

**Principles of Biomedical Ultrasound and
Photoacoustics
hw02: Speckle Statistics**

Due on Thursday, Nov 16, 2017

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1 Introduction

In this homework, we will use Matlab tool **Field2** to simulate speckle scattering.

2 Part I

In this part, we need to create a complex array with 10000 dimension, which magnitude is uniform distribution $[0, 1]$ and phase $[0, 2\pi]$. We name this array as **origin array**.

2.a Histogram of the Amplitude and Intensity

Figure 1 shows the histogram of amplitude and intensity of origin array.

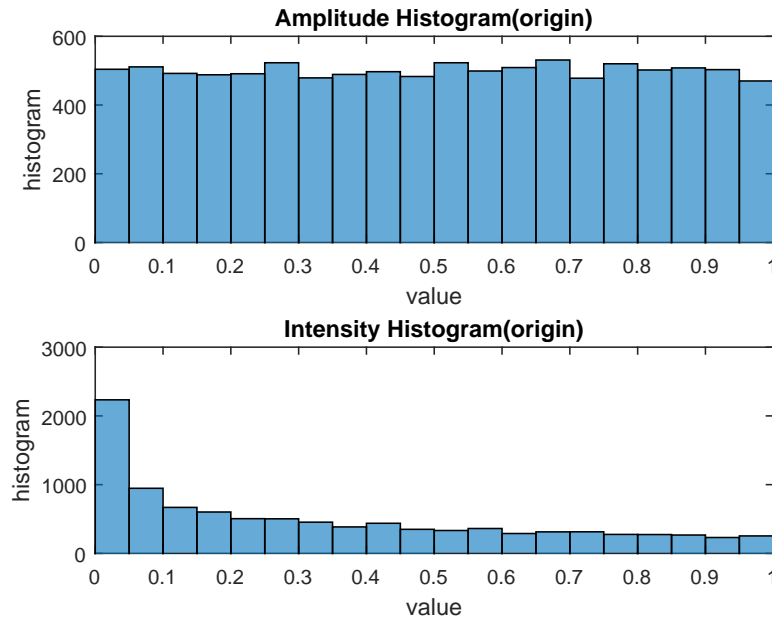


Figure 1: Histogram of amplitude (top) and intensity (bottom) of origin array

2.b Histogram and Ratio of new array

Now we create an new array with size **N** (**= 10000, 5000, 2000, 1000, 500**), which value is the sum of **M** (**= 1, 2, 5, 10, 20**) consecutive data:

$$val(i) = \sum_{k=(i-1)*M}^{i*M} origin(k)$$

And then plot their histogram and calculate ratio of mean and standard deviation as a function of **M**.

Figure [2, 3, 4, 5, 6, 7, 8, 9, 10, 11] show the histogram result and Figure [12, 13, 14, 15, 16] show the ratio as a function of **M**.

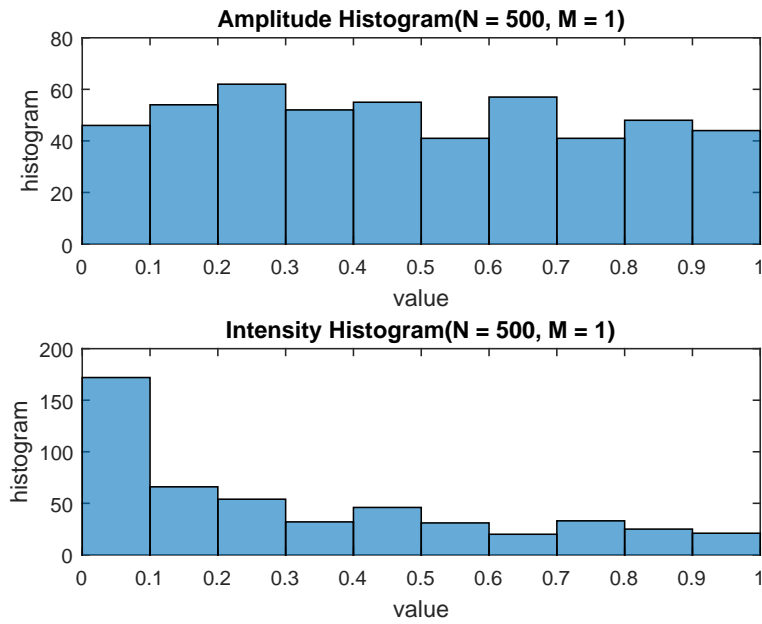


Figure 2: Histogram of amplitude (top) and intensity (bottom) of new array ($N = 500$, $M = 1$)

