Palawan State University
College of Sciences
Computer Studies Department

DIGITAL IMAGE PROCESSING LABORATORY EXERCISE #7

Computation of Mean, Standard Deviation, Correlation coefficient of the given Image

The computation of mean, standard deviation, and correlation coefficient of an image involves statistical analysis of the pixel values within the image matrix. Here's what each of these statistical measures represents in the context of image processing:

1. **Mean (Average):**
   - The mean of an image represents the average pixel intensity value across all pixels in the image.
   - It provides a measure of the central tendency of the pixel values and can indicate the overall brightness level of the image.
   - Mathematically, the mean μ of an image I with M rows and N columns is computed as:

$$\mu = \frac{1}{M \times N} \sum_{i=1}^{M} \sum_{j=1}^{N} I(i, j)$$

2. **Standard Deviation:**
   - The standard deviation of an image measures the dispersion or spread of pixel intensity values around the mean.
   - It provides information about the variability or contrast within the image.
   - Mathematically, the standard deviation σ of an image I is computed as:

$$\sigma = \sqrt{\frac{1}{M \times N} \sum_{i=1}^{M} \sum_{j=1}^{N} (I(i, j) - \mu)^2}$$

3. **Correlation Coefficient:**
   - The correlation coefficient measures the degree of linear relationship between pixel intensities of two images.
   - It quantifies how similar or dissimilar the pixel values of two images are.
   - Mathematically, the correlation coefficient ρ between two images ∫1 and ∫2 is computed as:

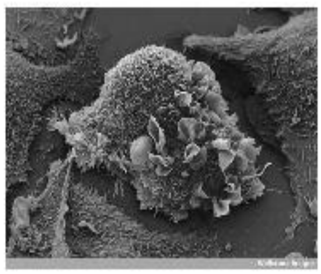
$$\rho = \frac{\sum_{i=1}^{M} \sum_{j=1}^{N} (I_1(i,j) - \mu_1)(I_2(i,j) - \mu_2)}{\sqrt{\sum_{i=1}^{M} \sum_{j=1}^{N} (I_1(i,j) - \mu_1)^2 \sum_{i=1}^{M} \sum_{j=1}^{N} (I_2(i,j) - \mu_2)^2}}$$

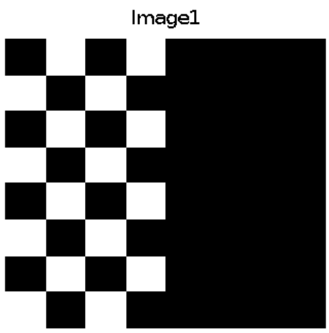
   - Here, μ1 and μ2 are the means of images ∫1 and ∫2 respectively.

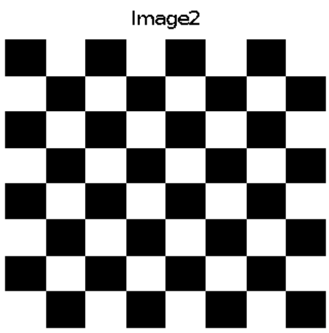
Computing these statistical measures provides insights into the distribution and relationships of pixel intensities within an image, which can be valuable for various image processing and analysis tasks.

```
i=imread('cancercell.jpg');
subplot(2,2,1); imshow(i);title('Original Image');

g=rgb2gray(i);
subplot(2,2,2); imshow(g);title('Gray Image');

c=imcrop(g);
subplot(2,2,3); imshow(c);title('Cropped Image');

m=mean2(c);disp('m'); disp(m);
s=std2(c); disp('s'); disp(s);

figure,
k=(checkerboard>0.8);
subplot(2,1,1); imshow(k); title('Image1');

k1=(checkerboard>0.5);
subplot(2,1,2); imshow(k1); title('Image2');

r=corr2(k,k1);
disp('r');disp(r);
```

```
m
   74.5173

s    44.2327

r
     0.5774
```







Exercise #7

Computation of Mean, Standard Deviation, Correlation coefficient of the given Image

Name:
Year/Block:
Application/Software:

1. Codes
2. Output
3. Answer the following questions:
   A. How do mean and standard deviation reveal an image's brightness and contrast, and how can Python or MATLAB efficiently calculate these statistics? What considerations are important for optimization? Also, how do variations in these measures affect an image's appearance, and can you provide enhancement examples?

   B. What is the correlation coefficient in image processing, and how is it computed? Can you give practical examples of its applications in tasks like registration or template matching? Additionally, what challenges arise in its use for image comparison, and how can these be addressed, especially in scenarios involving geometric transformations or noise?

   C. What trade-offs occur between accuracy and computational efficiency when selecting algorithms for statistical measures? How can alternative methods maintain acceptable accuracy levels while speeding up computations? Lastly, how crucial are parallelization and optimization techniques for large-scale image analysis, and what frameworks or hardware accelerators are suitable?