Load data

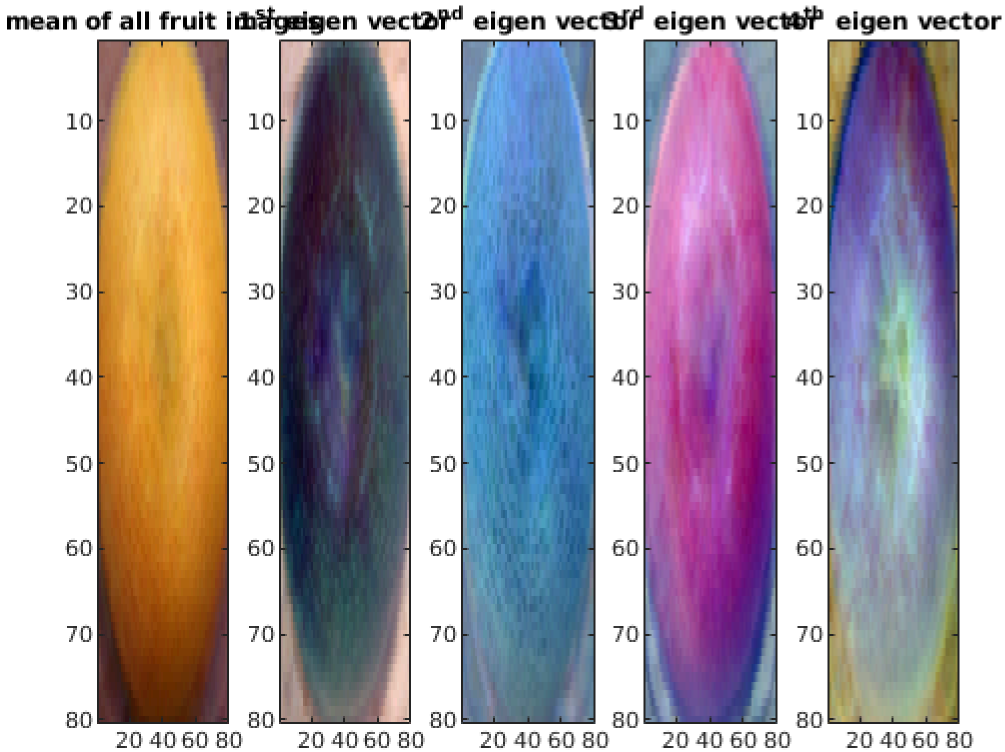
```
%192000 = 3x80x80 = size of each image
%change this if number of images is different from 16
num_images = 16;

I = zeros([19200 , num_images],"double");%vector to store the images
for i = 1:num_images
    %change this if path of image differs
    im = imread("data_fruit/image_" + string(i) + ".png"); %read the ith image
    I(:,i) = reshape(im,[19200, 1]); %reshape the image into a single vector
    %I(:,i) = rescale(I(:,i));
end
```

PCA

```
me = (sum(I,2)/size(I,2)); %mean
I = I - me; %origin shifted to mean
co = I*I' / size(I,2); %covariance matrix
[u, s] = eigs(co,4); % u=eigen vectors, diag(s)= eigenvalues
```

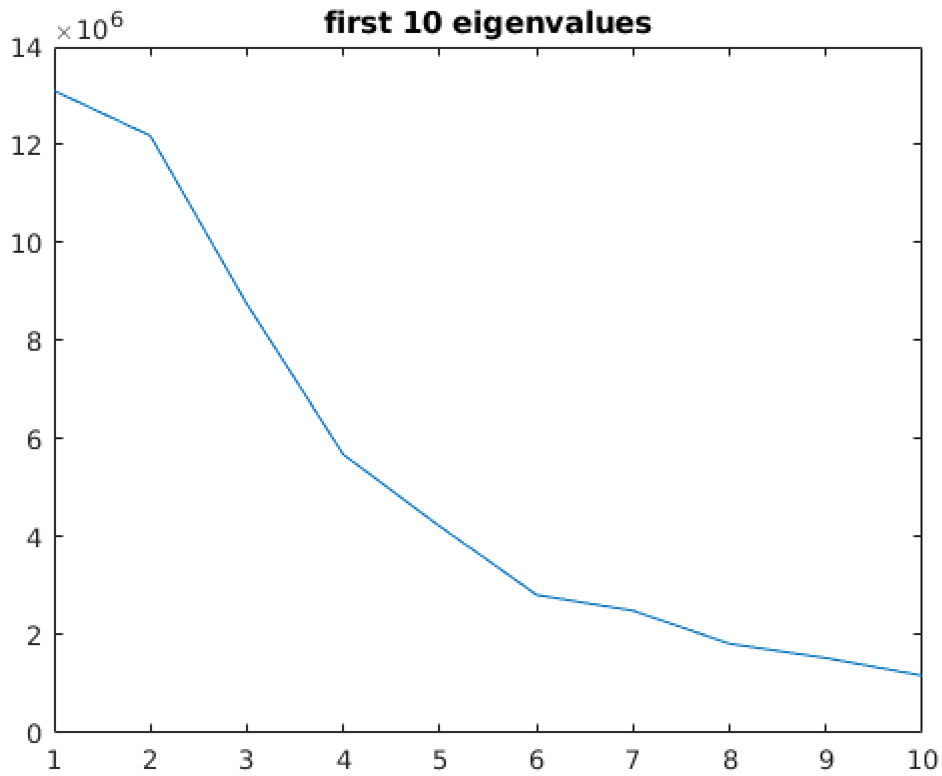
images of mean and eigenvectors

```
figure
subplot(1,5,1),imagesc(rescale(reshape(me,[80, 80, 3])))
title("mean of all fruit images")
subplot(1,5,2), imagesc(rescale(reshape(u(:,1),[80, 80, 3])))
title("1^{st} eigen vector")
subplot(1,5,3), imagesc(rescale(reshape(u(:,2),[80, 80, 3])))
title("2^{nd} eigen vector")
subplot(1,5,4), imagesc(rescale(reshape(u(:,3),[80, 80, 3])))
title("3^{rd} eigen vector")
subplot(1,5,5), imagesc(rescale(reshape(u(:,4),[80, 80, 3])))
title("4^{th} eigen vector")
```