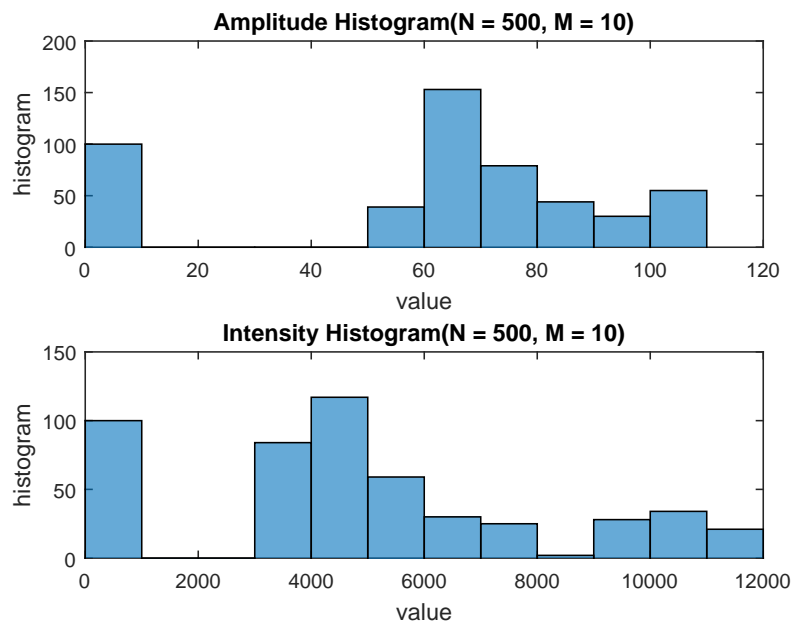


Figure 3: Histogram of amplitude (top) and intensity (bottom) of new array ($N = 500$, $M = 10$)

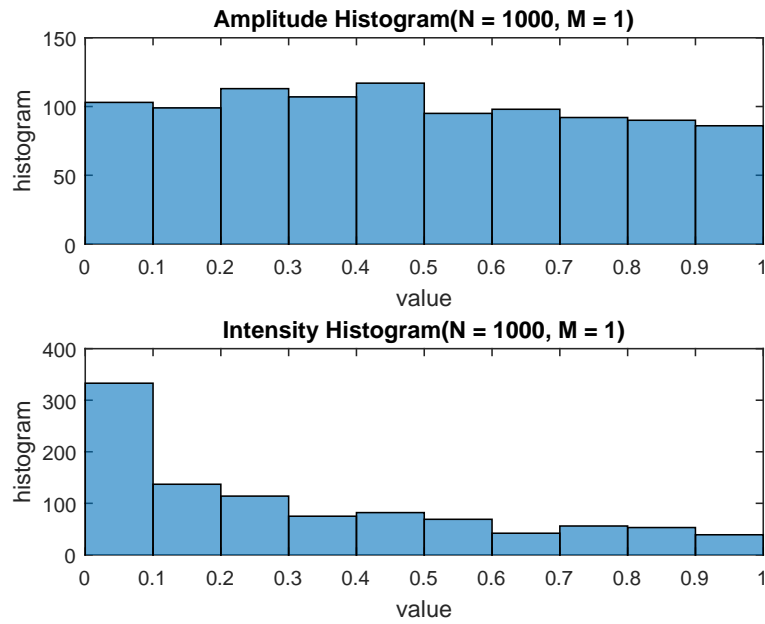


Figure 4: Histogram of amplitude (top) and intensity (bottom) of new array ($N = 1000$, $M = 1$)

