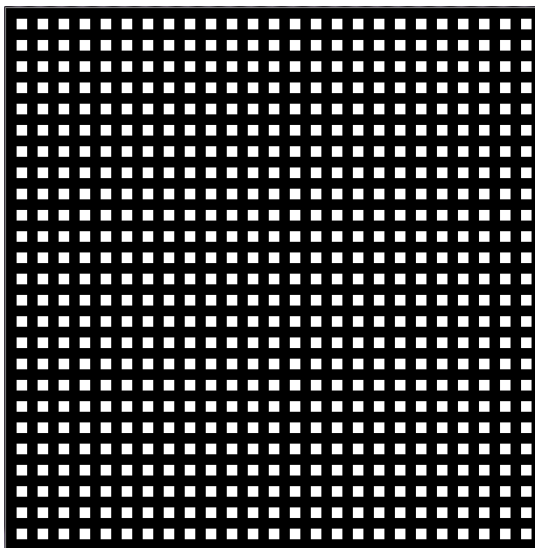
When it comes to a practical setup, I personally have been using hard edge gratings. The projection device and the camera will soften the edges, and the scattering from the object would also affect the output. This is while, utilizing image processing methods such as a Low-Pass filters to remove grating original lines will seriously degrade the images. So, I think utilizing soft edge gratings will degrade the final results. In Following Images, the outputs of each code is illustrated:



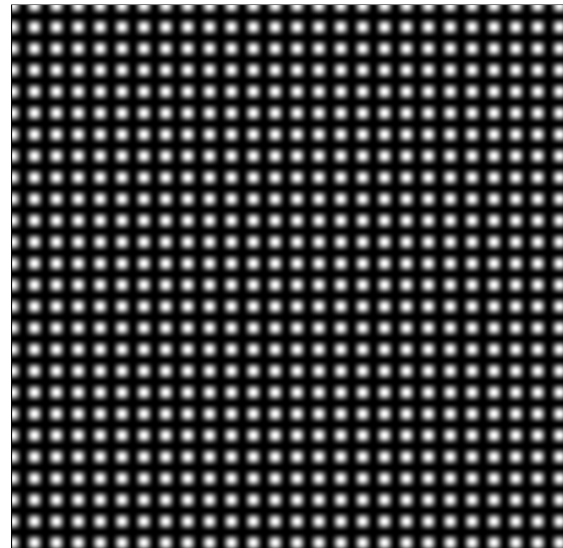
(A)



(B)



(C)



(D)

Figure 2 (A and B) presenting grating with hard edges in 1D (A) and in 2D (B), (C and D) presenting grating with soft edges in 1D (C) and in 2D (D)