Plot of first ten eigen-vectors

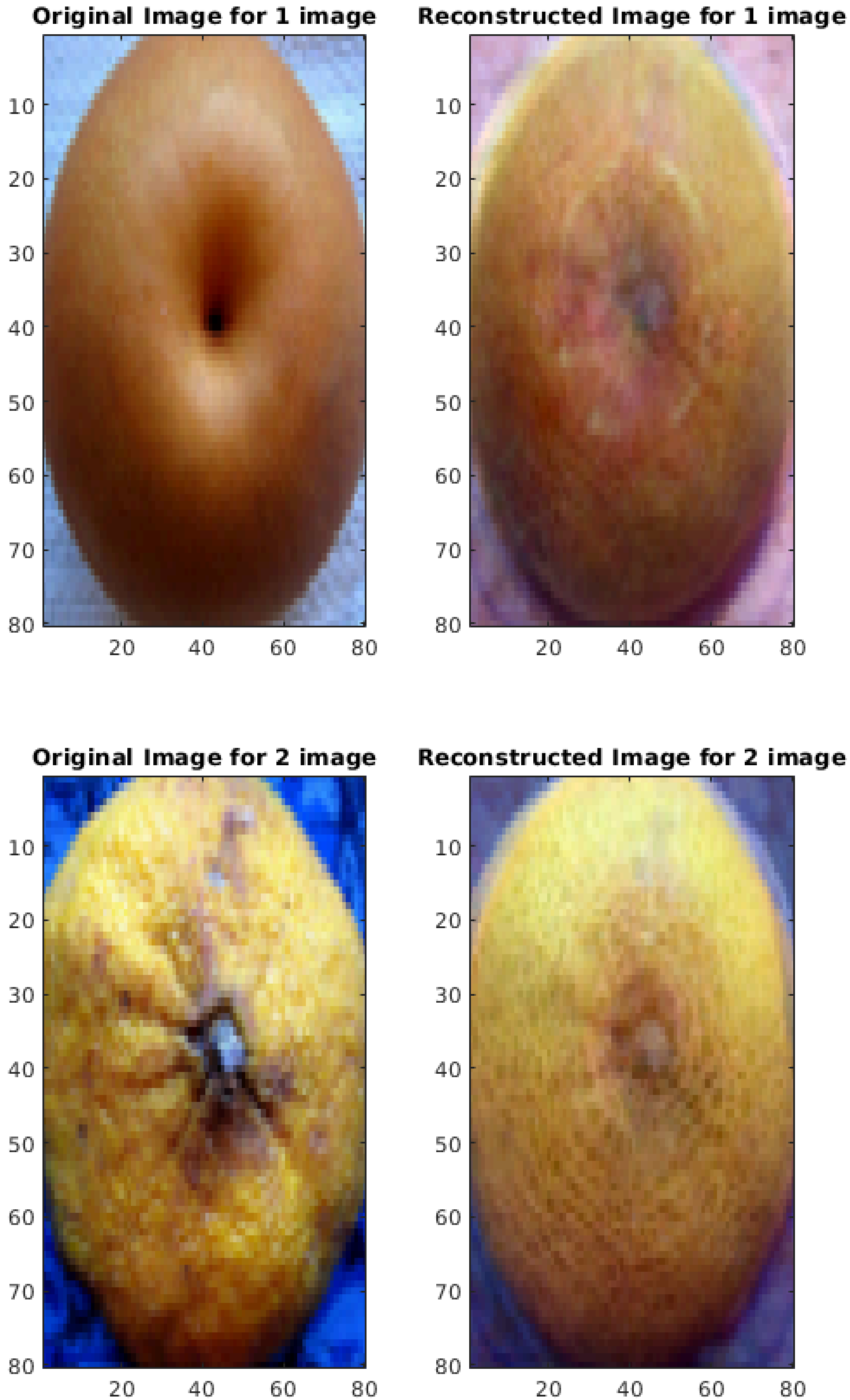
```
D = eigs(co,10);
figure
plot(D)
title("first 10 eigenvalues")
```