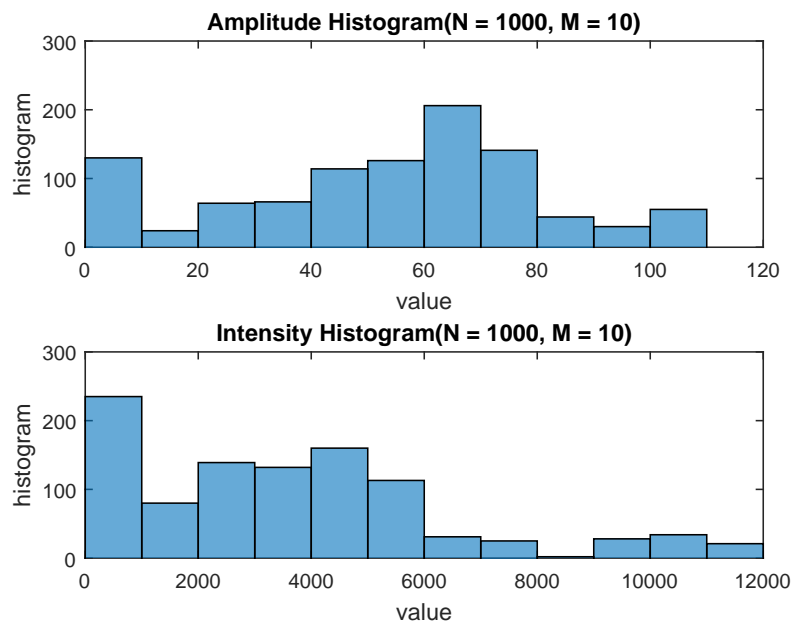


Figure 5: Histogram of amplitude (top) and intensity (bottom) of new array ($N = 1000$, $M = 10$)

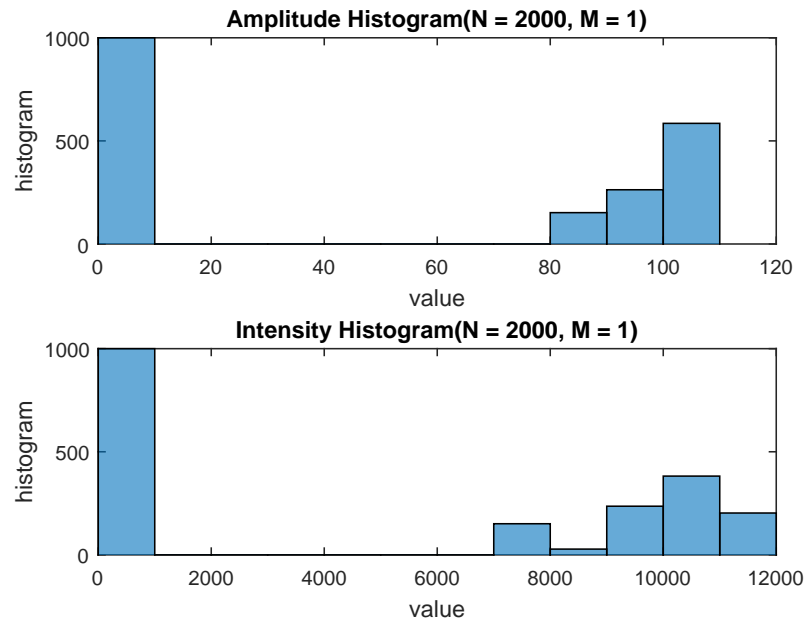


Figure 6: Histogram of amplitude (top) and intensity (bottom) of new array ($N = 2000$, $M = 1$)

