Image Processing as an Important Tool for Research Activities

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Abstract

Image processing is a useful tool for capturing object data in a 2D plane. This can be particularly useful for example capturing the amount of water droplets that traverse through a nozzle noting the size and position of each droplet. A high-speed camera that can capture high quality images will capture data that will be missed by the human eye. Along with this, Image processing can be used to portray an idea to a group. For example adding a colormap to a grayscale image will highlight different intensity values or compiling a group of images into a video format can highlight an object(s) of interest position and size over time.

Method

Baseline
Start with one image, because all the images relative to their project have consistency with image location.

Cropping
Its good practice to crop an image around the region of interest. The purpose of doing this is to eliminate the amount of filtering needed in an image.

Processing
Before filtering an image can be achieved, an image must be processed to ensure that contrasts between the objects in and the background are reflected to their maximum.

(Analysis)

Filtering
This is where the high and low contrast sections are used. For example if the objects of interest are high contrast, then a threshold value can be applied to convert the image into a logical array, only keeping the objects that match the threshold value. If needed, the objects that are still not needed can be eliminated here as well.

Bit Size
Image types define how many bits can be stored in an image. For compiling images into a video file, any scaling that would need to be accomplished would be done here. For example in Figure 2, the bit size was reduced from 16 to 8, making the storage space for that image smaller.

Applying Color
Applying color to a grayscale image shows different intensity values. For example in Figure 1, from an earlier project, color is applied to the image which in turn amplifies the cavitation about the turbine blade in a more visible way than the original image.

(Illustration)

Data Analysis

The objects within a logical array can be analyzed here by capturing size and location.

(Analysis)

Background Removal

Purpose
For image processing and data analytics, all unwanted data should be removed from the image.

Subtraction
This can be achieved by taking a picture of the experimental background and subtracting it from the experimental image.

Filtering
A Top hat filter can be applied to the original image, then subtracted from the original image resulting in the image without its background and only the objects of interest.

Figure 1: An example of a grayscale image with an applied colormap

Figure 3: An example of background subtraction, achieved by subtracting a blue background from the experimental image on the left.

Figure 4: An example of background removal. To achieve this, a top hat filter was applied to the image on the left, leaving the image on the right with a black background.

Figure 5: Image numbers 1 – 7, respectively, showing the process of a region of interest into usable data to be used for data analysis.

Cropping
– Cropping an image is an easy way to filter out any unwanted data outside of the region of interest.

Adjusting
– This method of filtering saturates the top and bottom 1% of all pixels, increasing the contrast of the image.

Adapting
– A filtering technique that uses a histogram adaption to enhance the contrast of the image.

Binary
– This is the image processing step that makes the image useful for data analysis. A filter is applied which dictates what contrast value is assigned a 1 or 0 in a logical array.

Conclusion

In Summary, Image processing as seen in figure 5, is an effective tool for data analysis by isolating the objects of interest, enhancing the contrast between the objects of interest and the background, conversion to binary, collecting object size and location and converting that data using a pixel scale factor.