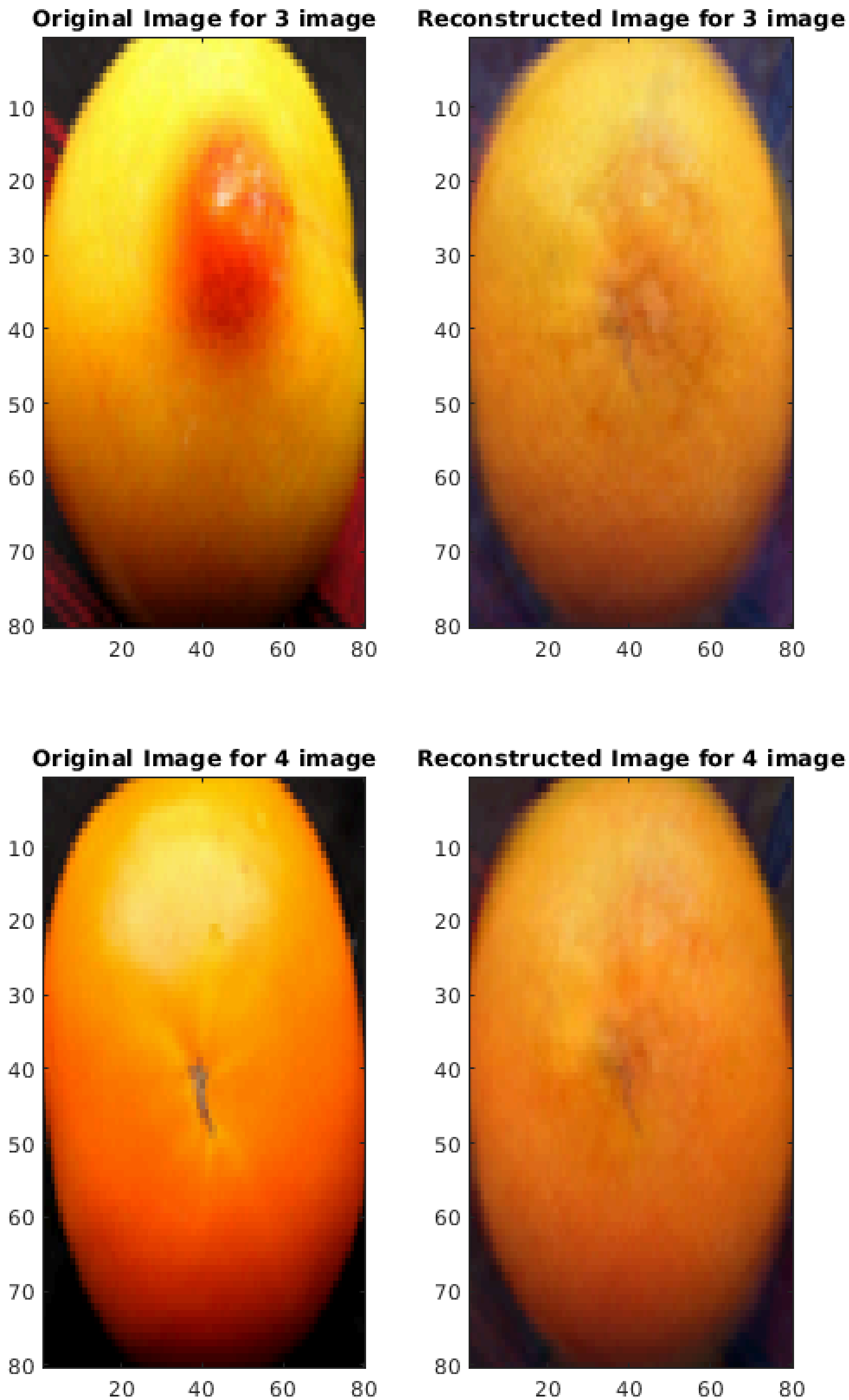


projections

The closest representation will be the projection of the image on the vector space formed by the four eigen vectors

```
weights = u' * I; % dot product of the image on the smaller space
re_I = u*weights+me; %the reconstruction is simply weights * eigen_vector + mean. Note that I =
for i=1:num_images %Plotting
    figure
    subplot(1,2,1), imagesc(rescale(reshape(I(:,i)+me,[80, 80,3]))) %original image
    title("Original Image for "+num2str(i) + " image")
    subplot(1,2,2), imagesc(rescale(reshape(re_I(:,i),[80, 80,3])))
    title("Reconstructed Image for "+num2str(i) + " image")
end
```


Original Image for 1 image
Reconstructed Image for 1 image
Original Image for 2 image
Reconstructed Image for 2 image
10
20
30
40
50
60
70
80
20
40
60
80