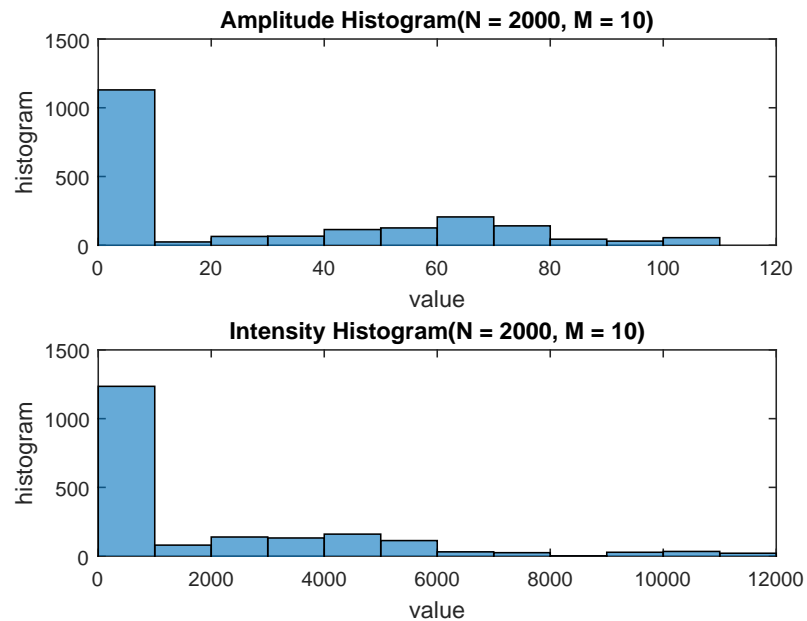


Figure 7: Histogram of amplitude (top) and intensity (bottom) of new array ($N = 2000$, $M = 10$)

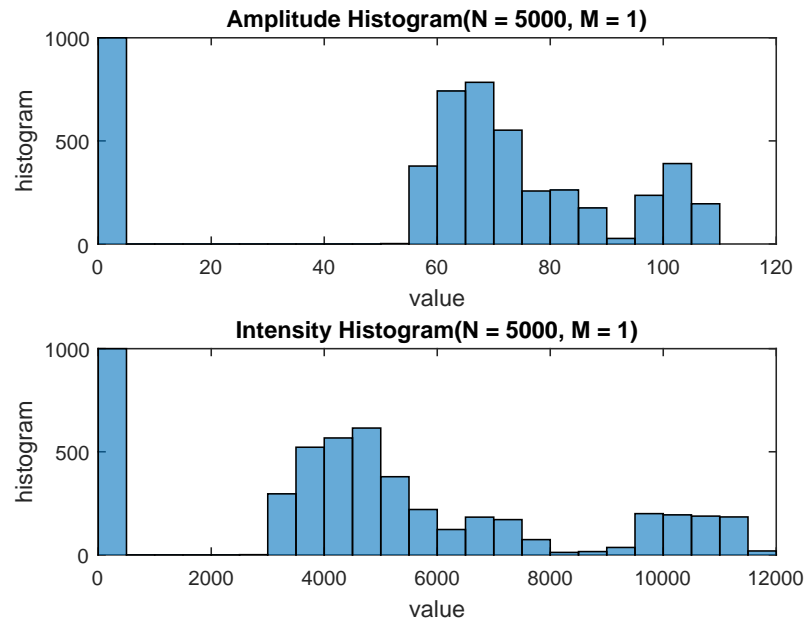


Figure 8: Histogram of amplitude (top) and intensity (bottom) of new array ($N = 5000$, $M = 1$)

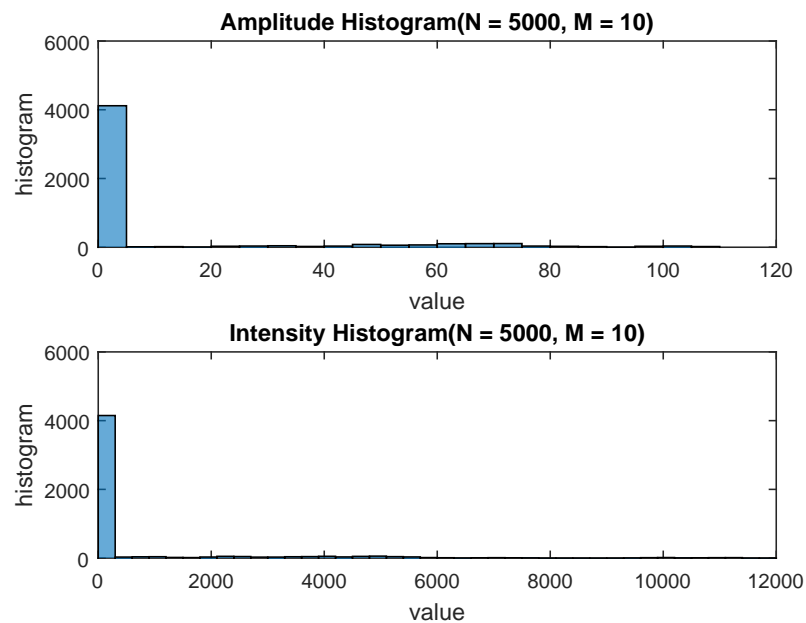


Figure 9: Histogram of amplitude (top) and intensity (bottom) of new array ($N = 5000$, $M = 10$)

