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HDR - the impact of input parameters on the result for Debevec algorithm

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Humans can perceive a much broader luminance range than an average camera. It is impossible to take a single photo that contains details for both very dark and bright areas.
HDRI (High Dynamic Range Imaging) methods address that problem, by merging multiple low dynamic range images (LDR) into a single picture. These methods are being used for professional cameras and even in smartphones.
The purpose of this article is to examine the optimal input parameters, including, among others, the number of images, their exposure times, and weighting functions using the Debevec-Malik method.
The images were taken from various scenes. Each scene was captured multiple times (in RAW and JPEG format) with different exposure duration, but with constant sensitivity and aperture. The experimental setup featured a stationary Nikon D40 camera mounted on a tripod. Photos had to be taken in the shortest possible time to avoid problems caused by movement within the scene, including clouds and people.
Multiple combinations of input parameters were investigated to create HDR images for every scene. In this paper, the histograms of both the composite HDR images and their individual source frames were examined. In addition, HDR images were evaluated in terms of noise characteristics, color fidelity, and overall realism. Finally, the radiance map and the camera response curve were analyzed to provide detailed information on image quality and dynamic range.
Each additional photo with a different exposure provides new information about the scene, potentially improving image quality and reducing noise. However, as will be shown, there is no need to use an excessively high number of images, as the benefits diminish rapidly after a certain point. Therefore, a smaller number of images can be used, resulting in faster processing times.
This research could be further expanded by incorporating a light meter to compare the obtained measured values with calibrated HDR image radiances. Additionally, exploring different HDR imaging approaches, pixel selection methods, and weight functions could help refine and validate the proposed methods.

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