



## Performance of Stereo Matching Techniques Based on Object Distance

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**Abstract** - To have the full advantage of stereo matching techniques, it is important to use it at right place. This paper presents an overview of stereo matching techniques SAD and SSD working and its practical use for different ranges of distance, which describes their performance when the object is far or near the stereo camera. For better performance of stereo vision every aspect of the stereo matching techniques must be analyzed. Hence this paper is presenting the scenarios in which the two most important techniques performances based on position of an object, either close or far away from the stereo camera. In this paper, the two Area Based Matching Techniques are introduced and their performances in different scenarios are being discussed.

**Keywords** – Stereo Matching, Stereo Camera, SAD, SSD, Area Based Matching Techniques

### I. INTRODUCTION

Stereo matching plays an important role for having depth information. In this method the two images are being matched in order to make one image, as disparity map i.e. select a block or an object in left image and try to find that part in the right image. Disparity continuity is the property assumes that changes in the image disparity are generally smooth, i.e., if a disparity map is considered it is presented in a continuous way except for a few discontinuities [1].

Each matching technique has its advantages and disadvantages and these depend on the restrictions of system and the cameras geometry. This is a method that processes the given information using local and global methods and, after that, it compares both the results and combines them in order to obtain a better result. This fact is very difficult to obtain because the system would need huge computational resources and would not work in a real time system.

1. **Local Methods** :In this method the small portion of stereo images are being matched. They are usually very efficient but sensitive to local ambiguities of the regions. It works as block by block matching with a particular window size (optimum), for presenting precise detailing. Area-Based Matching is one of the most popular methods under this category.
2. **Global Methods** :In this method the entire images are matched. They are usually less sensitive to local peculiarities and they add support to some regions that are difficult to study in a local way. However, they tend to be computationally expensive. Some of the popular methods are dynamic programming and nearest neighbor.

In the area based matching technique, a window in one image is taken and the exact match of that block is searched in the other image. For example, take a block from the left image and then try to search that block in the right image, keep on searching until the perfect match is found.

The two techniques are to be compared in different scenarios are:

1. SAD
2. SSD

### II. EXPERIMENTAL ASPECT

- A. Calibration : - Calibration is the step which will setup the environment we are going to work and set the camera parameters to some constant variables so that whenever we use it we will get the same result. Calibration is must before performing stereo matching as the stereo images must be taken in the environment with least error. Follow the following steps in order to calibrate the camera using Stereo Camera Calibrator App provided by MATLAB.

1. Prepare camera and checkerboard pattern
2. Load images of checkerboard, taken within the frame.
3. Calibrate the stereo camera
4. Evaluate camera accuracy
5. Adjust parameters accordingly to improve accuracy
6. Export parameter objects

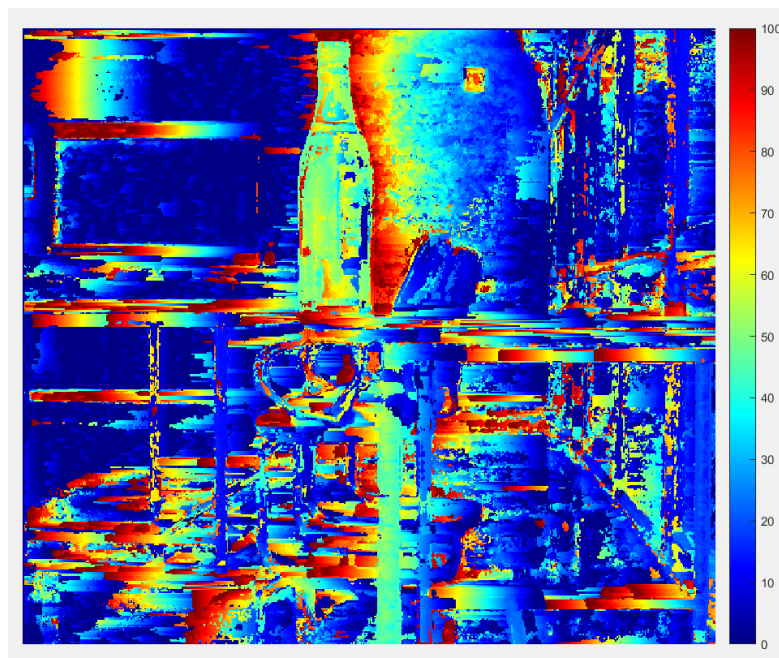
The above are the steps for calibration of stereo camera in order to use it, a perfectly calibrated camera will give a better quality of image as well as a better output will be generated as the settings are done in order to take two stereo images. In the calibration step the rectification is also being done which align the images horizontally.