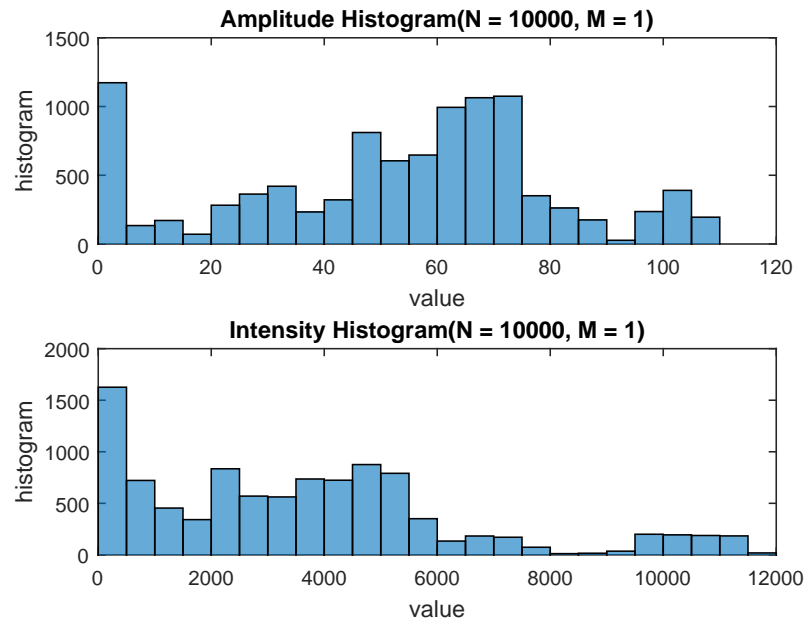


Figure 10: Histogram of amplitude (top) and intensity (bottom) of new array ($N = 10000$, $M = 1$)