Original Image for 3 image
Reconstructed Image for 3 image
Original Image for 4 image
Reconstructed Image for 4 image
10
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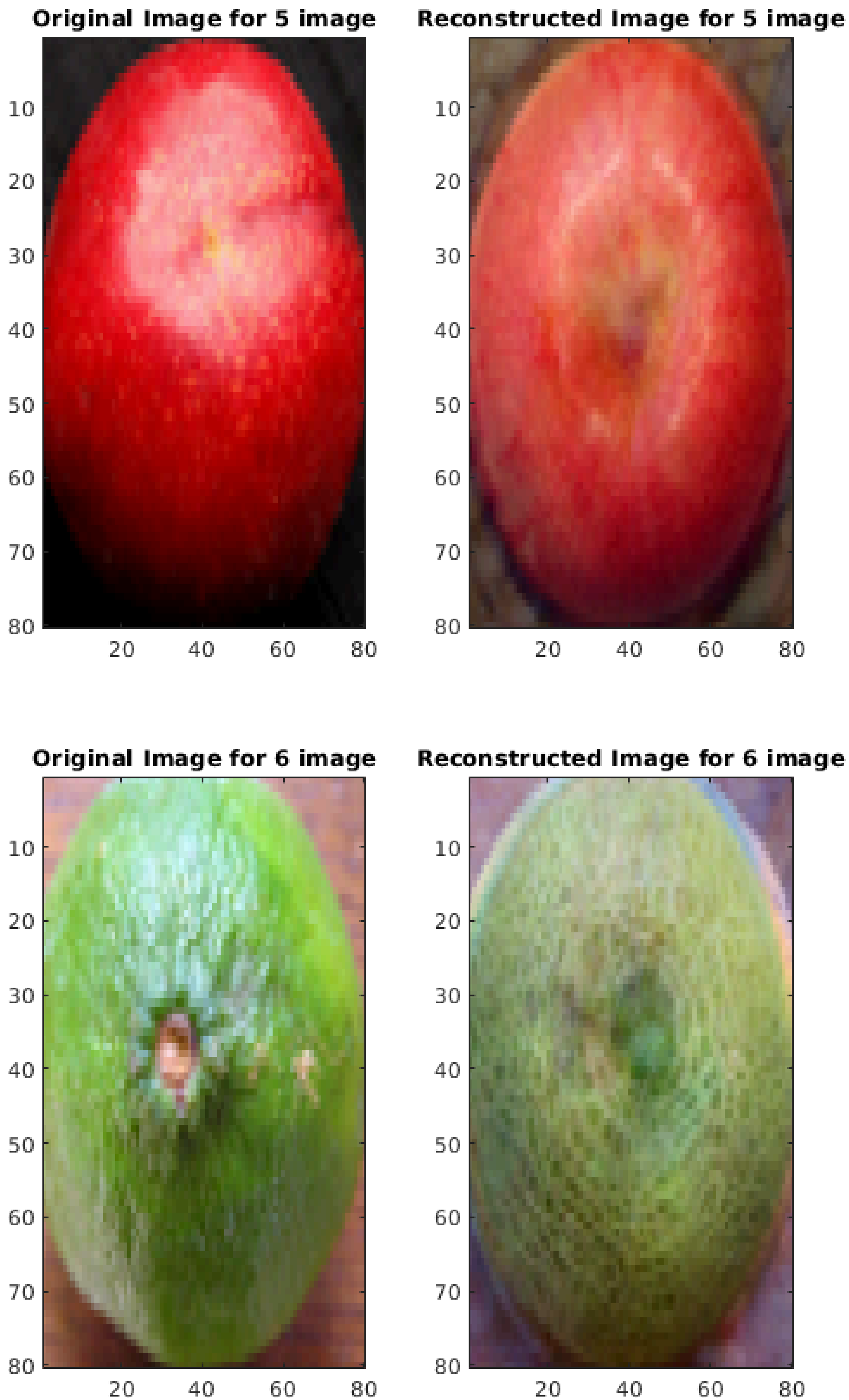
40
50
60
70
80
20
40
60
80


Original Image for 5 image
Reconstructed Image for 5 image
Original Image for 6 image
Reconstructed Image for 6 image


Original Image for 7 image
Reconstructed Image for 7 image
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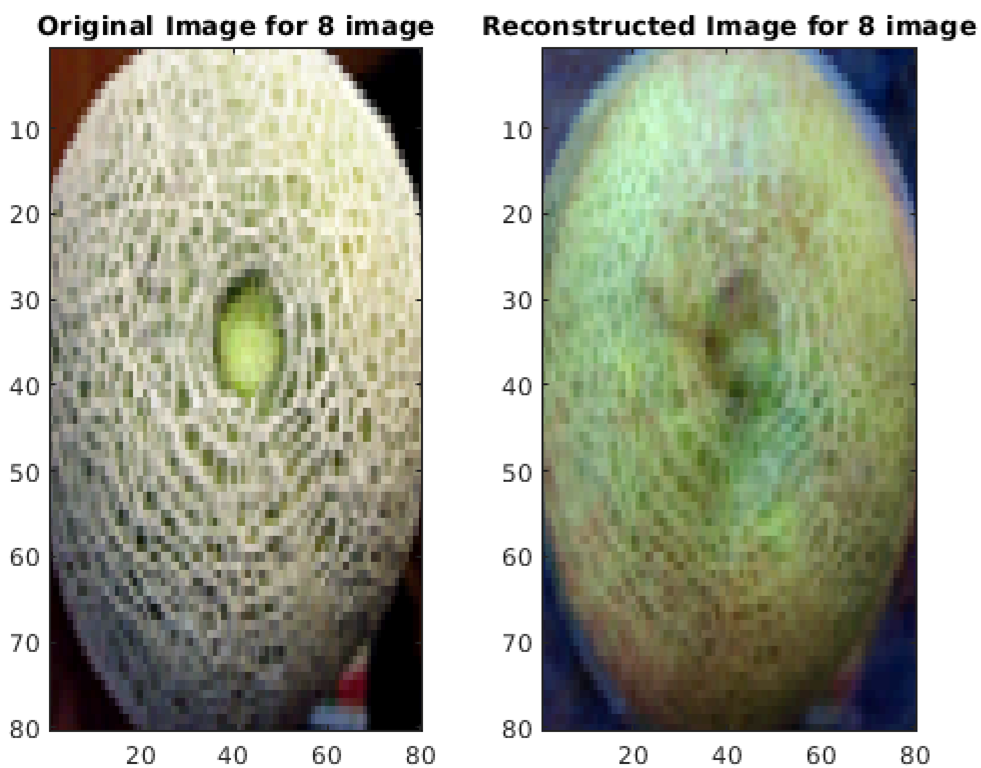
40
60
80