#### B. Block Matching :-

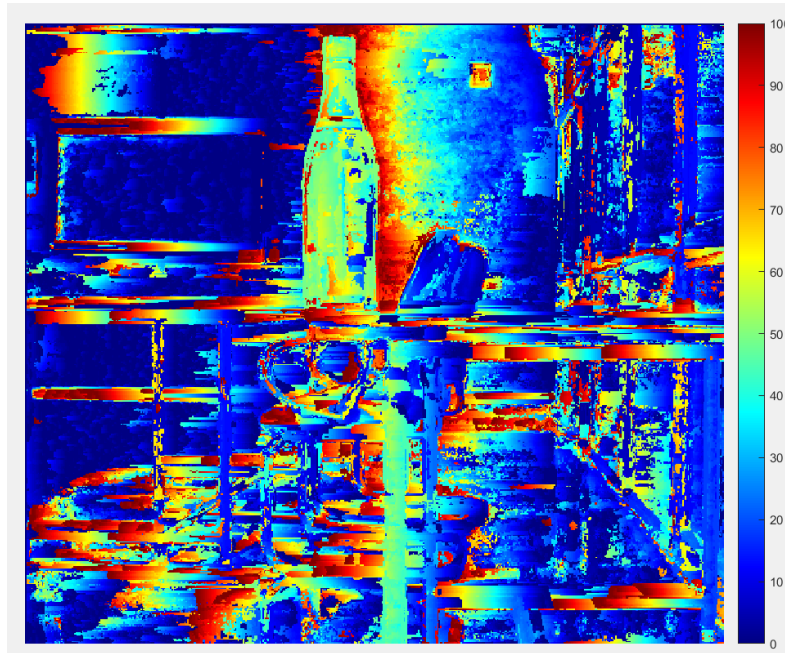
The following steps are to be followed for block matching –

1. Take the two images, say left image as the reference image and the right image as the target image.
2. Select a block of any window size in the reference image.
3. Start searching for the same pixel intensities of the reference block in the target image(to limit the search area use epipolar lines i.e. rows of the reference block and the target block will be the same)
4. Generate a 3D array for disparity map.
5. Take an initial value using a function of image intensities.
6. Compute minimum matching value between reference window and candidate windows at each shift, using a matching technique.
7. For each pixel of the reference image, find the disparity element, where the disparity value at which minimum value is obtained. The set of disparity values represents the disparity map.[2]

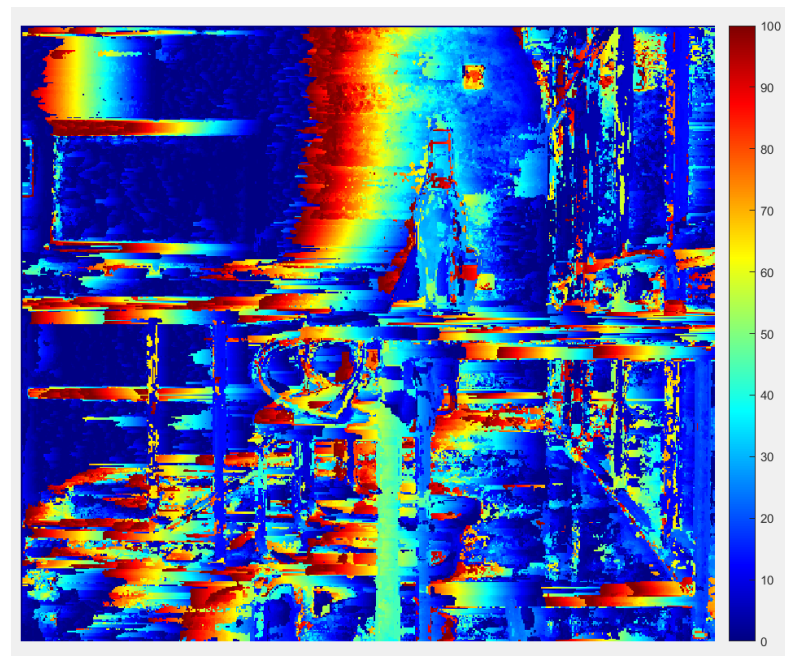
### III. RESULT



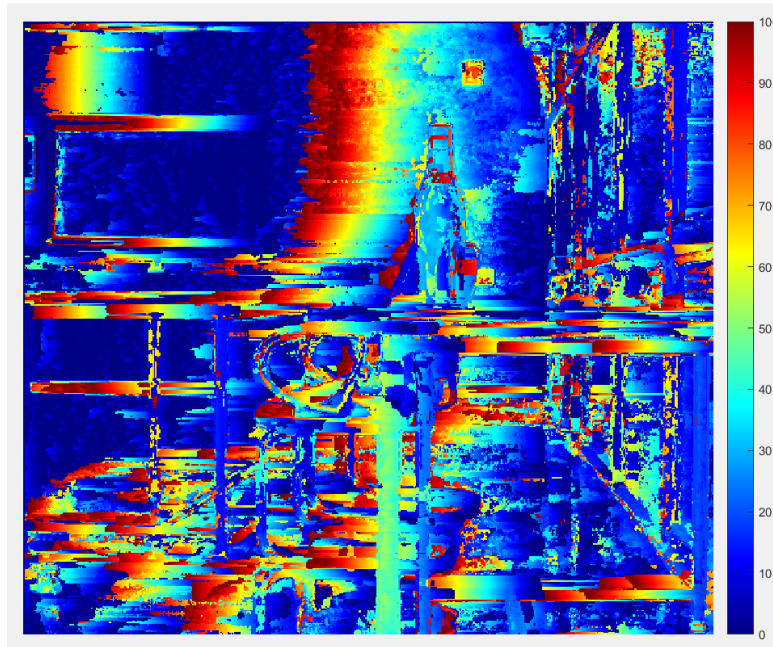
**Fig 1. SAD with distance in centimeters**



**Fig 2. SSD with distance in centimeters**



**Fig 3. SAD with distance in meters**



**Fig 4. SSD with distance in meters**

#### **IV. Conclusion**

Apart from choosing an appropriate window size, selection of a technique is important for better results. Hereby, we can conclude that for different scenario the performance of these techniques varies. Sum of Absolute Differences(SAD) works better when the object is nearer to the stereo camera and Sum of Squared Differences(SSD) is better for object at farther distance (within the range), to the stereo camera.

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