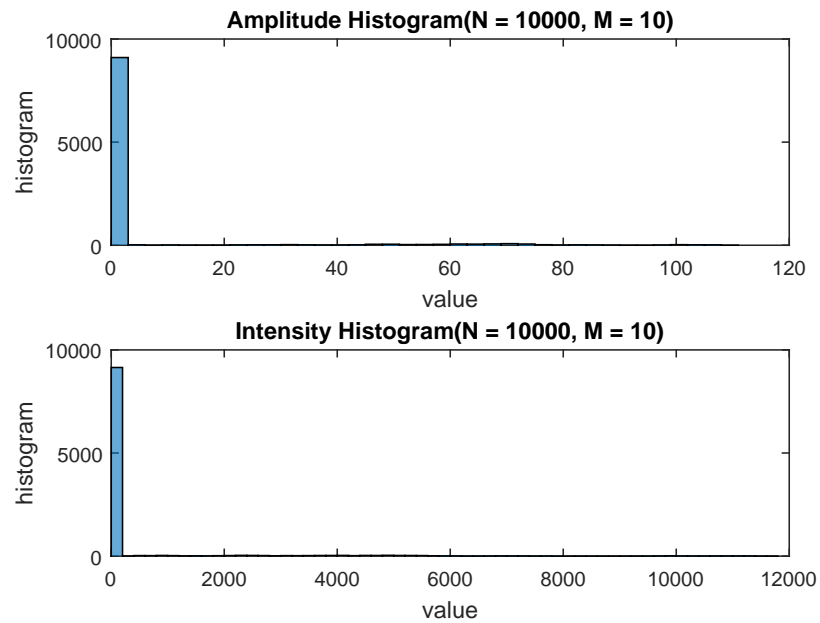
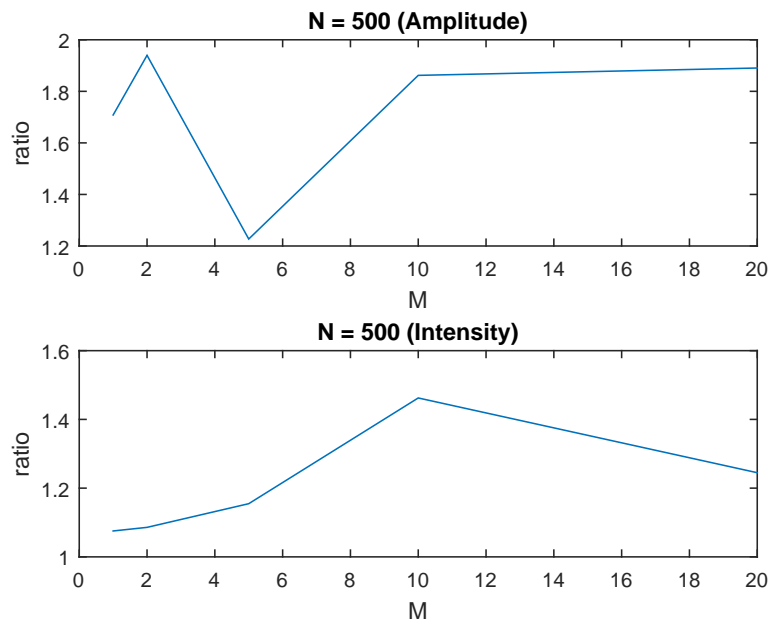
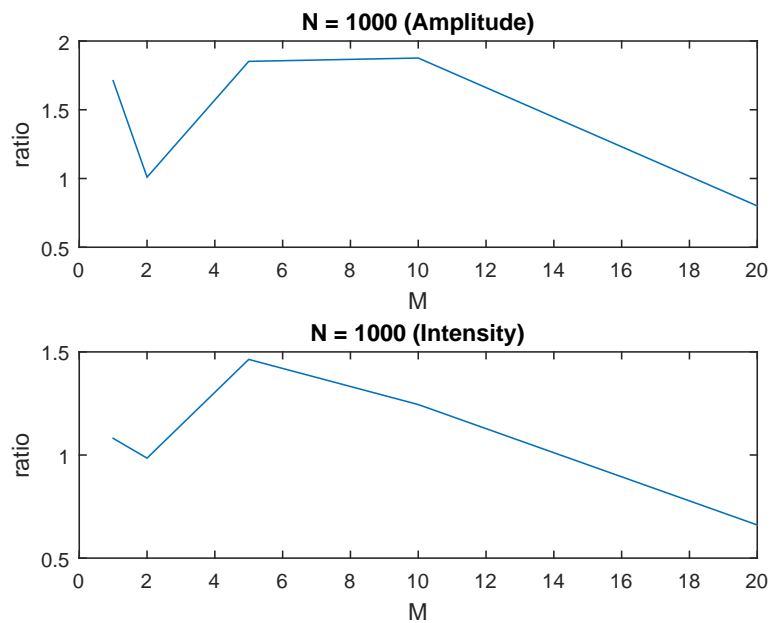
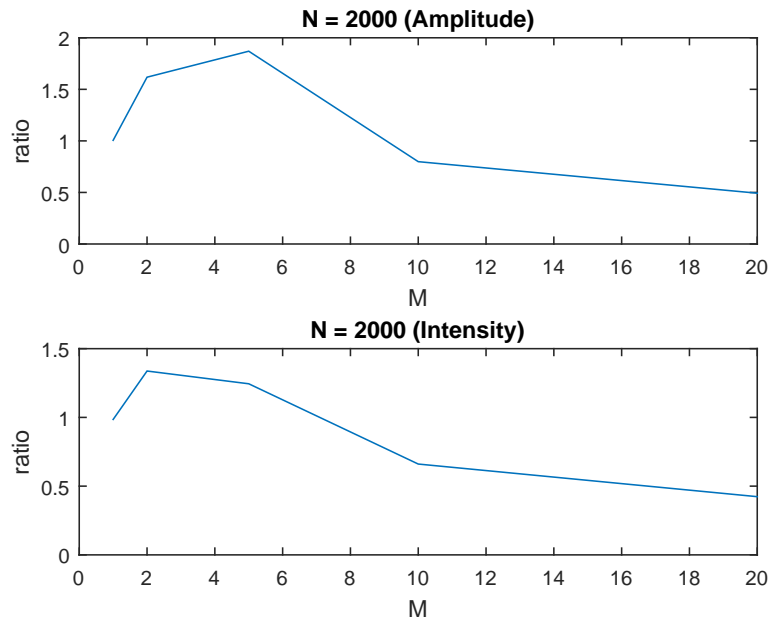
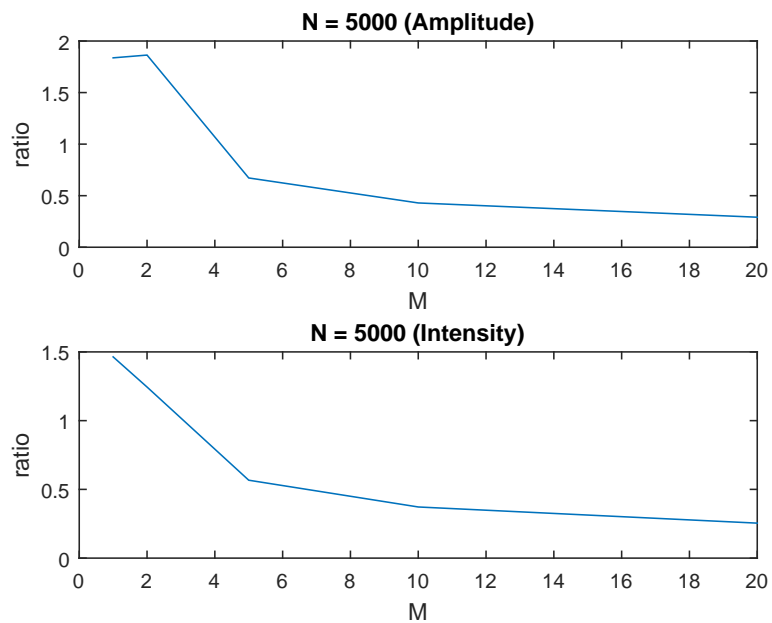