Original Image for 8 image
Reconstructed Image for 8 image
10
20
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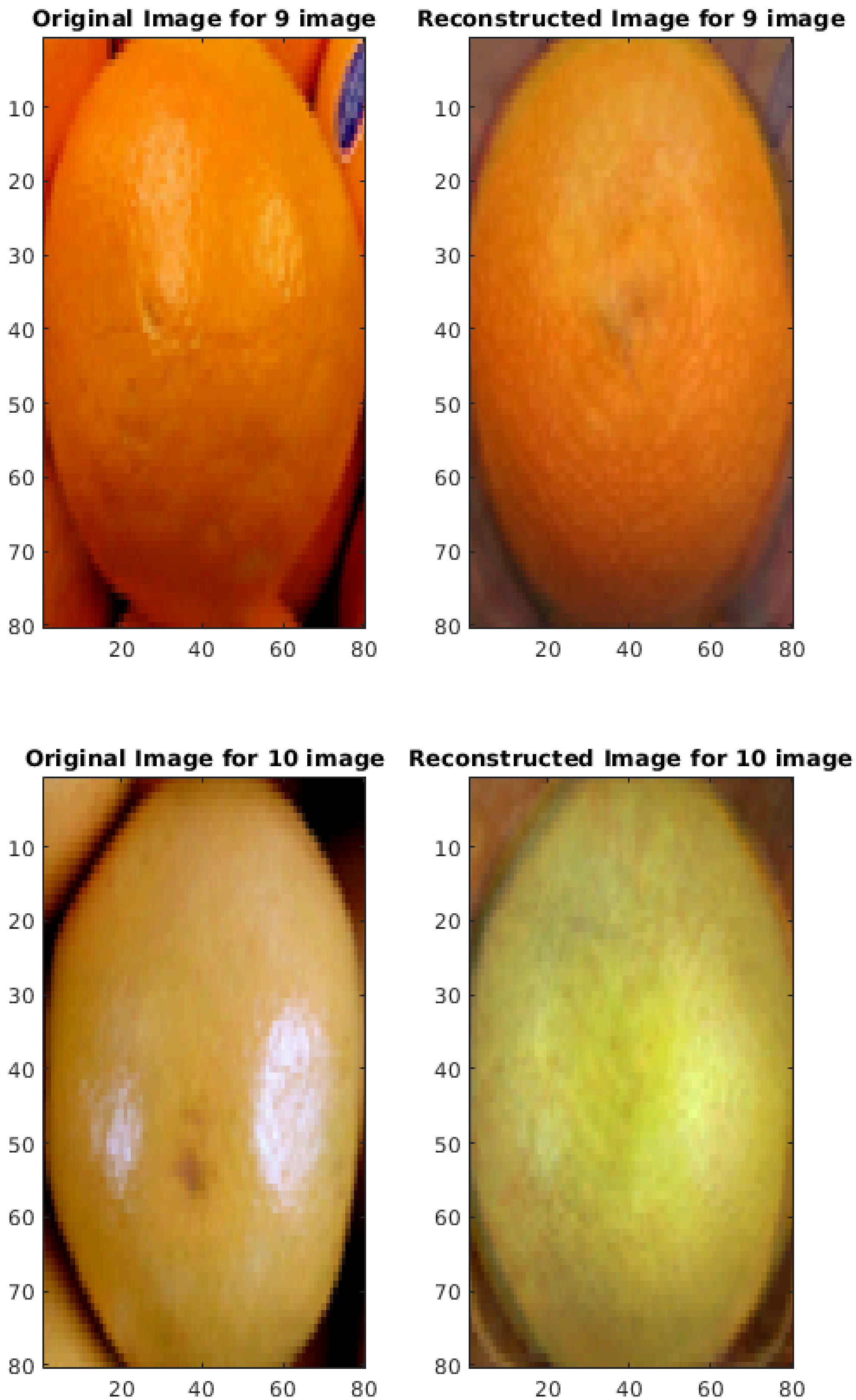
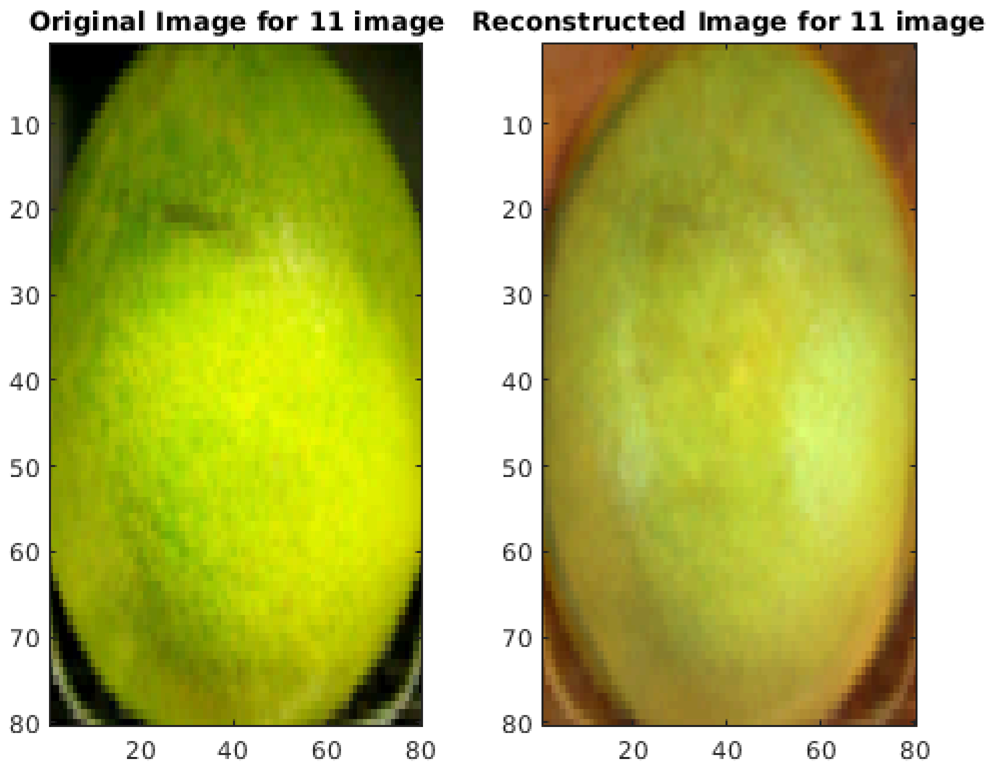
70
80
20
40
60
80


