OPTIMIZATION OF HIGH DYNAMIC RANGE IMAGES FOR ROBOTIC VISION APPLICATIONS

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High dynamic range images are alternative to solve the loss of information due to the digital cameras inability to cover all intensities present in a scene at the same time. Exist many techniques to generate HDR image. Among them, tone mapping and multi exposure are the most important. Another method consist in generate the HDR image directly with specialized hardware [1].

The multi exposure method proposed by Debevec and Malik [2] consists in combining the information from several images taken with different exposure into a single image. The main problem was to choose which parts of images contained useful information. Goshtasby proposed to divide images into blocks. Each block can be selected in case it contains “the best exposure”. According to Goshtasby “the best exposure” is when the block of image provided more information than the same block of the image with different exposure. Jiao [3] uses the variance like measure amount of information. If the block have a large variance value then the region have more information. Good results depend on the correct size of block, so finding the correct size was the new problem, also the way to combine this blocks.

We propose an algorithm which objective consist in information fusion presented in three images of the same scene with different exposures 0 eV, -2 eV, +2 eV. In order to choose the best block size we tuned four parameters: transition zones, zero limits (two values) and dispersion limit. These parameters allow determined the best size and identify which block of the three images contains more information. In many cases more than one contains information helpful so to create HDR image we used three coefficients which allow indicate the degree of influence of each image.

To generate an optimized HDR image we used a genetic algorithm which minimizes a function that depends of the distribution of histogram. This way we can ensure that the parameters are the best and therefore the HDR image is optimal. The workflow that allows creating an HDR is shown in figure 1. The algorithm proposed is able to generate an optimal HDR image, though it is slow. To improve the algorithm performance, it was divided into two sections: sequential and parallel. The parallel section was implemented in CUDA, since each block is independent, and the coefficients can be computes simultaneously. The sequential section consists of the genetic algorithm and MATLAB code to generate the HDR image.