Figure 11: Histogram of amplitude (top) and intensity (bottom) of new array ($N = 10000$, $M = 10$)

Figure 12: Ratio of mean and standard deviation ($N = 500$)Figure 13: Ratio of mean and standard deviation ($N = 1000$)

Figure 14: Ratio of mean and standard deviation ($N = 2000$)Figure 15: Ratio of mean and standard deviation ($N = 5000$)

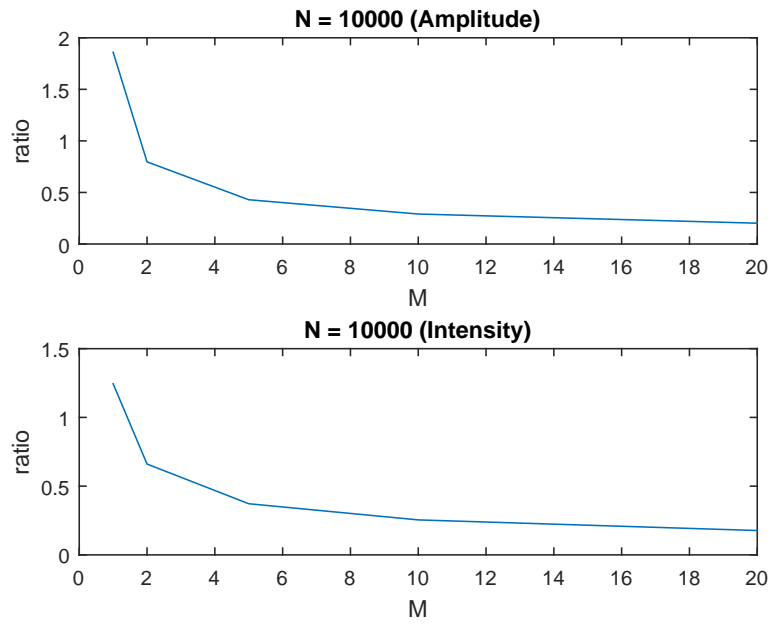


Figure 16: Ratio of mean and standard deviation ($N = 10000$)