Original Image for 9 image
Reconstructed Image for 9 image
Original Image for 10 image
Reconstructed Image for 10 image


Original Image for 11 image
Reconstructed Image for 11 image
10
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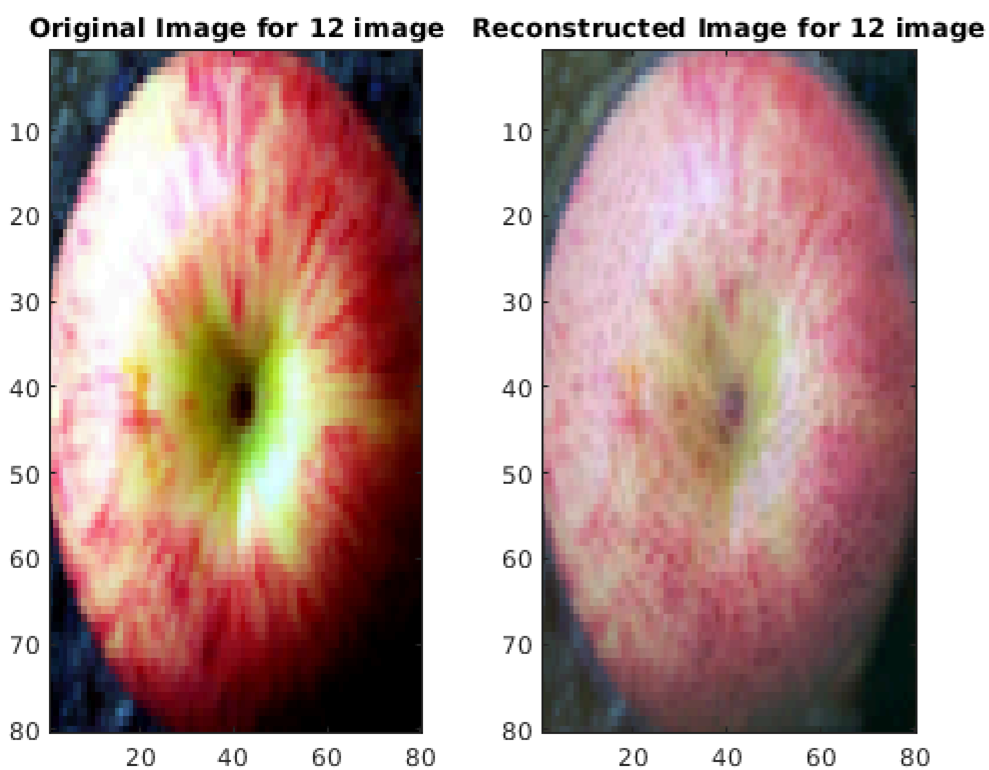
40
60
80


Original Image for 12 image
Reconstructed Image for 12 image
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60
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Original Image for 13 image
Reconstructed Image for 13 image
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50
60
70
80
20
40
60
80