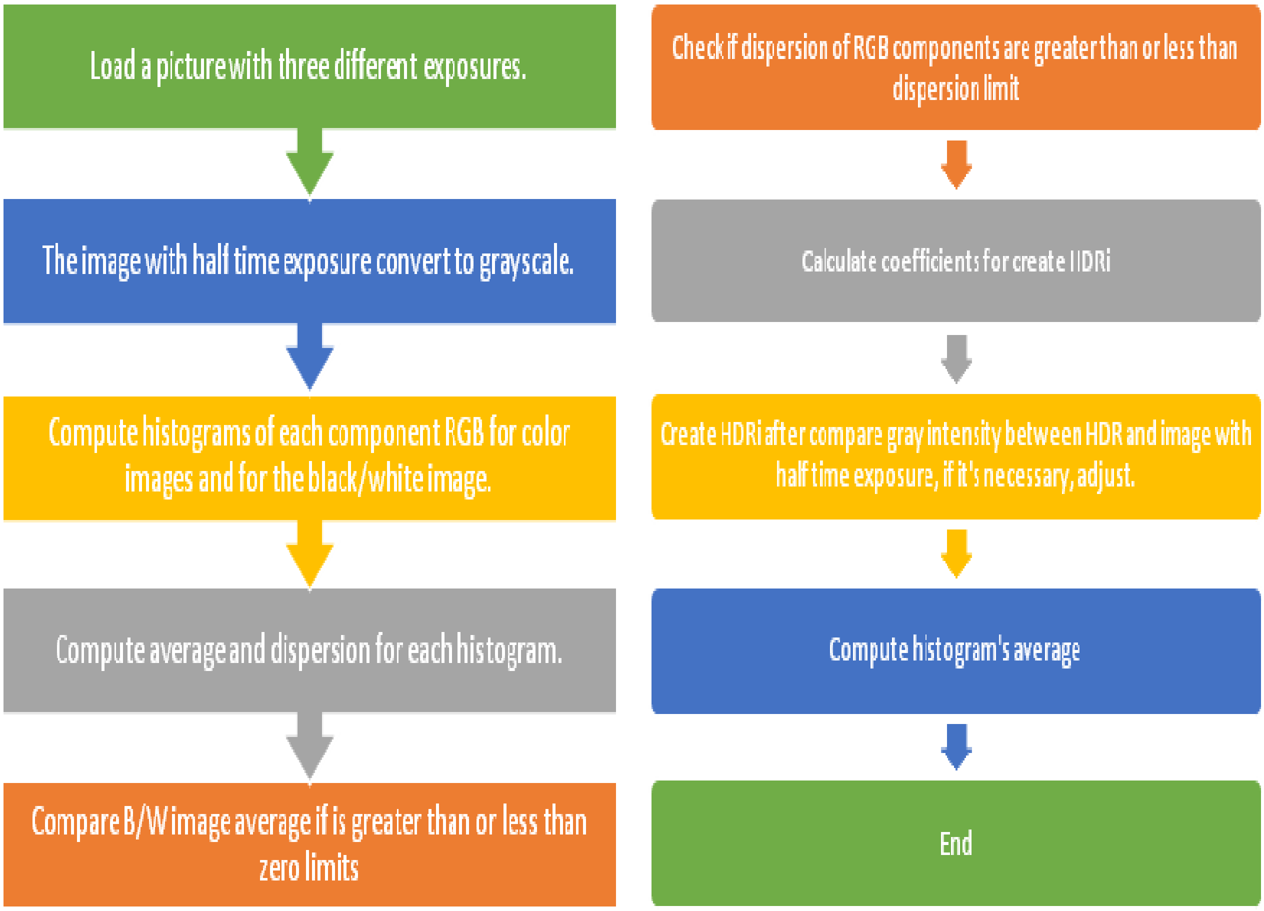
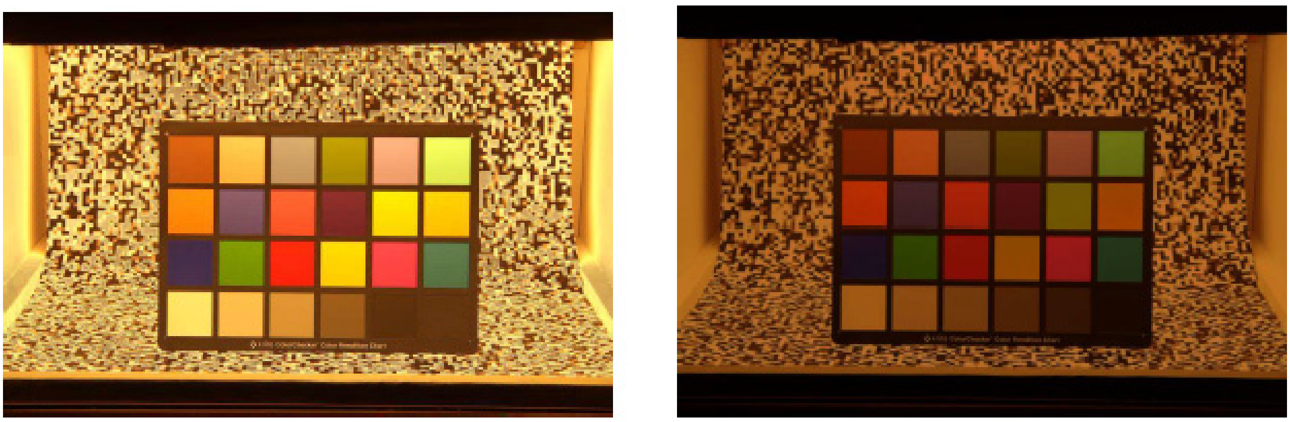


Figure 1 – Workflow to create HDR image

The results obtained through our algorithm can be considered good, due to possibility to generate automatically an optimal HDR image. Required time has been reduced from 9 hours to 12 minutes. We compared our algorithm to the one proposed by Reinhard [4], through textural features, proposed by Haralick [5], applied by Ukovich [6] with matrix Co-occurrence, showed that our algorithm provides images HDR of more quality, as can be seen in figure 2 and the table 1.



a) Multiexposure b) Reinhard

Figure 2 – Comparison between Multi-exposure vs Reinhard

Table 1 – Textural features comparison between Multi-exposure vs Reinhard

Scene 8	ASM(energy)				Contrast				Correlation			
	0°	45°	90°	135°	0°	45°	90°	135°	0°	45°	90°	135°
Multiexposure	0.0858	0.0687	0.0783	0.0686	0.5875	1.2024	0.8167	1.2088	0.9468	0.8909	0.9260	0.8904
0 Ev	0.1124	0.0948	0.1046	0.0947	0.4102	0.9254	0.6131	0.9310	0.9655	0.9221	0.9484	0.9216
Reinhard'05	0.2208	0.1916	0.2095	0.1915	0.1378	0.2829	0.1902	0.2835	0.9534	0.9043	0.9357	0.9041

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