

```
% Two-Step Enhancement Framework for Improving Underwater Image Quality
```

```
% Step 1: Color Correction
```

```
% Step 2: Contrast Enhancement
```

```
clc;
```

```
clear;
```

```
close all;
```

```
% Load the underwater image
```

```
inputImage = imread('underwater_image.jpg'); % Replace with your image path
```

```
figure;
```

```
imshow(inputImage);
```

```
title('Original Underwater Image');
```

```
% Step 1: Color Correction
```

```
% Apply White Balance to correct color cast
```

```
colorCorrectedImage = whiteBalance(inputImage);
```

```
figure;
```

```
imshow(colorCorrectedImage);
```

```
title('Color Corrected Image');
```

```
% Step 2: Contrast Enhancement
```

```
% Apply Contrast-Limited Adaptive Histogram Equalization (CLAHE)
```

```
contrastEnhancedImage = contrastEnhancement(colorCorrectedImage);
```

```
figure;
```

```
imshow(contrastEnhancedImage);
```

```
title('Contrast Enhanced Image');
```

```
% Save the final enhanced image  
imwrite(contrastEnhancedImage, 'enhanced_underwater_image.jpg');
```

```
% Function for White Balance (Color Correction)
```

```
function correctedImage = whiteBalance(image)
```

```
    % Convert the image to double for calculations
```

```
    image = double(image);
```

```
    % Calculate the mean of each color channel
```

```
    meanR = mean(mean(image(:,:,1)));
```

```
    meanG = mean(mean(image(:,:,2)));
```

```
    meanB = mean(mean(image(:,:,3)));
```

```
    % Compute the scaling factors
```

```
    scaleR = meanG / meanR;
```

```
    scaleB = meanG / meanB;
```

```
    % Apply the scaling factors to each channel
```

```
    correctedImage(:,:,1) = image(:,:,1) * scaleR;
```

```
    correctedImage(:,:,2) = image(:,:,2);
```

```
    correctedImage(:,:,3) = image(:,:,3) * scaleB;
```

```
    % Normalize the image to the range [0, 255]
```

```
    correctedImage = uint8(correctedImage);
```

```
end
```

```
% Function for Contrast Enhancement (CLAHE)
```

```
function enhancedImage = contrastEnhancement(image)
```

```
% Convert the image to LAB color space  
labImage = rgb2lab(image);  
  
% Apply CLAHE to the L channel (lightness)  
labImage(:, :, 1) = adapthisteq(labImage(:, :, 1), 'ClipLimit', 0.02, 'Distribution', 'rayleigh');  
  
% Convert the image back to RGB color space  
enhancedImage = lab2rgb(labImage);  
enhancedImage = uint8(enhancedImage * 255);  
end
```