Original Image for 14 image
Reconstructed Image for 14 image
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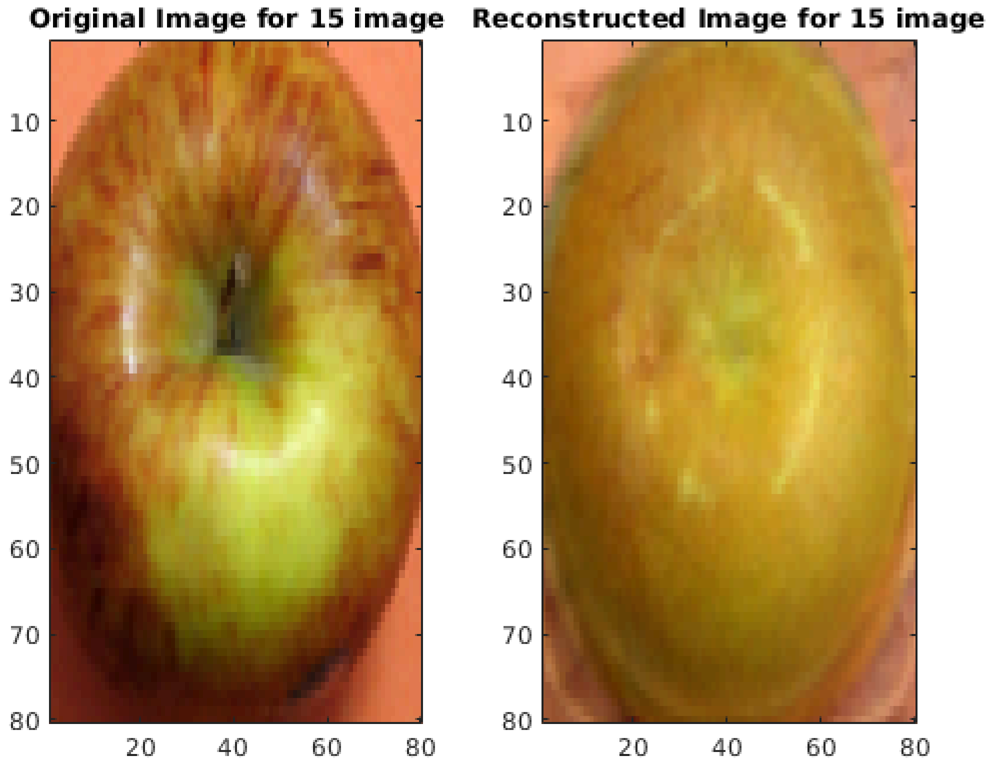
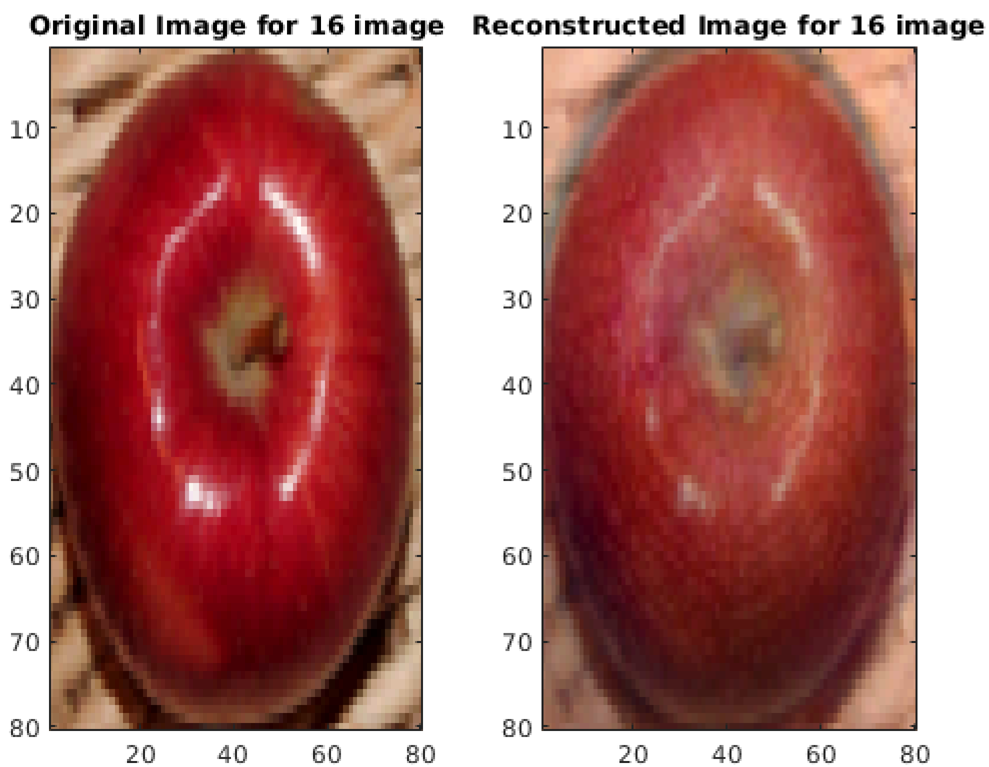
40
60
80

