

* Please download the data files from “NCKU Moodle”

1. Nano-gratings manufactured by Nano-Imprinting Lithography has been widely used in life, such as cameras. In order to make the grating work in a fixed light band, it is important to measure its period. The grating pictures measuring by AFM, as shown in the figure (a) (b), are a grayscale image, whose white region has the greater structure high than its black region.

However, manual measurement always produces subjective errors. We need an Objective mathematical method to determine the grating period. Please use the signal process skills in DSP class to determine (1) the grating period, (2) the grating angle with horizontal. And also compare the period result with the directly human judgment by yourself.

Note: you might use the information of both real size and pixel size to determine the sampling period of image.

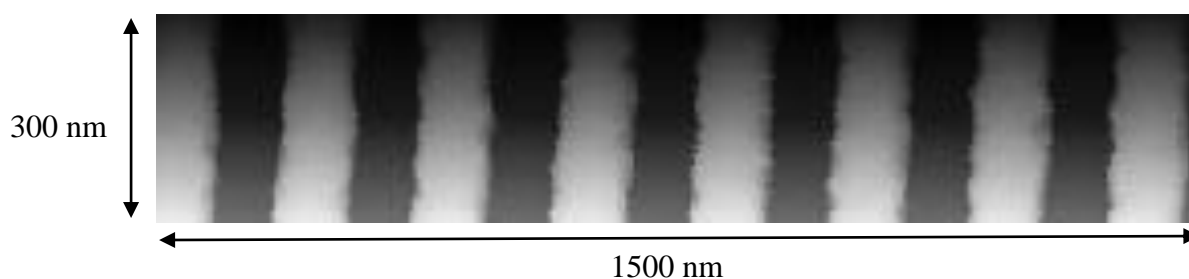


figure (a)

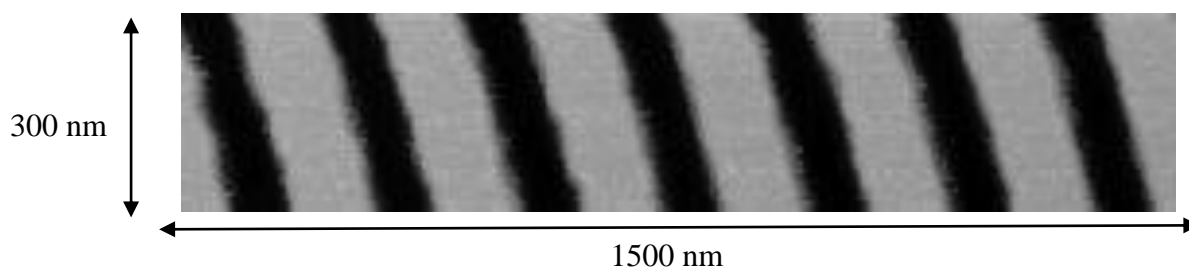


figure (b)

2. In below is the famous Lenna image, a standard image widely used in digital image processing.
(a). Please first download this Lenna color image and transform it into a grey-scaled image; (b). please use Sobel operator to extract the contour profile of the image. Please develop your own Sobel operator program and submit your computer codes along with your report.

(下圖是影像處理的標準測試圖，萊娜圖(Lenna)，圖檔請從 moodle 下載。(a)請將萊娜圖讀入程式中，進行灰階轉換，並呈現結果。(b)將圖片資料型態轉換為浮點數(double)進行計算，並利用 Sobel 運算子分別計算下圖的 xy 方向邊緣線後，繪製出完整的邊緣輪廓圖。請附上 code，禁止使用現有的 Sobel 函式進行運算)。

$$G_x = \begin{bmatrix} -1 & 0 & +1 \\ -2 & 0 & +2 \\ -1 & 0 & +1 \end{bmatrix} * I, \quad G_y = \begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ +1 & +2 & +1 \end{bmatrix} * I$$

$$G = \sqrt{G_x^2 + G_y^2}, \quad G = |G_x| + |G_y|$$