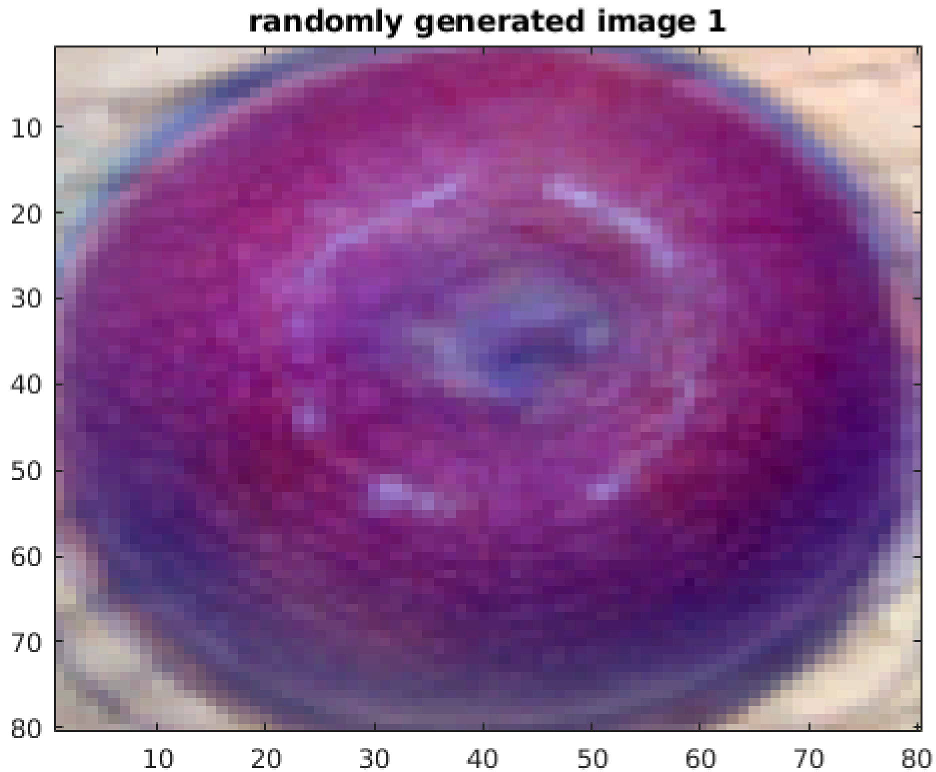


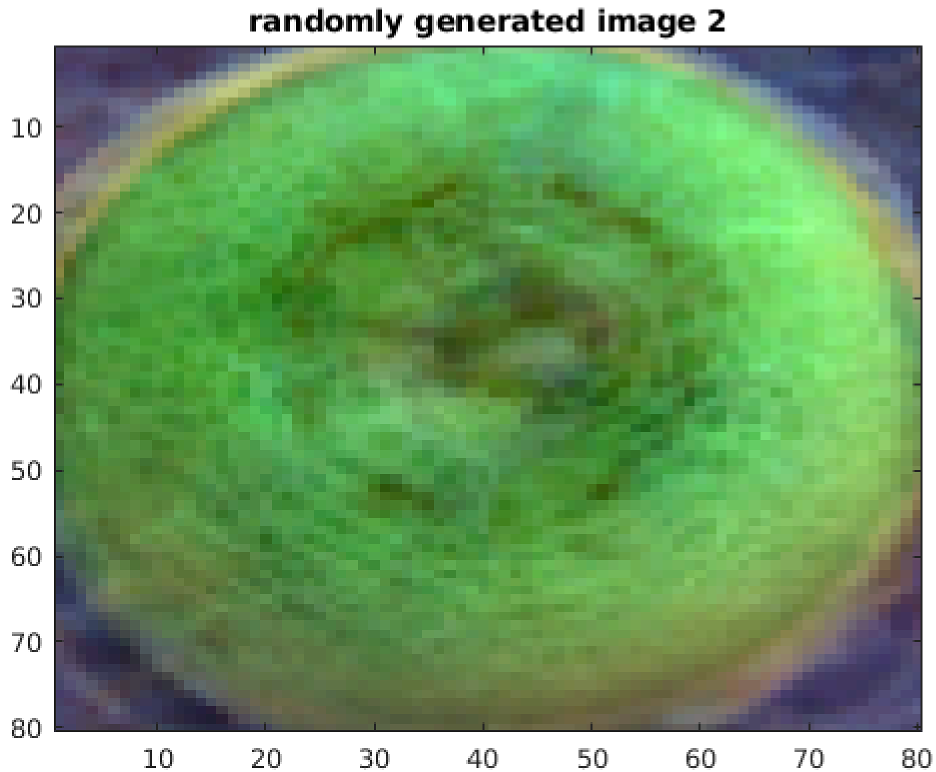


Random Fruits from normal distribution

```
rng(4)
```

```
for i=1:3
    w = randn(4,1)*(rand+0.1)*norm(me);
    new_image = u*w+me;
    figure, imagesc(rescale(reshape(new_image,[80, 80,3])))
    title("randomly generated image "+num2str(i))
end
```




randomly generated image 2
10
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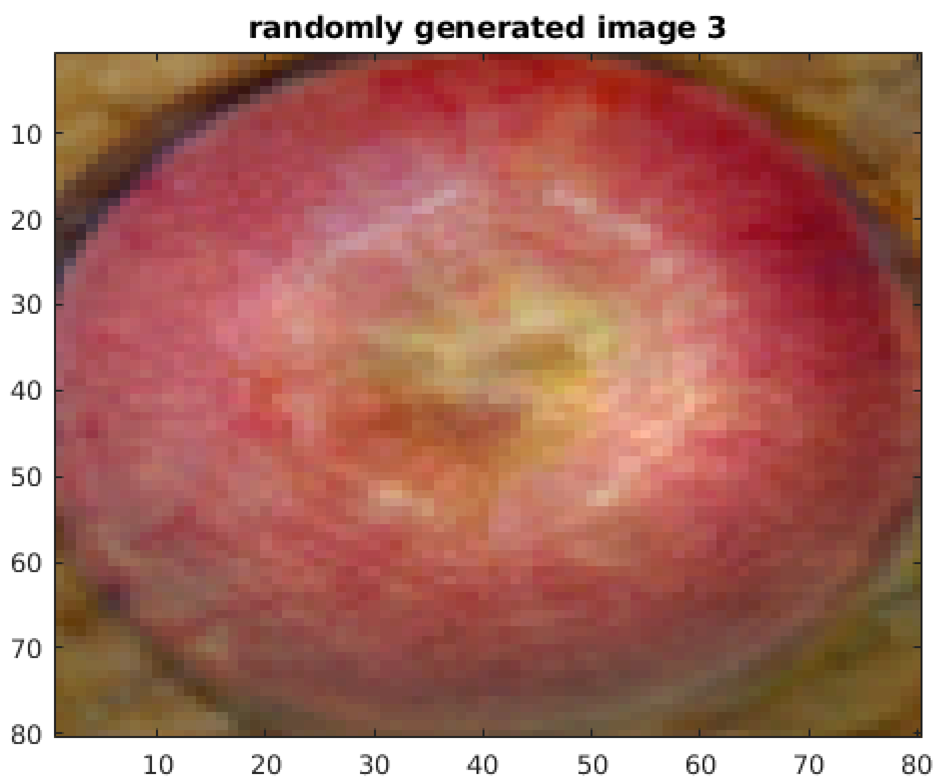
randomly generated image 3
10
20
30
40
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70
80